Designation: D2968 – 13

Standard Test Method for Med and Kemp Fibers in Wool and Other Animal Fibers by Microprojection[1]

This standard is issued under the fixed designation D2968; 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 by microprojection of the percentage of medullated fibers (med and kemp fibers) in wool or other animal fibers such as mohair, cashmere, alpaca, or camel's hair in their various forms.

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]

D123 Terminology Relating to Textiles

D2130 Test Method for Diameter of Wool and Other Animal Fibers by Microprojection

D4845 Terminology Relating to Wool

3. Terminology

3.1 For all terminology related to D13.13, Wool and Felt, see Terminology D4845.

3.1.1 The following terms are relevant to this standard: kemp fiber, med fiber, medulla, *in mammalian hair fibers*, medullated fiber, wool.

3.2 For definitions of all other textile terms see Terminology D123.

4. Summary of Test Method

4.1 The magnified images of a specimen of the animal fibers are examined. All medullated fibers are measured and classed as either med fibers or kemp fibers. The observed numbers of med and kemp fibers are expressed as percentages of the total number of fiber images examined.

5. Significance and Use

5.1 Test Method D2968 for the determination of med and kemp fibers by microprojection may be used for the acceptance testing of commercial shipments of wool and other animal fibers, but caution is advised since only a few types of animal fibers have been subjected to interlaboratory tests to ascertain the precision of tests for med and kemp fibers by this test method. Comparative tests as directed in 5.1.1 may be advisable.

5.1.1 In case of a dispute arising from differences in reported test results when using Test Method D2968 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 which are as homogeneous as possible and which 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 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 view of the known bias.

5.2 Knowledge of the incidence of med fibers and kemp fibers in wool and other animal fibers is of importance to manufacturers of woven or knitted fabrics because of the apparent dye resistance and light reflectance qualities of these fibers. This is not to imply that all kemp fibers will resist dye and all med fibers will accept dye normally. In practice, a proportion of kemp fibers will appear normal after dyeing and a proportion of med fibers will appear chalky white after dyeing. From the perspective of visual and aesthetic problems, medullated fibers having an abnormally large diameter and a high degree of medullation are probably the worst kind.

6. Apparatus and Material

6.1 The apparatus and material required in this test method are identical to those specified in Test Method D2130.

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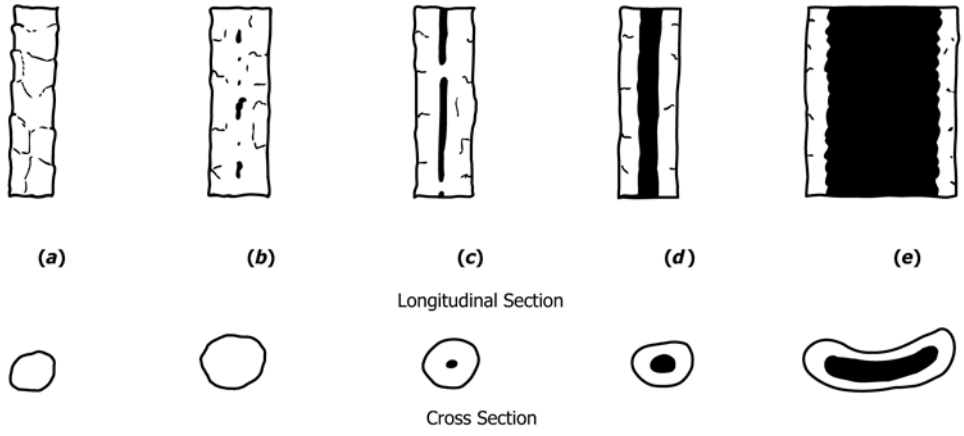
[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.



(*a*) Non-medullated
(*b*) Fragmented med fiber
(*c*) Interrupted med fiber
(*d*) Continuous med fiber
(*e*) Continuous kemp fiber

NOTE 1—The contrast between the solid and the hollow portions of the medullated fibers is significantly reduced when the medulla becomes filled with mounting medium.

FIG. 1 Types of Medulla in Wool and Mohair Fibers

7. Sampling

7.1 Adequate sampling procedures for loose fibers (grease, pulled, and scoured), sliver, top, yarn, and fabric are described in Test Method D2130.

8. Procedure

8.1 Prepare the test specimens, calibrate the microprojector, condition the specimens, and prepare the slides by use of the heavy-duty cross-section device as directed in Test Method D2130. Have two operators independently prepare at least one slide for each test specimen.

8.2 Have each of the two operators make observations using the procedure specified in Test Method D2130, except that only medullated fibers need be measured. For such fibers, measure the diameter of both the medulla and the fiber, calculate their ratio, and classify the fiber as either med or kemp as defined in Terminology D4845. For every fiber examined, record whether it is unmedullated, med, or kemp. See Fig. 1.

8.3 Count and record the number of med and kemp fibers and the total number of animal fibers examined. Unless otherwise directed in an applicable specification or by agreement, each operator should observe 500 fibers for a total of 1000 fibers.

9. Calculation

9.1 Calculate, to the nearest 0.1 %, the med and kemp fibers content using (Eq 1) and (Eq 2):

$$\text{med fibers, \%} = 100\,m/n \quad (1)$$

$$\text{kemp fibers, \%} = 100\,k/n \quad (2)$$

where:

m = number of med fibers observed,
k = number of kemp fibers observed, and
n = total number of animal fibers observed.

10. Report

10.1 State that the specimens were tested as directed in Test Method D2968. Describe the material or product sampled and the method used.

10.2 Report the following information:
10.2.1 The med fibers content,
10.2.2 The kemp fibers content, and
10.2.3 The total number of animal fibers observed.

11. Precision and Bias

11.1 *Interlaboratory Test Data*[3]—An interlaboratory test was conducted in 1970 in which three randomly drawn samples from one lot of mohair top were tested in each of five laboratories. Two operators in each laboratory each examined 500 fibers per sample. The test results for med fibers and kemp fibers were found to be free of bias due to sampling or testing errors for nine of the ten operators involved.

11.1.1 Interlaboratory test data are on file only for mohair top. These test results were found to be free of bias due to sampling and testing errors for nine out of ten operators. Since similar data for med and kemp measured on other types of animal fibers or mohair samples removed from forms other than top are not on file, no statements can be made concerning the bias measurements made on such samples.

11.1.2 Test results for med and kemp fibers are reported as a percent of the fibers examined. Such test results have a binomial distribution and for the small percentages of interest would require a transformation when analyzing the data. For this reason, the precision of test results is evaluated in terms of the count of med fibers observed and the count of kemp fibers observed in the 1000 fibers examined for a single test result.

[3] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D13-1036.

Such counts have a Poisson distribution and may be compared directly without requiring a transformation.

11.2 *Critical Differences*—Two counts of med fibers in test results or two counts of kemp fibers in test results should be considered significantly different at the 95 % probability level if the smaller of the two counts is equal to or less than the value listed in Table 1.

NOTE 1—In comparing observed counts for test results from each of two different laboratories, test results from two operators within the same laboratory, or other similar cases, Table 1 may be used, only if a comparison based on recent data obtained on specimens randomly drawn from one sample of the material to be evaluated has verified the absence of bias between the two specific laboratories or operators.

11.3 *Confidence Limits*—Single counts of med fibers or single counts of kemp fibers in a test result have the 95 % confidence limits listed in Table 2.

11.4 *Bias*—Test Method D2968 for testing the percentages of med and kemp fibers in wool and other animal fibers has no known bias and may be used as a referee method.

12. Keywords

12.1 animal fibers (except wool); microscopical examination; wool

TABLE 1 Values of *b* for Critical Differences in Number of Med or Kemp Fiber Counts, *a* and *b*, for Two Test Results[A]

r = *a* + *b*	*b*	*r* = *a* + *b*	*b*	*r* = *a* + *b*	*b*	*r* = *a* + *b*	*b*
1	0	26	7	51	18	76	28
2	0	27	7	52	18	77	29
3	0	28	8	53	18	78	29
4	0	29	8	54	19	79	30
5	0	30	9	55	19	80	30
6	0	31	9	56	20	81	31
7	0	32	9	57	20	82	31
8	0	33	10	58	21	83	32
9	1	34	10	59	21	84	32
10	1	35	11	60	21	85	32
11	1	36	11	61	22	86	33
12	2	37	12	62	22	87	33
13	2	38	12	63	23	88	34
14	2	39	12	64	23	89	34
15	3	40	13	65	24	90	35
16	3	41	13	66	24	91	35
17	4	42	14	67	25	92	36
18	4	43	14	68	25	93	36
19	4	44	15	69	25	94	37
20	5	45	15	70	26	95	37
21	5	46	15	71	26	96	37
22	5	47	16	72	27	97	38
23	6	48	16	73	27	98	38
24	6	49	17	74	28	99	39
25	7	50	17	75	28	100	39

[A] The probability level for the critical difference is 95 %, for two-sided limits. If the observed value of $b \geq$ the tabulated value, the two test results should be considered significantly different at the indicated probability level.

a = the larger of two counts, each of which is the total count for all specimens in a test result, and each of which is based on the same number of specimens,

b = the smaller of two counts taken as specified for *a*, and

r = *a* + *b*.

Where $r > 100$, use the following:

$$b = c - 1 - k\sqrt{c}$$

where:

b = calculated value of *b*, rounded to the nearest whole number,

c = *r*/2, and

k = 1.386 for the 95 % probability level.

TABLE 2 95 % Confidence Limits for Number of Counts per Test Results[A]

Observed Count	Lower Limit	Upper Limit	Observed Count	Lower Limit	Upper Limit
0	0.0	3.7			
1	0.0	5.6	26	17.0	38.1
2	0.2	7.2	27	17.8	39.3
3	0.6	8.8	28	18.6	40.5
4	1.1	10.2	29	19.4	41.6
5	1.6	11.7	30	20.2	42.8
6	2.2	13.1	31	21.1	44.0
7	2.8	14.4	32	21.9	45.2
8	3.4	15.8	33	22.7	46.4
9	4.1	17.1	34	23.5	47.5
10	4.8	18.4	35	24.4	48.7
11	5.5	19.7	36	25.2	49.8
12	6.2	21.0	37	26.0	51.0
13	6.9	22.2	38	26.9	52.2
14	7.6	23.5	39	27.7	53.3
15	8.4	24.7	40	28.6	54.5
16	9.1	26.0	41	29.4	55.6
17	9.9	27.2	42	30.3	56.8
18	10.7	28.4	43	31.1	57.9
19	11.4	29.6	44	32.0	59.1
20	12.2	30.8	45	32.8	60.2
21	13.0	32.1	46	33.7	61.4
22	13.8	33.3	47	34.5	62.5
23	14.6	34.5	48	35.4	63.6
24	15.4	35.7	49	36.2	64.8
25	16.2	36.9	50	37.1	65.9

[A] Lower confidence limit for counts = $c\,[1\text{-}(1/9\,c) - t\,(1/9\,c)^{1/2}]^3$
Upper confidence limit for counts = $d\,[1\text{-}(1/9\,d) + t\,(1/9\,d)^{1/2}]^3$

where:

c = observed number of counts,
d = c + 1, and
t = value of Student's t for infinite degrees of freedom, two-sided limits, and the specified probability level (t = 1.960 at the 95 % probability level).