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Standard Test Method for Bow and Skew in Woven and Knitted Fabrics¹

This standard is issued under the fixed designation D 3882; 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 determination of bow and skew of filling yarns in woven fabrics and the courses in knitted fabrics.

1.2 This test method can also be used to measure the bow and skew of printed geometric designs such as plaids, designs.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as the standard. ~~Within the text, the inch-pound units are shown in parentheses. 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 this test method, the standard.~~

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:*²

D 123 Terminology Relating to Textiles

D 1776 Practice for Conditioning and Testing Textiles

D 2904 Practice for Interlaboratory Testing of a Textile Test Method that Produces Normally Distributed Data

D 2906 Practice for Statements on Precision and Bias for Textiles

D 3990 Terminology Relating to Fabric Defects

3. Terminology

3.1 *Definitions:* (For all terminology related to Fabric Defects see D3990.)

3.1.1 *The following terms are relevant to this standard:*

3.1.2 *bow, n*—a fabric condition resulting when filling yarns or knitting courses are displaced from a line perpendicular to the selvages and form one or more arcs across the width of the fabric. (See also *double bow*.)

3.1.2.1 *Discussion*—bow and bias is a synonym for bow and skew.

3.1.3 *double bow, n*—two fabric bows, arcing in the same direction, as in a flattened *M* or *W* depending on the viewing angle. (See also *double bow*.) (Compare *double reverse bow*.)

3.1.3.1

3.1.3.1 *Discussion*—In tubular knits, there may be differential bowing between the top and bottom of the tube.

3.1.3

3.1.4 *double hooked bow, n*—one hooked bow at each side of the fabric that arc in opposite directions. (See also *hooked bow*.)

3.1.4

3.1.5 *double reverse bow, n*—two fabric bows arcing in opposite directions. (See also *bow double bow*.) (Compare *double bow*.)

3.1.5 *double bow*.)

3.1.6 *hooked bow, n*—a fabric condition in which the filling yarns or knitted courses are in the proper position for most of the fabric width but are pulled out of alignment at one side of the fabric. (See also *double hooked bow*.)

3.1.6

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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.

3.1.7 *knitted fabric, n*—a structure produced by interlooping one or more ends of yarn or comparable materials.

3.1.7

3.1.8 *skew, n*—a fabric condition resulting when filling yarns or knitted courses are angularly displaced from a line perpendicular to the edge or side of the fabric.

3.1.7.1

3.1.8.1 *Discussion*—Knitted courses or filling yarns usually appear as straight line at right angles to the edge or side of the fabric. When tubular knitted fabric is finished, differential skew may occur on the top and bottom part of the tube.

3.1.8

3.1.8.2 *Discussion*—*bow and bias* is a synonym for *bow and skew*.

3.1.9 *standard atmosphere for testing textiles, n*—laboratory conditions for testing fibers, yarns, and fabrics in which air temperature and relative humidity are maintained at specific levels with established tolerances.

3.1.8.1

3.1.9.1 *Discussion*—Textile materials are used in a number of specific end-use applications that frequently require different testing temperatures and relative humidities. Specific conditioning and testing of textiles for end-product requirements can be carried out using Table 1 in Practice D 1776.

3.1.9 For definitions of fabric defect terms, refer to Terminology D3990. For definitions of other textile terms used in this test method, refer to Terminology D123

3.1.10 For definitions of fabric defect terms, refer to Terminology D 3990. For all other terminology related to textiles, see Terminology D 123.

4. Summary of Test Method

4.1 *Bow*—A straightedge is placed across the fabric between two points at which a marked filling yarn, knitting course, designated printed line, or designated design meets the two selvages or edges. The greatest distance between the straightedge and the marked filling line, knitting course, designated printed line, or designated design is measured parallel to the selvage.

4.2 *Skew*—The straight-line distortion of a marked filling yarn, knitting course, designated printed line, or designated design is measured from its normal perpendicular to the selvage or edge.

5. Significance and Use

5.1 This test method is considered satisfactory for acceptance testing of commercial shipments.

5.1.1 If there are differences of practical significance between reported test results for two laboratories (or more), comparative tests should be performed to determine if there is a statistical bias between them, using competent statistical assistance. As a minimum, the test samples to be used are as homogeneous as possible, are drawn from the material from which the disparate test results were obtained, and are randomly assigned in equal numbers to each laboratory for testing. Other fabrics with established test values may be used for this purpose. The test results from the two laboratories should be compared using a statistical test for unpaired data, at a probability level chosen prior to the testing series. If a bias is found, either its cause must be found and corrected, or future test results must be adjusted in consideration of the known bias.

5.2 Individual rolls are normally accepted or rejected on the basis of the maximum amount of bow or skew in a specific roll of fabric. The average bow or skew in a roll or lot or the range of bow or skew in a roll may be determined but are not normally used in the trade for acceptance or rejection.

5.3 Bow or skew can be induced during fabric manufacturing, dyeing, tentering, finishing, or other operations where a potential exists for uneven distribution of tensions across the fabric width. Bow and skew are more visually displeasing in colored, patterned

TABLE 1 Critical Differences, 95 % Probability Level, for Bow and Skew for the Conditions Noted

Property	Number of Observations in Each Average	Critical Differences for the Conditions Noted ^A , %		
		Repeatability		Reproducibility
		(Single-Operator) Precision	(Within-Laboratory) Precision	(Between-Laboratory) Precision
Bow	1	0.80	0.80	0.80
	3	0.46	0.46	0.46
	6	0.33	0.33	0.33
	12	0.23	0.23	0.23
	24	0.16	0.16	0.16
Skew	1	2.99	2.99	3.18
	3	1.73	1.73	2.04
	6	1.22	1.22	1.63
	12	0.86	0.86	1.38
	24	0.61	0.61	1.24

^AThe critical differences for Table 1 were calculated using $t = 1.960$, which is based on infinite degrees of freedom.

fabrics such as plaids and horizontal stripes rather than in solid colors because the contrast makes the distortion more prominent. These defects may cause sewing problems in such fabrics and draping problems in finished products. In some cases, a specified amount of skew is needed, for example, to prevent ~~trouser leg twisting~~ twisting of pant legs made of twill fabric. Matching plaids from distorted patterns may create serious problems for the garment manufacturer or home sewer. Wavy or sharp breaks in the bow line are more detrimental to the appearance of small parts of a garment (such as collars, pockets, and so forth) than a gradual slope from a straight line.

5.3.1 Automotive interior textiles used for seat bolsters, cushions, headrests and door panels may be susceptible to bow and skew, especially when visually patterned fabrics are joined or mated to a straight edge surface.

6. Apparatus

6.1 *Measuring Stick or Steel Tape*, graduated in 1-mm ($1/16$ -in.) divisions and longer than the width of the fabric that is to be measured.

6.2 ~~Rigid Straightedge~~ Rigid Straightedge or t-square, longer than the width of the fabric that is to be measured.

6.3 *Flat Surface*, of sufficient length to unroll or unfold the fabric (see 6.4).

6.4 *Fabric Inspection Table* (Optional), to unroll and roll fabric rolls or unfold and fold fabric bolts with sufficient lighting that provides transmitted light from underneath the fabric to make the defect more clearly visible.

7. Sampling and Test Specimens

7.1 *Primary Sampling Unit*—Consider rolls or bolts of fabric or fabric components of fabricated systems to be the primary sampling unit, as applicable.

7.2 *Laboratory Sampling Unit*—As a laboratory sampling unit take the entire roll or bolt after removing a first 1-mm (1-yd) length. For fabric components of fabricated systems, use the entire system.

7.3 *Test Specimens*—As test specimens, select 3 test areas from each laboratory sampling unit. Exclude the first and last fifth of the roll or bolt or piece length. Select test areas at random but no closer to one another than one fifth of the roll or bolt or piece length.

7.3.1 Optical test specimens—Select 3 test areas from each sampling unit. Exclude the first and last 10 m (11 yd) of a roll and test random areas within the roll.

7.3.1.1 Cut pieces that are at least 400 mm (16 in.) in width can be measured for bow and skew.

8. Conditioning

8.1 Condition the test specimens to moisture equilibrium for testing in the standard atmosphere for testing textiles in accordance with Practice D 1776 or, if applicable, in the specified atmosphere in which the testing is to be performed.

8.1.1 When full rolls or bolts of fabric cannot be properly conditioned in a reasonable time with available facilities, perform the test without conditioning and report the actual condition prevailing at the time of the test. Such results may not correspond with the results obtained when testing conditioned specimens at the standard atmosphere for testing textiles.

9. Procedure

9.1 Test the test specimens in the standard atmosphere for testing textiles in accordance with Section 8.

9.2 Handle the test specimens carefully to avoid altering the natural state of the material.

9.3 Lay the fabric on a smooth, horizontal surface without tension in any direction or use the optional fabric inspection table.

9.4 *Bow*:

9.4.1 Measure the bow in three places spaced as widely as possible along the length of the fabric or along a minimum of 1 m (1 yd). If possible, make no measurement closer to the ends of the roll or piece of fabric than 1 m.

~~9.4.2 If evident, follow m (1 yd).~~

9.4.2 Follow a distinctive color yarn or pattern line across the width of the fabric. Otherwise, trace Trace one filling yarn, knitting course, or printed line across the full width of the fabric using a soft pencil or suitable marker.

9.4.3 Place a rigid straightedge across the fabric connecting the points at which the distinctive color yarn or pattern line, or marked yarn meets the two selvages or edges.

9.4.4 Measure the distance along the straightedge between the two selvages or edges to the nearest 1 mm ($1/16$ in.) and record as the baseline distance (BL).

9.4.4.1 For certain end uses where several narrow panels are sewn in a garment, it will be necessary to measure the bow across a narrower distance than the total width of the fabric, for example, a width of 38 cm (15 in.). This distance is used as the fabric width when calculating the bow.

9.4.4.2 For automotive or other applications where narrow panels or cut pieces are used, it will be necessary to measure bow across a narrower distance than across the full width of the fabric, for example, a width of 400 mm (16 in.). Use this distance as the fabric width when calculating bow.

9.4.5 Measure the greatest distance parallel to the selvages or edges between the straightedge and the distinctive color yarn or pattern line, or marked yarn to the nearest 1 mm ($1/16$ in.) and record as the bow distance (*D*) including the type. (See Fig. 1).

9.4.5.1 If double bow is evident, measure and record both distances.