Designation: D1234 – 13

Standard Test Method of Sampling and Testing Staple Length of Grease Wool[1]

This standard is issued under the fixed designation D1234; 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[2] covers procedures for sampling and measuring the unstretched staple length, and variability in length, of grease or pulled wool staples. The test method is also applicable to mohair and other animal fibers in staple form. The procedure is not recommended for individual fibers or groups of straightened fibers.

NOTE 1—The determination of fiber length in wool top is covered in Test Method D519, the determination of fiber length of wool is covered in Test Method D1575.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address 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:*[3]

D123 Terminology Relating to Textiles

D519 Test Method for Length of Fiber in Wool Top

D1575 Test Method for Fiber Length of Wool in Scoured Wool and in Card Sliver

D4271 Practice for Writing Statements on Sampling in Test Methods for Textiles (Withdrawn 2009)[4]

D4845 Terminology Relating to Wool

3. Terminology

3.1 For all terminology relating to D13.13, Wool and Wool Felt, refer to Terminology D4845.

3.1.1 The following terms are relevant to this standard: grease wool, staple, staple length.

3.2 For definitions of other textile terms used in the test method, refer to D123.

4. Summary of Test Method

4.1 By hand or by means of a sampling tool, staples (subsampling units) are withdrawn from randomly selected sampling units (bags, bales, or packages) from a lot of wool or other animal fibers. The unstretched lengths of the staples are measured and the average staple length, standard deviation, and coefficient of variation calculated.

5. Significance and Use

5.1 The testing procedure in this test method for the determination of staple length is considered satisfactory for acceptance testing of commercial shipments of grease wool since the test method has been used in the trade for acceptance testing.

5.1.1 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 tests 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 homogeneous as possible and that are from a lot of material of the type in question. The test specimens should then be randomly 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 the testing is begun. If a bias is found, either its cause must be found and corrected, or the purchaser and the 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 Felt.

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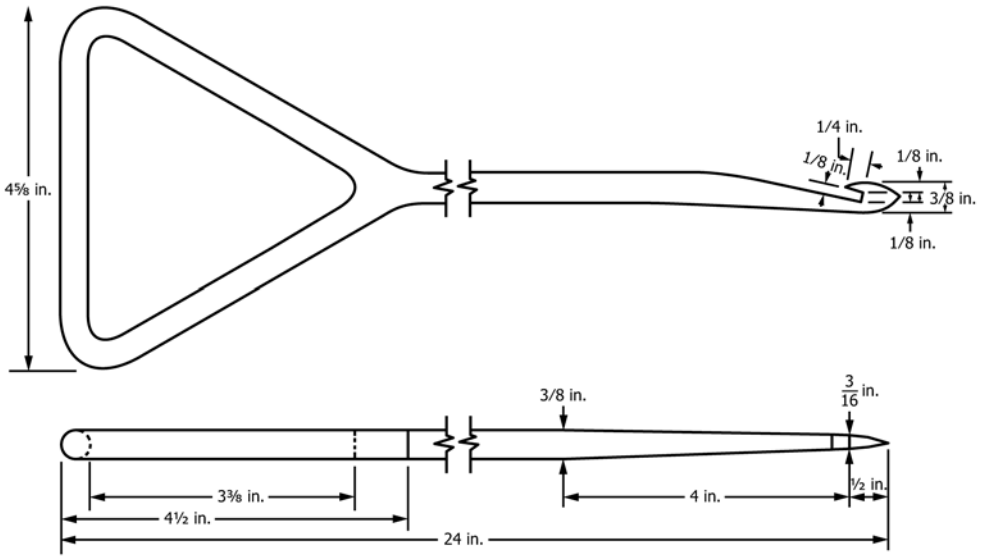
[2] Further information covering the procedures and techniques described in this test method appears in D. D. Johnston, H. Dean Ray, W. J. Manning, and E. M. Pohle, "Relationships of Staple Length in Grease Wool and Resultant Top," *Textile Research Journal*, Vol 21, October 1951, pp. 757–762.

[3] 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.

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

5.2 The test method is used for the determination of the average unstretched staple length and the staple length distribution of a lot of wool in order to assign length classes when determining the conformance of lots and shipments to length specifications.

5.3 In this test method, the size of a lot covered by the test procedure is limited to not more than 200 packages per test. Any shipment exceeding the above limits is divided into lots within the prescribed limits.



in.	⅛	3/16	¼	⅜	½	3⅜	4	4½	4⅝	24
mm	3.0	5.0	6.0	10.0	13.0	86.0	102.0	114.0	118.0	610.0

FIG. 1 Wool Staple Sampling Tool

5.4 The nature of the sampling procedure is such that grease wool staples as originally drawn from the wool of the lot require only a slight amount of preparation before measurement. The bulk and laboratory samples are synonymous in this test method.

5.5 Compression of wool in the bale makes it difficult to penetrate the interior of the bale with the sampling tool. However, staples can be drawn from the surface of the bale with the sampling tool or by hand.

5.6 Practice D4271 contains information on how to write a section on sampling in test methods.

NOTE 2—An extensive discussion of grease wool staple sampling can be found in the literature.[5]

6. Apparatus

6.1 *Sampling Tool*—A spear-shaped tool with a hook or barb at one end for use in extracting a small quantity of wool from within a bag (Fig. 1). This tool is not available commercially.

6.2 *Velvet Board*—A board or pad, 6 by 12 in. (150 by 300 mm), covered with black velvet or a black low-pile material.

6.3 *Ruler*—A scale graduated in inches and 0.25-in. (5-mm) divisions or a metric scale graduated in millimetres.

7. Sampling

7.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of packages of wool from a lot as directed in Table 1. Consider packages of wool as the primary sampling units.

7.2 *Laboratory Samples*—Consider the packages of wool in the lot sample as the laboratory sample.

7.3 *Test Specimens*—From each package in the laboratory sample, take ten staples, with five staples being taken at equally spaced intervals from each of two opposite sides of the package. Each staple should be about 0.25 in. (5 mm) in diameter. If larger, reduce the staple to the correct size by gently withdrawing the excess fibers from one side of the staple. Take the staples as follows:

7.3.1 *Sampling by Tool:*

7.3.1.1 *Depth of Draw*—Gage the depth for inserting the sampling tool so that different levels of the package are sampled. For example, draw the first specimen from the center of the package, the next about two thirds of the distance from the outside to the center, and the third specimen about one third the distance from the outside to the center. Repeat this order at

TABLE 1 Sampling Schedule for Wool in Packages

Number of Packages in Lot	Number of Packages in Lot Sample
Less than 10	all
10 to 100	10
101 to 200	15
More than 200	20

[5] Donald D. Johnston, H. Dean Ray, and Elroy M. Pohle, "Staple Length Sampling Schedules for Raw Wool Packaged in Bags," U.S. Dept. of Agriculture Marketing Service, No. 182, 1957, p. 15.

random locations along each side of the bag for drawing each successive test specimen.

7.3.1.2 *Taking a Draw*—Insert the point of the tool through the burlap covering of the package at random locations and thrust the shaft to the depth as described in 7.3.1.1. Pull the tool from the package, using a slight turning movement. Retain, as the test specimen, that portion of the wool staple lodged in the hook of the sampling tool.

7.3.2 *Sampling by Hand*—Cut a 2-in. (50-mm) opening in the burlap covering the package at the point where the sample is to be withdrawn. Withdraw a staple at random from the exposed wool with the fingers. Discard and replace the staple if it appears to have been cut by opening the burlap.

8. Conditioning

8.1 For tests made as directed in Section 9, specimens need be neither preconditioned nor conditioned.

9. Procedure

9.1 Place the ruler lengthwise on the velvet board. Lay the staple alongside the ruler, flattening and pressing the staple out straight in order to remove any crooks or bends. Do not stretch or elongate the staple by pulling or exerting pressure. With the staple held in position by the pile of the fabric, carefully adjust the position of the ruler so that the zero mark corresponds with the base of the staple. Remove the hands and read the length of the staple to the nearest 0.25 in. (5 mm). When a staple does not have a clearly defined length, that is, a blunt end, but has a tapered end or tip, determine the length at a point midway between the base of the taper and the tip. Record the measurements obtained from successive staples by 0.25 in. on a class-interval form as shown in Table 2.

10. Calculation

10.1 Calculate the average staple length and the standard deviation rounded to the nearest 0.1 in. (2 mm), and calculate the coefficient of variation to the nearest 0.1 %. If the distribution of staple lengths is desired, calculate cumulative frequencies and construct a cumulative staple length frequency curve. The worksheet illustrated in Table 2 is recommended for recording and calculating the test data. Plot a cumulative staple length frequency curve like that illustrated in Fig. 2. Plot the points using the first cumulative frequency and the corresponding upper limit for each class interval (100 % and 4.125 in. for the first class interval in Table 2). Plot zero percent at the lower limit for the smallest class interval (1.375 in. for the data in Table 2).

11. Report

11.1 Report the following information:

11.1.1 *Conditions of Test:*

11.1.1.1 Identification of lot sampled,

11.1.1.2 Number and type of packages in lot,

11.1.1.3 Sampling procedure employed,

11.1.1.4 Number of staples drawn, and

11.1.1.5 Any deviations from standard method.

11.1.2 *Test Results:*

11.1.2.1 Average staple length rounded to the nearest 0.1 in.,

11.1.2.2 Standard deviation of the individual staple lengths,

TABLE 2 Illustrative Form for Recording Test Data and Calculating the Average Staple Length of Wool, the Standard Deviation, and the Coefficient of Variation

(A similar form can be developed based upon metric units.)

Staple Length Analysis

Sample .....

Lot No .....
Operator .....
Date .....

Class Intervals, in.	Tally	Frequency	Percent	Cumulative Frequencies	
				First Cumulative, less than	Second Cumulative, less than
3.875 to 4.125	...	2	2	100	588
3.625 to 3.875	...	6	6	98	488
3.375 to 3.625	...	10	10	92	390
3.125 to 3.375	...	7	7	82	298
2.875 to 3.125	...	18	18	75	216
2.625 to 2.875	...	17	17	57	141
2.375 to 2.625	...	15	15	40	84
2.125 to 2.375	...	14	14	25	44
1.875 to 2.125	...	6	6	11	19
1.625 to 1.875	...	2	2	5	8
1.375 to 1.625	...	3	3	3	3
Totals	...	...	$n = 100$	588	2279
Divided by n	...	...	...	$F_1 = 5.88$	$F_2 = 22.79$

B = Largest midpoint value = 4.00 in.
m = Class interval = 0.25 in.
$\bar{X}$ = Average staple length, in.
S = Standard deviation, in.
v = Coefficient of variation
$\bar{X} = B - m\,(F_1 - 1) = 4.00 - 0.25\,(5.88 - 1) = 2.78$
$S = m\sqrt{2F_2 - F_1 - F_1^2} = 0.25\sqrt{2(22.79) - 5.88 - (5.88)^2} = 0.57$ in.
$V = 100s/X = (100)(0.57)/2.78 = 20.50$ %.

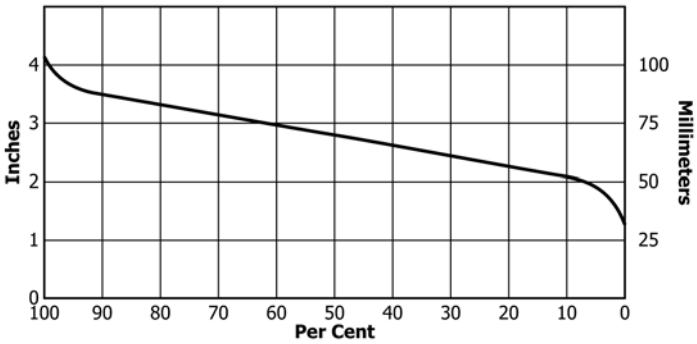


FIG. 2 Cumulative Staple Length Frequency Curve

11.1.2.3 Coefficient of variation of the individual staple lengths, and

11.1.2.4 Cumulative frequency curve if desired.

12. Precision and Bias

12.1 *Precision*—When measuring the minimum number of test specimens called for in Table 1, the 95 % confidence limits would be a minimum of ±4 % of the mean staple length.[5]

12.2 *Bias*—Test Method D1234 for testing the staple length of grease wool has no known bias and is generally used as a referee test method.

13. Keywords

13.1 length; sampling; statistics; wool