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Standard Test Method for Length and Length Distribution of Cotton Fibers (Array Method)[1]

This standard is issued under the fixed designation D 1440; 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 fiber length and length distribution in loose cotton fibers.

NOTE 1—For another method for measuring fiber length, see Test Method D 1447.

1.2 *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 1441 Practice for Sampling Cotton Fibers for Testing[2]

D 1447 Test Method for Length and Length Uniformity of Cotton Fibers by Fibrograph Measurement[2]

D 1776 Practice for Conditioning Textiles for Testing[2]

3. Terminology

3.1 *Definitions:*

3.1.1 *coefficient of variation, CV*, *n*—a measure of the dispersion of observed values equal to the standard deviation for the values divided by the average of the values; may be expressed as a percentage of the average (*CV* %).

3.1.2 *length group*, *n*—all fibers, or pulls, whose lengths fall within a given length interval.

3.1.3 *length interval*, *n*—a class interval of ⅛ in. (3 mm), usually designated by its midpoint length in odd-numbered sixteenths of an inch.

Example: the 0 to ⅛-in. interval is designated as 1/16.

3.1.4 *mean length*, *n—in testing of cotton fibers*, the average length of all fibers in the test specimen based on weight-length data.

3.1.5 *pull*, *n*—a group of fibers grasped by the forceps at one time and drawn from the specimen in the combs.

3.1.6 *upper quartile length*, *n—in testing of cotton fibers*, that length which is exceeded by 25 % of the fibers by weight in the test specimen.

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

4. Summary of Test Method

4.1 A sorting apparatus consisting of two banks of parallel combs is used to straighten and align the fibers in a 75-mg test specimen. The fibers are pulled from one bank of combs and transferred to the other in such a manner that one end of each fiber is aligned with the base comb. The transfer is repeated to straighten the other ends of the fibers. As the fibers are withdrawn from the combs for the third time, they are placed in order of length on velvet covered boards. The pulls are measured, and those that fall within each length interval are collected and weighed. From these weight-length data, the upper quartile length, mean length, and coefficient of length variation are calculated.

5. Significance and Use

5.1 The array method provides objective measurements for determining the fiber length and length distribution in a sample of cotton. The results can be plotted to show the length-weight distribution of all the fibers in the sample. Data obtained from array tests are useful in fiber length research studies, for investigation of changes in fiber length distribution in ginning and mill processing, and for other research purposes.

5.2 Upper quartile length is correlated with, but usually longer than, Fibrograph and 2.5 % span length as defined in Test Method D 1447. Judgment must be used in making comparisons between length measures from arrays and measures obtained by other methods, which may be basically different.

5.3 The coefficient of length variation is a measure of length distribution, or nonuniformity of length. Because the fiber weight-length distribution is usually highly skewed, statistical judgments based on the assumption of normality are not justified.

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles, and is the direct responsibility of Subcommittee D13.11 on Cotton and Fibers.

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

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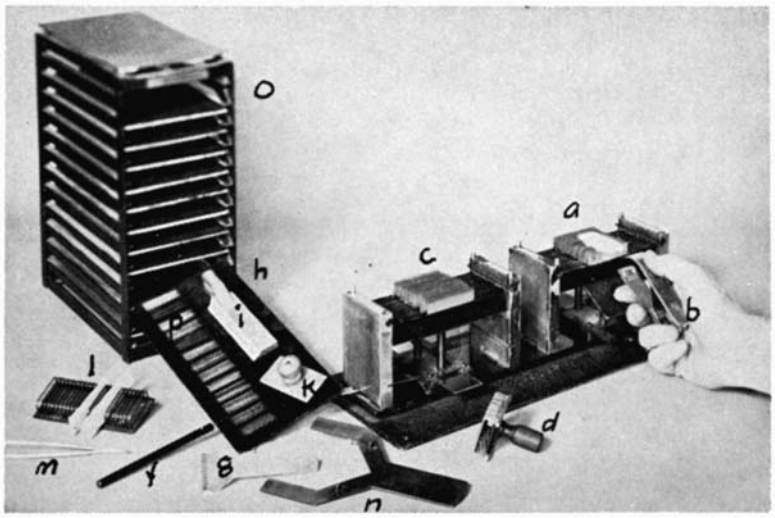

a and *c*—Banks of combs.
b—Forceps, tips padded with hard leather, for transferring fibers from one set of combs to the other.
d—Depressor for placing fibers in combs.
f—Dissecting needle.
g—Fork for scooping up fiber groups off velvet surface.
h—Aluminum plate covered with velvet cloth.
i—Special rule for measuring length of fiber groups.
k—Smooth plate for placing fibers onto velvet surfaces.
l—Wire rack for holding fiber groups wrapped in papers.
m—Smooth pointed tweezers.
n—Lift for raising combs in place.
o—Rack for holding velvet-covered boards.
p—Velvet-covered boards on which several pulls have been arrayed.

NOTE 1—Other accessories required for length arraying, not shown above, consist of the following: small whisk broom for cleaning velvet surfaces, one pair of tweezers with smooth round tips, forceps similar to *b* but having tips padded with rubber for laying groups on velvet surfaces, small papers for wrapping groups of fibers (papers 2½ by 3 in. (62 by 75 mm)) with small envelopes for them (2½ by 4¼ in. (62 by 110 mm)), and balances having ranges from 0 to 25 mg and 0 to 100 mg.

FIG. 1 Combs and Accessories for Arraying Fibers According to Length

5.4 The array method makes a physical separation of fibers of different lengths. It therefore serves as a standard, or benchmark, with which other methods may be compared and by which their precision and accuracy may be judged.

5.5 Test Method D 1440 for testing length and length distribution of cotton fibers (array method) is not commonly used for acceptance testing of commercial shipments.

6. Apparatus and Materials

6.1 *Double Bank Sorter*, and equipment as illustrated in Fig. 1. The method outlined here is especially adapted to the Suter-Webb Duplex Cotton Fiber Sorter,[3] but the procedure may be carried out with other similar apparatus with more or less obvious alterations.

6.2 *Balance*, with a capacity of at least 25 mg and a sensitivity of ±0.05 mg.

6.3 *Balance*, with a capacity of at least 100 mg and a sensitivity of ±0.1 mg.

6.4 *Standard Calibration Cotton Samples*, for the calibration of array length measurements.

NOTE 2—Standard calibration cotton samples are available from the Cotton Division, Agricultural Marketing Service, U.S. Department of Agriculture, 3275 Appling Rd., Memphis, TN 38133.

6.5 *Secondary Standard Cotton*—Lots of cotton the length of which has been established by extensive comparisons with USDA standards.

7. Sampling

7.1 Prepare the laboratory sample as directed in Test Method D 1441. Take either two or three subsamples depending on the precision desired. Take subsamples that weigh approximately 80 mg each for use in preparing the test specimen in one of the following manners:

7.1.1 From a hand sliver, carefully separate a 2-in. (50-mm) length of the sliver for each subsample.

7.1.2 From a mechanically blended 3-g sliver, separate 2-in. (50-mm) subsamples.

7.1.3 From a mechanically blended 10-g sliver, pull out of the middle of the sample a subsample about 2 in. (50 mm) long, extending through its whole thickness, and wide enough to weigh approximately 80 mg. Take subsamples from near the beginning, midway, and near the end of the sliver.

[3] The sole source of supply of the apparatus known to the committee at this time is the Alfred Suter Co., New York, NY. If you are aware of alternative suppliers, please provide this information to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

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