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Designation: ~~D6828 – 02 (Reapproved 2011)~~ D6828 – 02 (Reapproved 2015)

Standard Test Method for Stiffness of Fabric by Blade/Slot Procedure[1]

This standard is issued under the fixed designation D6828; 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 the stiffness of fabrics by measuring the force required to push a specimen into a slot of predetermined width with a metal blade working at a predetermined capacity.

NOTE 1—For other methods for testing stiffness, refer to Test Methods D1388, D4032, and D5732.

1.2 This test method is applicable to fabrics of any fiber content whose stiffness does not exceed the capacity of the Penetrator Beam apparatus. Specimens can be taken from fabrics, rolls, or end products.

1.3 The values stated in SI units are to be considered as standard; the values inch-pound units are included for information only.

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]

D123 Terminology Relating to Textiles
D1388 Test Method for Stiffness of Fabrics
D1776 Practice for Conditioning and Testing Textiles
D2904 Practice for Interlaboratory Testing of a Textile Test Method that Produces Normally Distributed Data (Withdrawn 2008)[3]
D2906 Practice for Statements on Precision and Bias for Textiles (Withdrawn 2008)[3]
D4032 Test Method for Stiffness of Fabric by the Circular Bend Procedure
D4850 Terminology Relating to Fabrics and Fabric Test Methods
D5732 Test Method for Stiffness of Nonwoven Fabrics Using the Cantilever Test (Withdrawn 2008)[3]

2.2 *Statistical Analysis Software:*[4]

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3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of textile terms used in this method refer to Terminology D4850. For other terms used in this method, refer to Terminology D123.

4. Summary of Test Method

4.1 A swatch of fabric rests on two flat plate supports separated by a fixed distance. A force is applied to the fabric swatch midway between the supports by means of a blade attached to a motor driven beam. The maximum force needed to push the fabric through the supports is measured as a resistance to bending of the fabric.

5. Significance and Use

5.1 This test method is considered satisfactory for quality control testing.

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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.

Current edition approved ~~May 1, 2011~~July 1, 2015. Published ~~July 2011~~September 2015. Originally approved in 2002. Last previous edition approved in ~~2007~~2011 as D6828 – 02(~~2007).~~(2011). DOI: ~~10.1520/D6828-02R11.~~10.1520/D6828-02R15.

[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] The last approved version of this historical standard is referenced on www.astm.org.

[4] SAS Institute, Box 8000, Cary, NC 27511.

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5.2 If there are differences of practical significance between reported test results for two laboratories, comparative tests should be performed to determine if there is a statistical bias between them, using competent statistical assistance. As a minimum, use test samples as homogeneous as possible, drawn from the material from which the disparate test results were obtained, and randomly assigned in equal number to each laboratory for testing. 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 results for the source material must be adjusted in consideration of the known bias.

5.3 The stiffness of fabric relates to its resistance to bending with further processing and use. It measures the fiber and yarn bending capabilities, the cohesion of individual fibers and yarns relative to their displacement and binders or finishes that hold them in place.

6. Apparatus

6.1 *Handle-O-Meter Tester,*[5](Fig. 1), having the following parts:

6.1.1 *Specimen Platform,* consisting of two adjustable plates capable of forming an opening between the two plates.

6.1.2 *Penetrating Blade,* to force the fabric into the slot between the plates.

6.1.3 *Penetrator Beam,* to move the Penetrator Blade.

6.1.4 *Force Measuring Device,* operating at a predetermined capacity, to measure the force required to force the fabric into the slot.

6.1.5 *Calibration Weight,* for calibration of the force appropriate for the Penetrator Blade.

6.2 *Specimen Marking Template,* 102 by 100 ± 5.0 mm (4.0 by 4.0 ± 0.2 in.).

7. Sampling and Test Specimens

7.1 *Primary Sampling Unit*—Consider material as put-up for shipment to be the primary sampling unit, such as rolls, bolts or pieces of fabric, or carton of garments or flat goods, as applicable. (See Annex A1.)

7.2 *Laboratory Sampling Unit*—As a laboratory sampling unit take from rolls at least one full-width piece of fabric that is 1 m (1 yd) in length along the selvage (machine direction), after first removing a 1 m (1 yd) length.

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[5] The sole source of supply of the apparatus known to the committee at this time is Thwing-Albert Instrument Co., Philadelphia, PA. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee [1], which you may attend.

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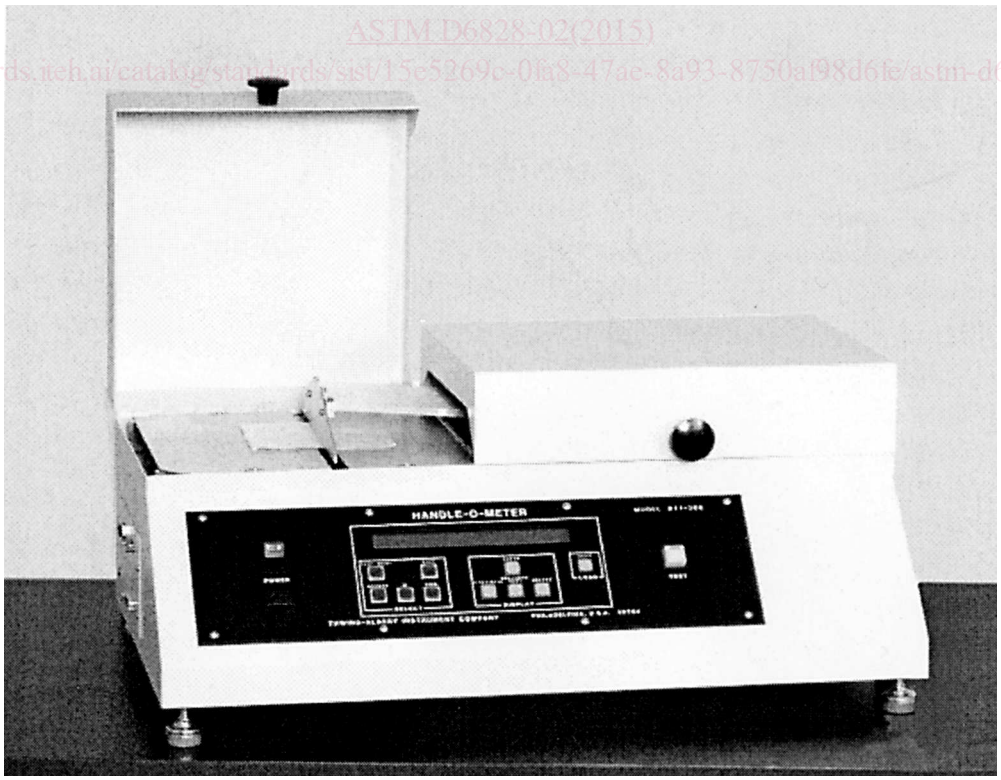

FIG. 1 Handle-O-Meter Tester

7.3 *Test Specimens*—From each laboratory sampling unit, take five specimens 100 by 100 ± 2.5 mm (4 by 4 ± 0.1 in.). Take specimens representing a broad distribution from different positions diagonally across the width of the laboratory sampling unit. Specimens should be staggered in such a manner that no specimens contain the same yarns. With the face of the specimen up, place a small locator mark in the lower right hand corner of the specimen parallel to the warp/machine direction (MD). (See Annex A2.) The mark will be used to correctly position the specimen prior to testing so that the stiffness of four different areas of the specimen can be determined. Label specimen to maintain identity.

7.3.1 For fabric widths 100 mm (4 in.) or more, take no specimens closer than 25 mm (1 in) from the selvage edges of the laboratory sampling unit.

7.3.2 For fabric widths less than 150 mm (4 in.), use the entire width of the laboratory sampling unit for specimens.

7.3.3 Ensure specimens are free of folds, creases, or wrinkles. Avoid getting oil, water, grease, etc. on the specimens when handling.

7.3.4 If the fabric has a pattern, ensure that the specimens are a representative sampling of the pattern.

8. Preparation of Apparatus

8.1 Place the tester on a flat surface and level according to manufacturers instructions.

8.2 Install Penetrator Beam Assembly. Selection of beam is determined by thickness and weight of the fabric. Most fabrics will require a 1000 g beam.

8.3 Engage the power control and allow 15 min for the circuitry to stabilize.

8.4 Calibrate the instrument by placing the calibration weight specified on the upper edge of the blade. The reading will be a negative number. Make necessary adjustments as directed in the instruction manual.

8.5 Set the width of the slot by moving the plates to the desired location as directed in the instruction manual. Slot width is determined by the fabric to be tested. Most fabrics will require a 10 mm (0.40 in.) slot width.

8.6 Select Quadruple mode using Mode button on control panel.

8.7 Maintenance (see Annex A3).

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9. Conditioning

9.1 Bring the test specimens to moisture equilibrium for testing in the standard atmosphere for testing textiles as directed in Practice D1776 or, if applicable, in the specified atmosphere in which the testing is to be performed.

10. Procedure

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10.1 Make all the tests in the standard atmosphere for testing.

10.2 Zero the instrument by pressing the zero/force button to obtain a zero reading on the force display.

10.3 Place specimen face-up over the slot on the platform so that the warp/machine direction mark on the specimen is in the lower left corner and perpendicular to the slot. About ⅓ (30 mm, 1.3 in.) of the specimen should be to the right of the slot and ⅔ (65 mm, 2.6 in.) to the left. (See Annex A2, Position 1.)

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

10.5 Depress the test switch and allow the blade to complete one cycle by pushing the specimen into the slot and returning to the start position. It is not necessary to close the lid of the instrument during testing.

10.6 Record the maximum reading in the warp/machine direction face up.

10.7 Remove the specimen from the slot, keeping face-side up. Rotate the specimen 90° clockwise so that the warp/machine direction mark is parallel to the slot and the locator mark is positioned in the vertical direction in the lower left corner of the specimen (see Annex A2, Position 2). Arrange the specimen so that about ⅓ of the specimen is to the right of the slot and ⅔ to the left. Re-zero the tester if the digital force display does not read zero.

10.8 Activate the tester and record the maximum force in the filling/cross direction face-up.

10.9 Remove the specimen from the slot and turn it over so that the back side is facing up and the warp/machine direction (MD) of the specimen is perpendicular to the slot. The locator mark on the underneath side of the specimen must be on the opposite side from its location in 10.3. (See Annex A2, Position 3). This procedure will expose a fresh area of the specimen for testing.

10.10 Activate the tester and record the maximum reading of the warp/machine direction face down.

10.11 Remove the specimen from the slot, keeping back side of specimen facing up. Rotate the specimen 90° counterclockwise so that the warp/machine direction of the specimen is parallel to the slot and the locator mark on the underneath side of the specimen is on the opposite side from its location in 10.7. (See Annex A2, Position 4.)

10.12 Activate the tester and record the maximum reading of the filling/cross direction face down.

10.13 Continue as directed in 10.3 – 10.12 until all specimens have been tested.

11. Calculation

11.1 Determine Total Stiffness of each specimen (see Annex A2).

11.2 Average Total Stiffness measurements for each laboratory sampling unit using values from the individual specimens. Calculate the standard deviation of the specimens.

12. Report

12.1 State that the specimens were tested as directed in Test Method D6828. Describe the material or product sampled and sampling method used.

12.2 Report the following information:

12.2.1 Total stiffness of each specimen and the average stiffness of the specimens from each laboratory sampling unit.

12.2.2 Dimensions of the test specimens.

12.2.3 Testing conditions used.

12.2.4 Slot width and Penetrator Beam used and instrument model.

13. Precision and Bias

13.1 *Summary*—The following precision and bias statements have been prepared in accordance with Practice D2906. In comparing two single observations (single operator precision) for the materials tested, the difference should not exceed the values shown in Table 2 in 95 our of 100 cases when both observations are taken by the same well trained operator using the same piece of test equipment and specimens randomly drawn from the same sample of material. Larger differences are likely to occur under all other circumstances. The true value of stiffness can be defined only in terms of a specific test method. Within this limitation, this test method has no know bias. Paragraphs 13.2 – 13.4 explains the bias for this summary and for evaluations made under other conditions.

13.2 *Interlaboratory Test Data*—An interlaboratory test was run in 2001, in which randomly-drawn samples of two fabrics were tested in each of two laboratories. Two operators in each laboratory each tested ten specimens of each fabric using this test method. Five of the ten specimens were tested on one day and five specimens were tested on a second day. Analysis of the data was conducted using Practice D2904, Practice D2906 and Statistical Analysis Software (SAS). The components of variance for stiffness expressed as standard deviations were calculated to be the values listed in Table 3. The two fabric types were: (*1*) Woven mid weight and (*2*) Warp knit with weft insertion.

13.3 *Precision*—For the components of variance reported in Table 3, 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 2. 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 2—Since this interlaboratory test included only two materials and two laboratories, estimates of between-laboratory precision should be used with special caution. Interlaboratory testing of other fabric types is in progress.

NOTE 3—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 e equal numbers to each of the laboratories.

13.4 *Bias*—The procedure in this test method for measuring stiffness has no bias because the value of this property can be defined only in terms of a test method.

14. Keywords

14.1 bending; fabric; penetrator blade; stiffness

TABLE 1 Average Stiffness Values, g[A]

Fabric #1			
day #1		day #2	
operator 1	operator 2	operator 1	operator 2
140.4	141.3	147.1	149.6
Fabric #2			
day #1		day #2	
operator 1	operator 2	operator 1	operator 2
546.0	595.2	592.7	583.5

[A] Mean of Total Stiffness Measurements (MD face-up + CD face-up + MD face-down + CD face-down = Total Stiffness) obtained for five specimens.