Designation: D3883 – 04 (Reapproved 2020)

Standard Test Method for Yarn Crimp and Yarn Take-up in Woven Fabrics[1]

This standard is issued under the fixed designation D3883; 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 relationship between the length of a piece of fabric and the length of the yarn in the fabric by measurement of the yarn crimp and yarn take-up.

1.2 This test method applies to woven fabrics.

1.3 The values stated in either SI or inch-pound units are to be regarded separately as standard. Within the text, the inch-pound units are shown in parentheses. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D123 Terminology Relating to Textiles

D1776/D1776M 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D2904 Practice for Interlaboratory Testing of a Textile Test Method that Produces Normally Distributed Data (Withdrawn 2008)[3]

D2906 Practice for Statements on Precision and Bias for Textiles (Withdrawn 2008)[3]

D4849 Terminology Related to Yarns and Fibers

D4850 Terminology Relating to Fabrics and Fabric Test Methods

3. Terminology

3.1 For definition of textile terms used in this test method: bench marks, refer to Terminology D4849.

3.2 For definitions of textile terms used in this test method: yarn crimp and yarn take-up, refer to Terminology D4850.

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

4. Summary of Test Method

4.1 Bench marks are placed on a length of a yarn as it lies in a woven fabric. The distance between the bench marks is measured. The yarn is removed from the fabric, straightened by applying suitable tension, and the distance between the bench marks is remeasured. Yarn crimp is the change in length expressed as a percent and based on the in-fabric distance. Yarn take-up is the change in length expressed as a percent and based on the out-of-fabric distance.

5. Significance and Use

5.1 The relationship of the length of a piece of fabric and the length of yarn in the fabric can be determined accurately only be measuring the length of yarn entering the loom and the length of fabric made from that particular length of yarn. In most cases, however, the determination must of necessity be made on a woven fabric by measuring the length of yarn removed from a measured length of fabric, thus introducing certain variations that will influence the accuracy of the test. Yarn removed from the woven fabric contains undulations or waves that have been introduced by the weaving process. Heat, moisture, and mechanical shrinkage on subsequent finishing operations may accentuate these undulations, and in all

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.59 on Fabric Test Methods, General.

Current edition approved July 1, 2020. Published August 2020. Originally approved in 1980. Last previous edition approved in 2016 as D3883 – 04(2016). DOI: 10.1520/D3883-04R20.

[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.

probability, increase the force to pull them out and straighten the yarn. In order to accurately measure the length of the yarn after the removal of the crimp, these undulations must be pulled out without elongating the yarn. In some cases, the minimum force necessary to straighten the yarn will cause a certain amount of the elongation to take place, thus increasing the length of the yarn. Also, stresses imposed upon the yarn during the weaving process may have been sufficient to stretch the yarn beyond its elastic limit, again increasing its length. It is recognized that determination made by measuring length of yarn removed from a measured length of fabric may tend to give crimp values that are somewhat higher than the crimp in the yarn as it lay in the fabric. In the case of fabrics made from yarns that exhibit differential shrinkage, or yarns of widely different count, or yarns woven at different tensions, the crimp of each type of yarn in the fabric must be determined and reported separately.

5.2 This test method can be used for acceptance testing of commercial shipments but comparisons should be made with caution because information on estimates of between-laboratory precision is limited as noted in 13.1.

5.2.1 If there are differences of practical significance between reported test results for two laboratories (or more), comparative tests should be performed to determine if their is a statistical bias between them, using competent statistical assistance. As a minimum, ensure 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. 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 for that material must be adjusted in consideration of the known bias.

6. Apparatus

6.1 *Suitable Device*[4], for straightening the yarn through application of horizontal or vertical tension, having two yarn support surfaces or two clamps, the distance between which may be altered in order to apply the needed tension.

6.2 *Suitable Marking Device,* for marking bench marks on the yarn specimen.

7. Sampling and Test Specimens

7.1 *Primary Sampling Unit*—Consider rolls 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 from rolls two pieces of fabric, full width, each 375 mm (15 in.) in length along the selvage (machine direction) after removing a first 1-mm (1-yd) length. For fabric components of fabricated systems use the entire system.

7.3 *Test Specimens*—From each laboratory sampling unit, as required for each the warpwise and fillingwise directions, take ten test specimens, each 300 mm (14 in.) long as direction in Section 9. Consider the long direction as the direction of test.

7.3.1 For fabric widths 125-mm (5-in.) or more, take no specimen closer than 25-mm (1-in.) from the selvage edge.

7.3.2 For fabric widths less than 125-mm (5-in.), use the entire width 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. Conditioning

8.1 Condition the specimens by bringing them to approximate moisture equilibrium in the standard atmosphere for conditioning textiles as directed in Practice D1776/D1776M.

9. Preparation of Test Apparatus and Calibration

9.1 Set-up procedures for machines from different manufacturers may vary. Prepare and verify calibration of the testing device as directed in the manufacturer's instructions.

10. Procedure

10.1 Test the specimens in the standard atmosphere for testing textiles, as described in Practice D1776/D1776M.

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

10.3 Test ten specimens from the warpwise direction or ten specimens from the fillingwise direction, or both, as required in a material specification or contact order.

10.4 Using the marking device, make two lines (bench marks) 250 mm (10 in.) apart, perpendicular to the yarn being tested and extending 25 mm (1 in.) into the fabric, and record the distance between bench marks as distance (*F*) (in-fabric distance).

10.4.1 If a direct reading device is used, follow the manufacturer's recommendations for establishing the specimen length.

10.5 Prepare an edge by making a cut at least 350 mm (14 in.) long, parallel, and in the direction of the yarn to be measured, and such that it crosses near the ends of both lines of the bench mark.

10.6 Ravel several yarns from the cut edge, such that they contain the bench marks.

10.7 One at a time, when ready to use, ravel ten yarn specimens from the prepared edge of the fabric. Ensure that the bench marks appear on each yarn. Take care not to disturb the twist or strain the yarn. Maintain identity of the fabric direction being evaluated, that is, warpwise or fillingwise.

10.8 Fasten one of the yarn specimens in the clamps of a tensioning device or, if applicable, in the proper position of the yarn supports of a direct reading crimp tester with the bench marks coincident with the nips of the respective clamps that are set for the initial in-fabric length.

[4] Commercially available devices that have been found acceptable are a twist tester with tension device, a tensile testing machine, and a crimp tester of the direct reading type.

10.8.1 Clamp type devices may consist of a twist counter fitted with graduated sliding clamp, or a tension testing machine or which the movement or action can be stopped instantly at any point, such as the constant-rate-of-elongation (CRE-Type) or other similar instrument. For a direct reading crimp tester, the yarn is placed under the hook of the movable shaft with the bench marks on the yarn aligned with the upper fixed yarn supports.

10.9 Apply a force to the yarn just sufficient to remove undulations due to weaving, without imparting stretch as determined by using one of the following three options.

NOTE 1—The three options can give different results. For maximum precision between laboratories, it is recommended that the laboratories use the same equipment and the same option.

10.9.1 *Option A, By Hand*—Straighten the yarn by hand against a scale graduated in 1 mm (1⁄16 in.), observe and record the distance between bench marks to the nearest 1 mm (1⁄16 in.) as (*Y*) (straightened yarn distance).

NOTE 2—This is the least accurate option because the tension required to remove crimp is unknown.

10.9.2 *Option B, by Tension Device or Crimp Tester*—Using one of the tensioning devices or crimp tester, apply a tension force based upon the known yarn size. If the tension force is not sufficient to remove all the crimp, gradually increase the tension force until the crimp just removed. Use the determined force on all the yarns in the set and proportional force on any other samples in the series or test.

10.9.2.1 Estimate the required tension force using Eq 1:

$$\text{Tensile force, g} = \text{yarn number in tex} \times 0.25 \tag{1}$$

10.9.3 *Option C, Tensile Testing Machine*—Using a constant-rate-of-extension (CRE-type) of testing machine, determine the force to remove undulations by analysis of a force-extension as described in 10.9.3.1.

10.9.3.1 Establish Point A as the point where the force-extension curve begins, that is, zero force and zero extension. Extrapolate the straight-line portion of the force-extension curve through the extension axis, Line CE. The portion of the curve AD represents the removal of the crimp and initial stretch of the yarn. Establish Point D where the force-extension curve separates from the line CE. Establish Point B by constructing a line from Point C, parallel to the force axis to curve AD. Establish Point L by constructing a line from Point B through the force axis, parallel to the extension axis. The force corresponding to Point L is the required tensile force to remove the crimp without stretching (see Fig. 1).

10.10 Determine and record the length of the yarn to the nearest 2.5 mm (0.1 in.) after removal of the crimp as follows:

10.10.1 For clamp-type devices, measure the distance between the bench marks on the straightened yarn and record as distance (*Y*) (straightened yarn distance).

10.10.2 For constant-rate-of-extension machines, determine and record the straightened distance (*Y*) between bench marks directly from the extension axis of the force-extension curve illustrated on Fig. 1 by line LB, projected to the extension axis, allowing for any chart magnification ratio.

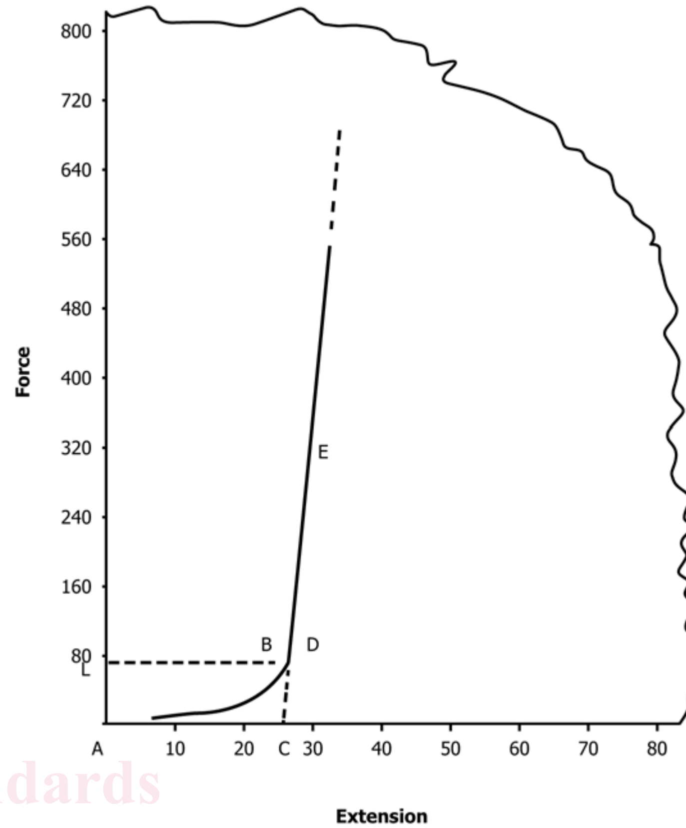

FIG. 1 Example Chart For Determining of Tensile Force Using Option C

10.10.2.1 For some tensile testers, straightened yarn distance (*Y*) and the percent yarn crimp or yarn take-up can be computer-processed automatically.

10.10.3 For direct-reading crimp testers, read the yarn crimp or yarn take-up directly from the dial or scale.

11. Calculation

11.1 Calculate the average distance between the two bench marks on the straightened yarn for all measured specimens to the nearest 2.5 mm (0.1 in.), for each warpwise direction and fillingwise direction, as applicable.

11.2 Calculate the average yarn crimp or average yarn take-up to the nearest 0.1 % using Eq 2 or Eq 3, for each warpwise direction and fillingwise direction, as applicable:

$$C = 100(Y - F)/F \tag{2}$$

$$T = 100(Y - F)/Y \tag{3}$$

where:

C = yarn crimp, %,
T = yarn take-up, %,
F = average of distances between bench marks on yarn in fabric, mm (in.) (from 10.4), and
Y = average of distances between bench marks on yarn after removal from fabric and straightened under tension, mm (in.) (from 10.10).

11.2.1 When data are computer-processed automatically, calculations generally are contained in the associated software.