Designation: D 1388 – 96 (Reapproved 2002)

Standard Test Method for Stiffness of Fabrics[1]

This standard is issued under the fixed designation D 1388; 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 stiffness properties of fabrics. Bending length is measured and flexural rigidity is calculated. Two procedures are provided.

1.1.1 *Option A*—Cantilever Test, employing the principle of cantilever bending of the fabric under its own mass.

1.1.2 *Option B*—Heart Loop Test, employing the principle of a loop formed in a fabric strip and hung vertically.

1.2 This test method applies to most fabrics including woven fabrics, air bag fabrics, blankets, napped fabrics, knitted fabrics, layered fabrics, pile fabrics. The fabrics may be untreated, heavily sized, coated, resin-treated, or otherwise treated.

1.3 The values stated in SI units are to be regarded as the standard. The U.S. customary units may be approximate.

1.4 *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:*

D 123 Terminology Relating to Textiles[2]

D 1776 Practice for Conditioning Textiles for Testing[2]

D 2904 Practice for Interlaboratory Testing of a Textile Test Method That Produces Normally Distributed Data[2]

D 2906 Practice for Statements on Precision and Bias for Textiles[2]

D 3776 Test Methods for Mass Per Unit Area (Weight) of Woven Fabric[3]

2.2 *ASTM Adjuncts:*

TEX-PAC[4]

3. Terminology

3.1 *Definitions:*

3.1.1 *bending length, n—in textiles*, a measure of the interaction between fabric weight and fabric stiffness as shown by the way in which a fabric bends under its own weight.

3.1.1.1 *Discussion*—Bending length reflects the stiffness of a fabric when bent in one plane under the force of gravity and is one component of drape.

3.1.2 *cross-machine direction, CD, n*—the direction in the plane of the fabric perpendicular to the direction of manufacture.

3.1.2.1 *Discussion*—The term cross-machine direction is used to refer to the direction analogous to coursewise or filling direction in knitted or woven fabrics, respectively.

3.1.3 *fabric, n—in textiles*, a planar structure consisting of yarns or fibers.

3.1.4 *flexural rigidity, n*—a measure of stiffness, where two equal and opposite forces are acting along parallel lines on either end of a strip of unit width bent into unit curvature in the absence of any tension.

3.1.5 *machine direction, MD, n*—the direction in the plane of the fabric parallel to the direction of manufacture.

3.1.5.1 *Discussion*—The term machine direction is used to refer to the direction analogous to walewise or warp direction in knitted or woven fabrics, respectively.

3.1.6 *stiffness, n*—resistance to bending.

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

4. Summary of Test Method Options

4.1 *Option A, Cantilever Test*—A specimen is slid at a specified rate in a direction parallel to its long dimension, until its leading edge projects from the edge of a horizontal surface. The length of the overhang is measured when the tip of the specimen is depressed under its own mass to the point where the line joining the top to the edge of the platform makes a 0.924 rad (41.5°) angle with the horizontal. From this measured length, the bending length and flexural rigidity are calculated.

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[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.60 on Fabric Test Methods, Specific.

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

[3] *Annual Book of ASTM Standards*, Vol 07.02.

[4] PC programs on floppy disks for analyzing Committee D-13 interlaboratory data are available through ASTM. For 3½ in. disks request PCN: 12-429040-18, for 5¼ in. disk request PCN: 12-429041-18.

4.2 *Option B, Heart Loop Test*—A strip of fabric is formed into a heart-shaped loop. The length of the loop is measured when it is hanging vertically under its own mass. From this measured length, the bending length and flexural rigidity are calculated.

5. Significance and Use

5.1 Both test options in this test method are considered satisfactory for acceptance testing of commercial shipments since current estimates of between-laboratory precision are acceptable and the method is used extensively in the trade for acceptance testing.

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 conduct 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 that are as homogeneous as possible and that are from a lot of material of the type in question. Test specimens should then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using the appropriate statistical analysis and an acceptable probability level chosen by the two parties before testing is begun. If a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results with consideration to the known bias.

5.2 In general, these procedures are more suitable for testing woven fabrics than knit fabrics.

5.3 The Cantilever Test Option is the preferred procedure because it is simpler to perform. It is, however, not suitable for very limp fabrics or those that show a marked tendency to curl or twist at a cut edge.

5.4 The Heart Loop Test Option is suitable for fabrics that show a tendency to curl or twist.

5.5 Both options can provide a correlation with a subjective evaluation of a given fabric type. That is, a higher number represents a stiffer fabric.

5.6 The stiffness of a fabric may change with storage.

5.7 No evidence has been found showing that bending length is dependent on the width. The tendency for specimens to curl or twist will affect the result, because of the rigidity provided at the edge. Consequently, the wider the strip, the less important is the edge effect.

6. Apparatus

6.1 *Option A*—Cantilever Bending Tester (Fig. 1 and Figs. 2).

6.1.1 *Horizontal Platform*, with a minimum area of 38 by 200 mm (1.5 by 8 in.) and having a smooth low-friction, flat surface such as polished metal or plastic. A leveling bubble shall be incorporated in the platform.

6.1.1.1 *Indicator*, inclined at an angle of 0.724 ± 0.01 rad (41.5 ± 0.5°) below the plane of the platform surface.

6.1.1.2 *Movable Slide*, consisting of a metal bar not less than 25 by 200 mm (1 by 8 in.) by approximately 3 mm (⅛ in.) thick and having a mass of 270 ± 5 g (0.6 ± 0.01 lb).

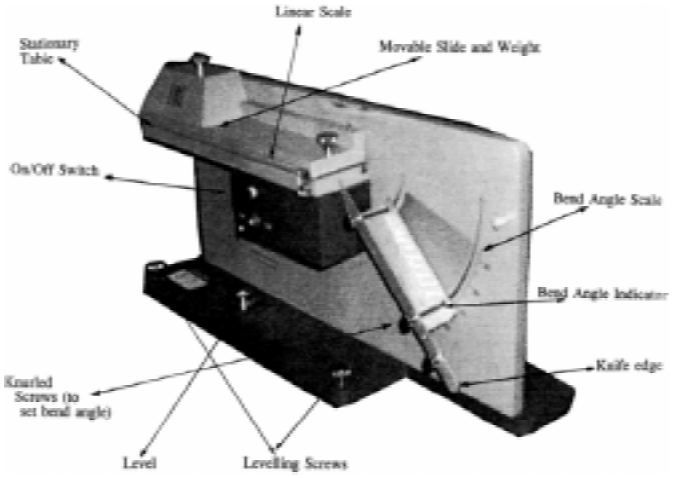

FIG. 1 Example of a Motorized Cantilever Test Apparatus

6.1.1.3 *Scale and Reference Point*, to measure the length of the overhang.

6.1.1.4 *Specimen Feed Unit*, motorized[5] (see Fig. 1) set to 120 mm/min (4.75 in./min) ±5 %, or manual equivalent.

6.1.2 *Cutting Die*—25 ± 1 mm by 200 ± 1 mm (1 ± 0.04 in. by 8 ± 0.04 in.).

6.2 *Option B*—Heart Loop Tester.

6.2.1 *Clamp and Stand*, for hanging the specimen.

6.2.2 *Scale*, suitably mounted on the stand for measuring the length of the specimen loop and calibrated either in cm (in.) or directly in bending length.

NOTE 1—If a constant strip length is adopted, the scale may be calibrated to read directly in units of bending length.

6.2.3 *Brass Bars*, two, 25 × 75 × 3 ± 0.1 mm (1 × 3 × 0.125± 0.005 in.).

6.2.4 *Pressure Sensitive Tape.*

6.2.5 *Jig*, constructed to allow positioning of the two bars with their inner edges parallel and at a distance from each other equal to the selected strip length.

7. Sampling and Test Specimens

7.1 *Lot Sample*—As a lot sample for acceptance testing, randomly select the number of rolls or pieces of fabric directed in an applicable material specification or other agreement between the purchaser and the supplier. Consider the rolls or pieces of fabric to be the primary sampling units. In the absence of such an agreement, take the number of fabric rolls specified in Table 1.

[5] A motorized bending tester such as described in Section 6.1 and Fig. 1 is being developed. Contact Instrument Marketing Services, a subsidiary of U.S. Testing Company, Inc., 291 Fairfield Avenue, Farfield, NJ 07004.

TABLE 1 Number of Rolls, or Pieces, of Fabric in the Lot Sample

Number of Rolls or Pieces in Lot, Inclusive	Number of Rolls or Pieces in Lot Sample
1 to 3	all
4 to 24	4
25 to 50	5
over 50	10 % to a max of 10 rolls or pieces

NOTE 2—An adequate specification or other agreement between the purchaser and supplier requires taking into account the variability between rolls or pieces of fabric and between specimens from a swatch from a roll or piece of fabric to provide a sampling plan with a meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quality level.

7.2 *Laboratory Sample*—For acceptance testing, take a swatch extending the width of the fabric and approximately 1 m (1 yd) along the machine direction from each roll or piece in the lot sample. For rolls of fabric, take a sample that will exclude fabric from the outer wrap of the roll or the inner wrap around the core of the roll of fabric, or any end piece.

7.3 *Direction of Test*—Consider the long dimension of the specimen as the direction of test.

7.4 *Number of Test Specimens*—From each laboratory sampling unit, take four specimens from the machine direction and four specimens from the cross-machine direction as applicable to a material specification or contract order.

7.5 *Cutting Test Specimens*—Cut the specimens to be used for the measurement of machine direction with the longer dimension parallel to the machine direction. Cut the specimens to be used for the measurement of the cross-machine direction with the longer dimension parallel to the cross-machine direction. Label to maintain specimen identity.

7.5.1 Take specimens, representing a broad distribution across the width and length, preferably along the diagonal of the laboratory sample, and no nearer the edge than one-tenth its width. Ensure specimens are free of folds, creases, or wrinkles. Avoid getting oil, water, grease, etc. on the specimens when handling.

7.5.2 *Cantilever Test*—Cut test specimens 25 by 200 mm, ±1 mm (1 by 8 in. ± 0.04 in.).

7.5.3 *Heart Loop Test*—No standard size for the test specimen is required. Cut test specimens 50 mm (2 in.) longer than the selected strip length to allow for clamping at the ends. See Table 2.

TABLE 2 Table of Bending Lengths

Loop Length, cm	Bending Length, cm		
	15-cm Strip Length	20-cm Strip Length	25-cm Strip Length
4.0	2.19	...	...
4.2	2.07	...	...
4.4	1.99	...	...
4.6	1.86	3.44	5.43
4.8	1.76	3.30	5.16
5.0	1.65	3.17	4.91
5.2	1.56	3.03	4.71
5.4	1.45	2.90	4.53
5.6	1.35	2.80	4.36
5.8	1.25	2.67	4.20
6.0	1.14	2.57	4.06
6.2	1.04	2.47	3.92
6.4	0.93	2.37	3.80
6.6	0.81	2.26	3.67
6.8	0.69	2.16	3.56
7.0	0.53	2.06	3.45
7.2	...	1.96	3.34
7.4	...	1.86	3.21
7.6	...	1.76	3.12
7.8	...	1.66	3.02
8.0	...	...	2.91
8.2	...	...	2.82
8.4	...	...	2.72

7.5.3.1 Select a specimen width at least 25 mm (1 in.) and no more than 75 mm (3 in.) with respect to the tendency of the fabric to curl. For fabrics having a slight tendency to curl, a 25 ± 1 mm (1 ± 0.04 in.) wide specimen has been found to be satisfactory. As the tendency to curl becomes greater, increase the width up to a maximum of 75 mm (3 in.).

7.5.3.2 Make several trial tests using various strip lengths selected from Table 2. Select a suitable strip length for a corresponding loop length from Table 2, such that the bending length is relatively independent of strip length.

NOTE 3—Strip length is the circumferential length of the unclamped portion of the specimen.

NOTE 4—Specimen strip widths greater than 75 mm (3 in.) have not been investigated and are not recommended since reliability of results are questionable.

NOTE 5—The bending length using the heart loop option is not entirely independent of the strip length. In general, the bending length rises with the strip length up to a value that remains relatively constant as the strip length is further increased. An additional rise may further be encountered for much longer strip lengths. Whenever possible, compare fabrics in the range where bending length is independent of strip length.

8. Preparation of Test Apparatus and Calibration

8.1 *Option A—Cantilever Test*:

8.1.1 Set the tester on a table or bench with the horizontal platform and inclined reference lines. Adjust the platform to horizontal as indicated by the leveling bubble.

8.1.2 Verify that the bend angle indicator is at the 0.724 rad (41.5°) angle marked on the scale.

9. Conditioning

9.1 Precondition the specimens by bringing them to approximate moisture equilibrium in the standard atmosphere for preconditioning textiles as directed in Practice D 1776, unless otherwise directed in a material specification or contract order.

9.2 After preconditioning, bring the test specimens to moisture equilibrium for testing in the standard atmosphere for testing textiles as directed in Practice D 1776 or, if applicable, in the specified atmosphere in which the testing is to be performed, unless otherwise directed in a material specification or contract order.

10. Procedure

10.1 Test the conditioned specimens in the standard atmosphere for testing textiles, which is 21 ± 1°C (70 ± 2°F) and 65 ± 2 % relative humidity, unless otherwise directed in a material specification or contract order.

10.2 *Option A—Cantilever Test*:

10.2.1 Remove the movable slide. Place the specimen on the horizontal platform with the length of the specimen parallel to the platform edge. Align the edge of the specimen with the line scribed on the right-hand edge of the horizontal platform.

NOTE 6—When known, place the specimen face-side up.

10.2.2 Place the movable slide on the specimen, being careful not to change its initial position.

10.2.3 For automatic testers, turn the tester switch on and watch the leading edge of the specimen closely. Turn the switch off the instant the edge of the specimen touches the knife edge.

10.2.4 For manual testers, move the clamped specimen by hand in a smooth manner at approximately 120 mm/min (4.75 in./min)± 5 % until the edge of the specimen touches the knife edge.

10.2.5 Read and record the overhang length from the linear scale to the nearest 0.1 cm (0.1 in.).

NOTE 7—If the specimen has a tendency to twist, take the reference point at the center of the leading edge. Do not measure specimens that twist more than 0.785 rad (45°).

10.2.6 Test the face and back of both ends of each specimen for a total of four readings per specimen.

10.3 *Option B—Heart Loop Test*:

10.3.1 Place the two bars parallel to one another on a horizontal surface such that the inner edges are separated by a distance equal to the selected strip length (see 6.2.5).

10.3.2 Lay the test specimen across the two bars with the outer edge approximately 5 ± 1 mm (0.5 ± 0.005 in.) from one end of each bar.

10.3.3 Attach one end of the specimen strip to one bar using pressure-sensitive tape, being careful to align to one edge of the bar. Apply just enough tension to the specimen to hold it taut, but without stretching, and attach the other specimen and to the second bar in a similar manner.

10.3.3.1 A suitable procedure for mounting and measuring the specimen is the use of two brass bars to which the specimen strip is fastened. The bars and the attached specimen strip are clamped to the stand in a suitable vertical position in front of a scale calibrated either in cm (in.) or directly in bending length.

10.3.4 Turn the bars and mounted specimen over, such that the fabric is on the under side of each bar. Grasp one bar in each hand, lift and rotate each bar 4.71 rad (270°). Rotate the left-hand bar in a clockwise direction and the right-hand bar in a clockwise direction. Bring the bars together such that the fabric ends are touching one another. Insert the assembly on a suitable holder with the loop formed free to hang vertically.

10.3.5 Allow the looped specimen to hang freely for 60± 5 s. Measure the distance from the top of the bars to the bottom of the loop to the nearest 2 mm (0.1 in.).

10.3.6 Remove the bars from the holder and free the adhering tape from each end of the strips carefully to prevent distortion of the fabric. Turn the specimen strip and test the other side of the fabric by re-attaching to the bars and testing as described in 10.3.1-10.3.5.

10.4 *Specimen Mass*—Determine the fabric mass per unit area as directed in Test Method D 3776, Option C.

10.5 *Specimen Area*—Determine the area of the specimens in Section 9.4 to the nearest 0.1 cm^2.

10.6 *Number of Specimens*—Continue as directed in 10.1-10.5 as applicable, until four specimens have been tested for each testing direction for each laboratory sampling unit.

11. Calculation

11.1 *Option A, Length of Overhang, Individual Specimens*—For each specimen, average the four readings obtained to the nearest 0.1 cm as the Length of Overhang (or one-half Loop Length), unless otherwise agreed upon between the purchaser and supplier.

NOTE 8—In some cases it may be of interest to differentiate between the sides of the fabric by averaging those readings made with the fabric face side up (out) separately from those with the fabric face side down (in).

11.2 *Option B, Loop Length, Individual Specimens*—For each specimen, average the two readings obtained to the nearest 0.1 cm as the Loop Length, unless otherwise agreed upon between the purchaser and supplier.

11.3 *Mass per Unit Area*—Use the mass per unit area as determined by Test Method D 3776 in cm^2.

11.4 *Bending Length, Individual Specimens*—Calculate the bending length as directed in 11.4.1 or 11.4.2, as applicable.

11.4.1 *Option A, Cantilever Test*—Calculate the bending length for each testing direction to the nearest 0.1 cm, using Eq 1.

$$c = o/2 \tag{1}$$

where:
c = bending length, cm, and
o = length of overhang, cm.

11.4.2 *Option B, Heart Loop Test*—Convert the readings from loop length to bending length using Table 2, or calculate the bending length for each testing direction to the nearest 0.1 cm, using Eq 2.

$$c = I_o f(b) \tag{2}$$

where:
c = bending length, cm,
I = loop length, distance between the bars when the strip is mounted, cm,
I_o = 0.1337L,
L = strip length, circumferential length of the unclamped portion of the specimen, cm,
$f(b)$ = (cos/tan) (see Table 3),
= 32.85 d/I_o, degree, and
d = $I - I_o$.

11.5 *Flexural Rigidity, Individual Specimens*—Calculate the flexural rigidity for each testing direction to three significant digits using Eq 3.

$$G = W \times c^3 \tag{3}$$

where:
G = flexural rigidity, mg cm,
W = fabric mass per unit area, mg/cm^2, and
c = bending length, cm, or

11.6 *Average Values*—Calculate the average bending length and flexural rigidity as applicable to a material specification or

TABLE 3 Table of *f (0)*

0, deg	0	1	2	3	4	5	6	7	8	9
0	...	3.855	3.059	2.671	2.425	2.250	2.115	2.007	1.917	1.841
10	1.774	1.716	1.663	1.616	1.573	1.533	1.496	1.462	1.430	1.400
20	1.372	1.345	1.319	1.294	1.271	1.248	1.226	1.205	1.186	1.164
30	1.144	1.126	1.107	1.089	1.071	1.054	1.037	1.022	1.003	0.986
40	0.970	0.954	0.933	0.922	0.906	0.891	0.875	0.860	0.845	0.829
50	0.813	0.799	0.784	0.768	0.753	0.738	0.722	0.707	0.692	0.676
60	0.661	0.645	0.630	0.614	0.596	0.582	0.586	0.549	0.533	0.516
70	0.499	0.482	0.465	0.447	0.429	0.411	0.392	0.373	0.354	0.333
80	0.313	0.291	0.269	0.246	0.222	0.197	0.170	0.140	0.107	0.067

contract order for each laboratory sampling unit and for the lot, for each testing direction.

$$G = 9.809 \times 10^6\ M^3 \quad (4)$$

where M = mass per unit area in gms/m^2.

11.7 *Standard Deviation, Coefficient of Variation*—Calculate when requested.

12. Report

12.1 Report that the stiffness as bending length and flexural rigidity was determined as directed in Test Method D 1388. Describe the material or product sampled and the method of sampling used.

12.2 Report the following information for each laboratory sampling unit and for the lot as applicable to a material specification or contract order.

12.2.1 Option used, cantilever test or heart loop test.

12.2.2 Bending length for each testing direction.

12.2.3 Flexural rigidity for each testing direction.

12.2.4 Number of specimens tested for each direction.

12.2.5 When calculated, the standard deviation or the coefficient of variation.

12.2.6 Make and model of cantilever testing machine.

12.2.7 Any modification of the test method.

13. Precision and Bias

13.1 *Summary*—In comparing two averages, the differences should not exceed the single-operator precision values shown in Table 4 for the respective number of tests and for materials having averages similar to those shown in Table 2 in 95 out of 100 cases when all the observations are taken by the same well-trained operator using the same piece of equipment and specimens randomly drawn from the sample of material. Larger differences are likely to occur under all other circumstances.

13.2 *Interlaboratory Test Data*[6]—An interlaboratory test was run in 1994–1995 in which randomly-drawn samples of three materials were tested as directed in Test Method D 1388 in six laboratories using Option A, the Cantilever test. A second interlaboratory test was run in 1994–1995 in which randomly-drawn samples of two fabrics were tested as directed in Test Method D 1388 in two laboratories using Option B, the Heart Loop test. Two operators in each laboratory each tested eight specimens of each fabric. Four of the eight specimens were tested on one day and four specimens were tested on a second day. Analysis of the data was conducted using Practice D 2904, Practice D 2906 and the adjunct "Tex-Pac". The components of variance for stiffness expressed as standard deviations were calculated to be the values listed in Table 5. The fabric types and designated procedures were:

TABLE 4 Stiffness of Fabrics, Bending Length, cm

Test Option and Materials	Number of Observations in Each Average	Critical Differences for the Conditions Noted[A]: Single-Operator Precision	Within-Laboratory Precision	Between-Laboratory Precision
Option A, Cantilever, cm				
Mat 4, S/0008H	1	0.17	0.20	0.63
	2	0.12	0.16	0.62
	5	0.07	0.13	0.61
	10	0.05	0.12	0.61
Mat 5, S/2438	1	0.30	0.34	0.88
	2	0.21	0.27	0.85
	5	0.13	0.21	0.83
	10	0.09	0.19	0.83
Mat 9, S/Denim	1	0.64	0.75	0.96
	2	0.45	0.60	0.84
	5	0.28	0.49	0.77
	10	0.20	0.44	0.74
Option B, Heart Loop, cm				
Mat 1, S/179B	1	0.34	0.39	0.74
	2	0.24	0.31	0.70
	5	0.15	0.24	0.68
	10	0.11	0.22	0.67
Mat 5, S/2438	1	0.20	0.21	0.28
	2	0.14	0.15	0.24
	5	0.09	0.10	0.21
	10	0.06	0.08	0.20

[A] The critical differences were calculated using $t = 1.960$, which is based on infinite degrees of freedom.

TABLE 5 Stiffness of Fabrics, Bending Length, cm

Test Option and Materials	Grand Average	Components of Variance Expressed as Standard Deviations[A]: Single-Operator Component	Within-Laboratory Component	Between Laboratory Component
Option A, Cantilever, cm				
Mat 4, S/0008H	1.90	0.061	0.040	0.215
Mat 5, S/2438	2.60	0.041	0.061	0.108
Mat 9, S/Denim	5.18	0.229	0.143	0.215
Option B, Heart Loop, cm				
Mat 1, S/179B	2.94	0.124	0.068	0.227
Mat 5, S/2438	1.97	0.073	0.017	0.067

[A] The square roots of the components of variance are being reported to express the variability in the appropriate units of measure rather than as the squares of those units of measure.

[6] ASTM Research Report is available from ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

13.2.1 *Cantilever Procedure*:

(1) Material 4—S/0008H, Plain Weave Sheeting, With Spun Yarns,

(2) Material 5—S/2438, Plain Weave, Oxford With Spun Yarns,

(3) Material 9—Denim, Twill Weave, With Spun Yarns.

13.2.2 *Heart Loop Procedure*:

(1) Material 1—S/179B, Twill Weave, With Spun Yarns,

(2) Material 5—S/2438, Plain Weave, Oxford With Spun Yarns.

13.3 *Precision*—For the components of variance reported in Table 5, two averages of observed values should be considered significantly different at the 95 % probability level if the difference equals or exceeds the critical differences listed in Table 4. There were sufficient differences related to the fabric type and structure to warrant listing the components of variance and the critical differences separately. Consequently no multi-material comparisons were made.

NOTE 9—Since the interlaboratory test for the Heart Loop stiffness option included only two materials and two laboratories, estimates of between-laboratory precision should be used with special caution.

NOTE 10—The tabulated values of the critical differences should be considered to be a general statement, particularly with respect to between-laboratory precision. Before a meaningful statement can be made about two specific laboratories, the amount of statistical bias, if any, between them must be established, with each comparison being based on recent data obtained on specimens taken from a lot of material to the type being evaluated so as to be as nearly homogeneous as possible and then randomly assigned in equal numbers to each of the laboratories.

13.4 *Bias*—The value of stiffness of fabrics can only be defined in terms of a test method. Within this limitation, Test Method D 1388 has no known bias.

14. Keywords

14.1 bending length, fabric; fabric; flexural rigidity, stiffness