Designation: D 519 – 04

Standard Test Method for Length of Fiber in Wool Top[1]

This standard is issued under the fixed designation D 519; 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 the average length and length distribution of fibers in wool top, on a mass-biased basis. The method is applicable to all types of fibers in sliver formed from long parallelized fibers.

NOTE 1—The determination of fiber length of wool is covered in Test Method D 1575, Test Method for Fiber Length of Wool in Scoured Wool and in Card Sliver, the staple length of grease wool is covered in Test Method D 1234, Test Method of Sampling and Testing Staple Length of Grease Wool.

NOTE 2—This test method specifically requires length in inches and mass in SI units and is not contrary to ASTM policy. The SI units in parentheses are provided for information only.

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:* [2]

D 123 Terminology Relating to Textiles
D 1234 Test Method of Sampling and Testing Staple Length of Grease Wool
D 1575 Test Method for Fiber Length of Wool in Scoured Wool and Card Sliver
D 1776 Practice for Conditioning and Testing Textiles
D 2130 Test Method for Diameter of Wool and Other Animal Fibers by Microprojection
D 4845 Terminology for Wool

3. Terminology

3.1 *Definitions:* For definition of textile terms used in this test method refer to Terminology D 4845.

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

4. Summary of Test Method

4.1 The weight (mass) of fibers, in definite length increments, is determined for each specimen or group of specimens forming one sample. From the data obtained, the weight-biased average fiber length and the weight-biased distribution is calculated. A cumulative weight average length frequency curve may be plotted.

5. Significance and Use

5.1 Knowledge of the average fiber length and the distribution of fibers is of primary importance to users of top in further processing.

5.2 Acceptance specifications for the fiber length and length distribution may be established by the user based on the type of yarn-making equipment employed and the desired end uses.

5.3 Test Method D 519 for testing wool top for fiber length is considered satisfactory for acceptance testing of commercial shipments since the method has been used extensively in the trade for acceptance testing and the current estimates of the between-laboratory precisions are acceptable.

5.3.1 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 testing 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 homogenous as possible and that are from a lot of the type material in question. The test specimens should then be assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using Student's *t*-test for unpaired data 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 supplier must agree to interpret future test results in the light of the known bias.

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles, and is the direct responsibility of Subcommittee D13.13 on Wool and Wool Felt.

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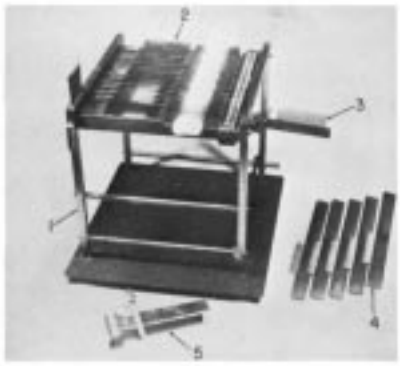
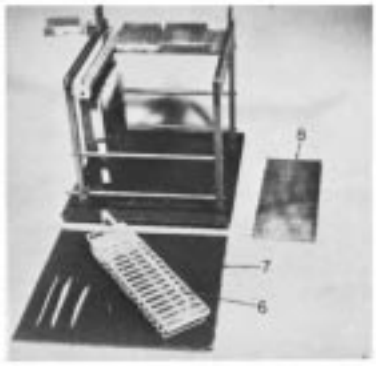
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards*volume information, refer to the standard's Document Summary page on the ASTM website





(Front View)
1—Frame.
2—Faller bars.
3—Side comb.
4—Retaining bars.

(Rear View)
5—Drawing clamp.
6—Depressor.
7—Plush board.
8—Faller bar lifting plate.

FIG. 1 Wool Fiber Stapling Apparatus

TABLE 1 Form with Recorded Data Showing the Calculation of the Average Fiber Length of Wool, the Standard Deviation, and Coefficient of Variation

NOTE 1—When using equipment graduated in metric units, use class intervals 10 mm long, and calculate the average and standard deviation to the nearest 0.2 mm.

Class Intervals, in.	Mass, g	Percentages	Cumulative Frequencies	
			First Cumulative, less than	Second Cumulative, less than
6.0 to 6.5	0.014	2.4	100.0	840.1
5.5 to 6.0	0.010	1.7	97.6	740.1
5.0 to 5.5	0.013	2.2	95.9	642.5
4.5 to 5.0	0.018	3.1	93.7	546.6
4.0 to 4.5	0.038	6.5	90.6	452.9
3.5 to 4.0	0.051	8.7	84.1	362.3
3.0 to 3.5	0.062	10.6	75.4	278.2
2.5 to 3.0	0.072	12.3	64.8	202.8
2.0 to 2.5	0.079	13.5	52.5	138.0
1.5 to 2.0	0.080	13.6	39.0	85.5
1.0 to 1.5	0.065	11.0	25.4	46.5
0.5 to 1.0	0.045	7.7	14.4	21.1
0 to 0.5	0.039	6.7	6.7	6.7
Totals	0.586	100.0 = Σ	840.1	4363.3
	Divided by Σ percentages		F_1 = 8.40	F_2 = 43.63

B = the largest midpoint value for which a frequency is recorded = 6.25 in.
m = the class interval = 0.5 in.
Percentage of fibers under 2 in. = 39.0 %.
Calculations:

$$\bar{X} = B - m(F_1 - 1) = 6.25 - 0.5(8.40 - 1) = 2.55 \text{ in.}$$

$$s = m\sqrt{2F_2 - F_1 - F_1^{\,2}} = 0.5\sqrt{87.26 - 8.40 - 70.56} = 1.44 \text{ in.}$$

$$v = 100\,(\sigma/X) = 100 \times (1.4/2.6) = 56.47\ \%.$$

where:

$\bar{X}$ = average fiber length of wool,
s = standard deviation, and
v = coefficient of variation.

6. Apparatus

6.1 *Comb Sorter*, which can be used to separate long fibers into 0.50-in. (12.7-mm) groups and the shorter fibers into 0.25-in. (6.4-mm) groups.[3] The essential parts are shown in Fig. 1. The bar or comb intervals are set at 0.5 in. (12.7 mm) and 0.25 in. (6.4 mm).

NOTE 3—Essentially, the same facilities can be secured with two Baer or two Zweigle sorters, or two Shirley units.

6.1.1 *Faller Bars*, free of broken, missing, crooked, dull, or corroded pins (*2*, Fig. 1).

6.1.2 *Clamp*, with jaws that meet straight and flush, and impart uniform pressure when closed (*5*, Fig. 1).

6.1.3 *Depressor*, at least as long as the sorter (*6*, Fig. 1).

6.2 *Balance*, with a sensitivity of 0.1 mg.

6.3 *Cardboard Cylinder*, approximately 3 in. (75 mm) in diameter, 8 in. (200 mm) in length, and having a ⅛-in. (3-mm) wall thickness.

7. Sampling

7.1 *Lot Sample*—As a lot sample for acceptance testing, take four lot sampling units (bales or cartons) for each 20 000 lb (9000 kg) or fraction thereof.

7.2 *Laboratory Sample*—As a laboratory sample for acceptance testing, draw one section of sliver from the balled top, at least 1 yd (1 m) in length from each lot sample unit. Material should be taken from the outside of the balled top. Wind the samples by hand onto cardboard cylinders under a tension of approximately 4.9 N and with a twist of approximately five turns per metre. These conditions can be produced conveniently as follows: Clamp a 0.45-kg mass onto one end of the sliver while holding the other end of the sliver in one hand, insert five turns of twist. Wind the sliver onto the cardboard cylinder while maintaining the tension and twist.

7.3 *Specimen*—Use each laboratory sample unit (a section of sliver from each lot sample unit) as a separate specimen for a complete test or combine the four laboratory sample units to form a single specimen, if appropriate.

8. Conditioning

8.1 Bring the laboratory sample, still on the cardboard cylinders, from the prevailing atmosphere to moisture equilibrium in the standard atmosphere for testing textiles.

8.2 Determine that moisture equilibrium for testing has been reached as directed in Practice D 1776.

9. Procedure

9.1 Test the conditioned specimens in the standard atmosphere for testing textiles.

9.2 Place the sorter so that the tops of the faller bars are level with the operator's hand and forearm when bent at the elbow in a horizontal position. Face the stapling apparatus (*1*, Fig. 1) with side comb (*3*, Fig. 1) extended and locked at the right side of the sorter as viewed by the operator. Lift and secure the faller bars (*2*, Fig. 1) in a horizontal position.

9.3 Immediately prior to performing the test, take one sliver from the cardboard cylinder. Holding the sliver under light tension place it on the pins on the right-hand side in such a way that approximately 6 in. (150 mm) of sliver extends in front of the first faller bar and press down with the depressor (*6*, Fig. 1). The specimen should be confined to a width of not more than 1½ in. (38 mm).

9.4 Using the hands, take and discard small amounts of fibers not to exceed ½-in. (12.7-mm) increments from the overhanging end of the sliver until not more than 1¼ in. (30 mm) extends forward of the front faller bar.

9.5 By means of the drawing clamp (*5*, Fig. 1) pull off the projecting fibers until the over-hanging portion of the sliver is squared and has an edge approximately ¾ in. (20 mm) forward of the front faller bar. Discard the fibers removed.

9.6 By means of the drawing clamp, grip the fibers across the full width of the sliver to a depth not to exceed 1/16 in. (1.6 mm) from the ends of the fibers (Note 4). Pull the fibers straight out slowly and pass them twice gently through the small combing bar. Discard all fibers removed by the small combing bar (Note 5).

NOTE 4—The depth of the clamp on the sliver and the length of the fibers affect the weight of the wool per draw. The weight per draw with the bite not in excess of 1/16 in. (1.6 mm) should be approximately 25 to 30 mg on an average fine wool top and somewhat higher on coarser wool top.

NOTE 5—The fibers are passed through the small combing bar to remove loose, broken, short or entangled fibers that are not grasped by the clamp. This action also helps to maintain the parallel alignment of the fibers.

9.7 Place the fibers held in the clamp on the left bank of pins in the following manner: Starting at the back, pull the tuft of fibers forward, across the top of the needles. Depress the fibers lightly with the hand to the needle points as the fibers held by the clamp are drawn forward, the intent being to straighten but not stretch the fibers.

9.8 Release the fibers when the nose of the clamp is exactly in line with the needle points of the front faller bar. The location at which the fibers are released is important. If the release point is not correct, carefully remove and discard the incorrect fiber group and make a replacement draw of fibers.

9.9 Press the released fibers down slowly between the pins with the depressor held level.

9.10 By means of the drawing clamp, repeatedly remove and discard the projecting fibers from the overhanging sliver specimen until the edge is again even.

9.11 Repeat the procedure in 9.5-9.10 until a bundle of fibers that will weigh from 500 to 1000 mg has been accumulated. In order to accumulate the required weight (mass), it may be necessary to reposition the specimen, repeating the steps outlined in 9.3 and 9.4 (Note 6). As draws are placed onto the left bank of combs, spread the fibers over a width of approximately 2 in. (50 mm).

NOTE 6—A single test may be made from one to four sliver specimens of a single sample by taking an equal number of draws from each of the sliver specimens to make a composite test.

9.12 When the test has been completed to this point, remove straggler fibers or single fibers that protrude past the fringe at the first bar.

[3] Apparatus meeting these requirements furnished by Alfred Suter Co., Prell Plaza, Orangeburg, NY, has been found satisfactory.

NOTE 7—The normal fringe at this point of the test is a light fuzz in front of the front row of pins. A heavy fuzz, or no fuzz, indicates improper lay-up, in which case discard the specimen and start a fresh lay-up. A normal fringe should not exceed 1/16 in. (1.6 mm).

9.13 Remove and discard the remaining sliver from the right bank of the sorter.

9.14 Place the removable retaining bars in position with the needles downward into the fiber bundle and turn the apparatus 180°. Drop the comb bars one at a time until the longest fibers protrude. Discard obviously loose fibers.

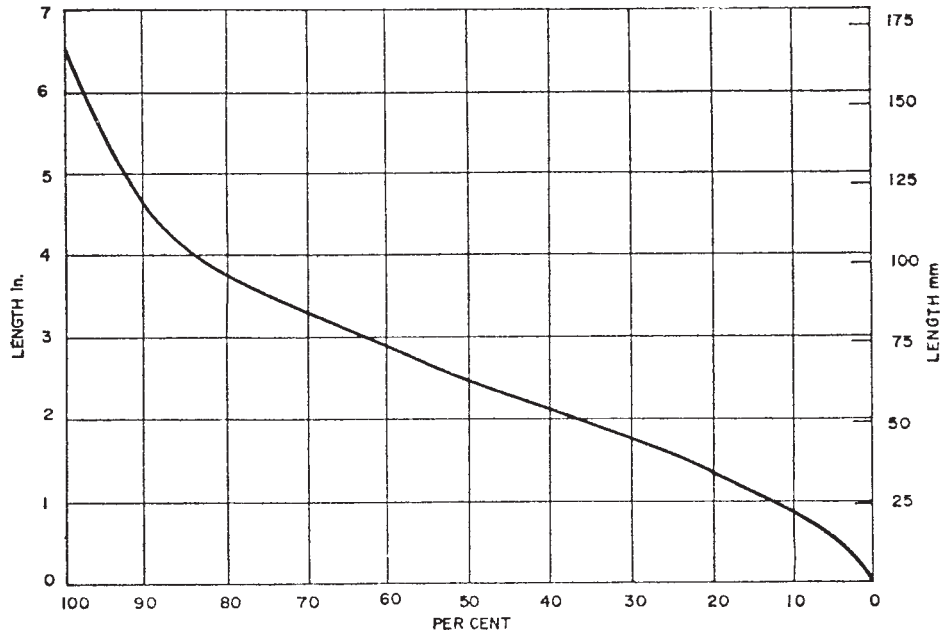


FIG. 2 Cumulative Length-Frequency Curve

9.15 Determine the distance from the front bar to the last bar that has been dropped. Record this distance as the longest class-interval, which serves as a guide for establishing the class-intervals for the calculation of the test. All class-intervals are ½ in. (12.7 mm).

9.16 Using the drawing clamp, *5*, remove in successive draws the fibers projecting from the next bar. Avoid disturbing the remaining fibers. Do not exert pressure on the next bar with the clamp. Accumulate all the fibers in the class-interval on a plush board in parallel array. Roll the fibers together and form a loop for weighing.

9.17 Lower the next front bar and repeat 9.16 until all the fibers have been removed in each class-interval. When drawings are made at the final ¼-in. (6.4-mm) increments, pool the fibers from each pair into one class-interval.

9.18 Weigh the fibers in each class-interval to the nearest 0.1 mg and record the weights on a data sheet (see Table 1).

9.19 If a composite test is not made, repeat the above procedure with the other three specimens to secure individual results.

10. Calculation

10.1 Calculate the average fiber length, the standard deviation, and the coefficient of variation as outlined in Table 1.

10.2 Plot the cumulative frequency curve from the data as in Fig. 2, locating the points on the graph at the upper cell boundaries, Table 1.

NOTE 8—For further information on plotting frequency curves, see ASTM Manual on Presentation of Data and Control Chart Analysis.[4]

11. Report

11.1 State that the test was performed as directed in ASTM Test Method D 519. Describe the material or product sampled and the method of sampling used.

11.2 Report the following information:

11.2.1 Average length to the nearest 0.01 in. (0.2 mm),

11.2.2 Standard deviation of the fiber length to the nearest 0.01 in. (0.2 mm),

11.2.3 Coefficient of variation of the fiber length in percent,

11.2.4 Percentage of fibers under 1 in. (25.4 mm) and

11.2.5 Cumulative length frequency curve (Fig. 2).

12. Precision and Bias

12.1 *Precision*—An interlaboratory test carried out in 1964 with twelve U.S. and European laboratories participating with a total of 72 tests on three tops having an average fiber length of 2.5 in. (63 mm), 3.0 in. (76 mm), and 3.25 in. (82 mm) showed a between-laboratories range of average length of 0.2 in. (5.0 mm). The maximum difference between duplicate tests in the same laboratory was 0.09 in. (2.3 mm) and the average difference was 0.04 (1 mm).

12.2 *Bias*—The bias of the results obtained with this test method cannot be stated specifically because the apparent length of crimped fibers is strongly dependent on the tension

[4] *ASTM Manual on Presentation of Data and Control Chart Analysis, STP 15D,* ASTM, 1976.

applied to the fibers when measuring their length. In this method, the fiber is measured with the normal crimp partly removed due to its being packed in the pins of the sorter while under low tension; the observed results are accordingly slightly longer than the length of the crimped fiber and shorter than the fiber length after removal of all crimp.

13. Keywords

13.1 fiber length; top; wool