Designation: D3513 – 02 (Reapproved 2012)

Standard Test Method for Overlength Fiber Content of Manufactured Staple Fiber[1]

This standard is issued under the fixed designation D3513; 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 percent by number of overlength or multiple length fibers in a sample of manufactured cut staple. The method is applicable to fiber taken immediately after manufacturing, from the bale, or from partially processed stock.

NOTE 1—For measurement of length and length distribution of manufactured staple fibers, refer to Test Method D5103.

1.2 This test method covers procedures using the Fibrosampler Model 335A (inch-pound units), the Fibrosampler Model 335B (SI units), and Fibrosampler combs Model 336.

1.2.1 The Fibrosampler Model 335A is equipped with a sample plate that has 15.8-mm (⅝-in.) diameter sample holes and is recommended for use on blended staple taken from the fiber blender or from a carding machine.

1.2.2 The Fibrosampler Model 335B is equipped with a sample plate that has 10-mm (0.4-in.) diameter sample holes and is recommended for use on unblended staple as may be taken from the fiber cutter or from a bale of staple fiber.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as the standard. The values stated in each unit are not exact equivalents; therefore, each unit must be used independently of the other.

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 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

D1447 Test Method for Length and Length Uniformity of Cotton Fibers by Photoelectric Measurement

D2258 Practice for Sampling Yarn for Testing

D3333 Practice for Sampling Manufactured Staple Fibers, Sliver, or Tow for Testing

D3888 Terminology for Yarn Spinning Systems

D3990 Terminology Relating to Fabric Defects

D4849 Terminology Related to Yarns and Fibers

D5103 Test Method for Length and Length Distribution of Manufactured Staple Fibers (Single-Fiber Test)

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of textile terms used in this test method: fiber beard, staple, overlength staple fibers and multiple-length staple fibers, refer to Terminology D4849.

3.1.2 For definitions of other textile terms used in this test method, refer to Terminologies D123, D3888, D3990, and D4849.

4. Summary of Test Method

4.1 Fibers are caught randomly on a comb to form a fiber beard. The probability that a given fiber length group represented in the original fiber population will appear in the test specimen is proportional to the ratio of the total length of that fiber length group to the total fiber length of the original sample. The beard is biased in the favor of long fibers.

4.2 The fiber beard is brushed out and laid on a specimen board. The density of the beard of the cut staple tapers to a line that is parallel to the base of the comb. The overlength fibers are observed to extend beyond this line and they can be identified easily.

4.3 The noticeably longer fibers are pulled from the fiber beard, verified for over- or multiple-length and counted. The result is then expressed as the percent overlength and percent multiple-length fiber in the original population.

5. Significance and Use

5.1 The existence of overlength fiber in manufactured staple can cause serious problems in the spinning of these fibers into yarn. Overlength fibers may create problems in carding, but more especially high-strength multiple cut fibers may cause cockling in spinning.

5.2 Since the overlength fibers are caused by dull or damaged cutting knives or by uneven flow of tow to the staple

[1] This test method is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.58 on Yarns and Fibers.

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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.

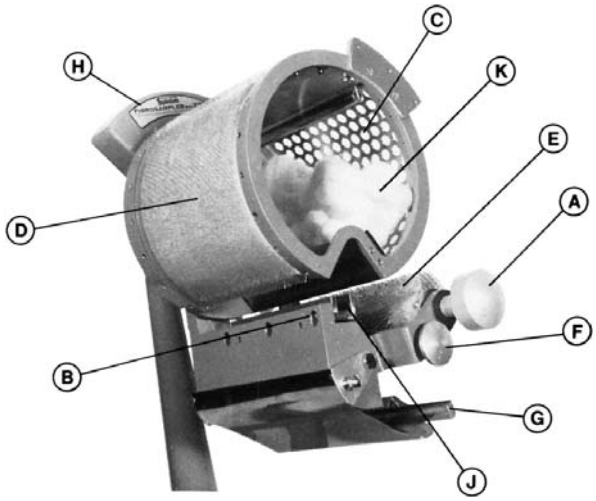

FIG. 1 Fibrosampler

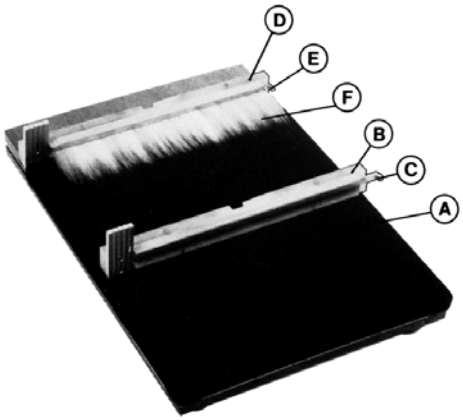

FIG. 2 Fibrosampler Combs

cutter, their existence within the fiber population is not uniform and their occurrence in the population follows a highly skewed distribution.

5.3 Manual methods of determining overlength fiber require much more operator time, and the standard deviations of the test between laboratories and operators are high. Use of the Fibrosampler method greatly reduces both operator time and standard deviation of testing.

5.4 In manufacturing it is important to know if fibers are overlength due to looping of the tow or multiple length due to damaged cutters.

5.5 This method for testing staple fiber for overlength fiber is not recommended for acceptance testing (see 13.1).

5.5.1 In some cases the purchaser and the supplier may have to test a commercial shipment of one or more specific materials by the best available method, even though the method has not been recommended for acceptance testing of commercial shipments. If there are differences of practical significance between reported test results for two laboratories (or more), comparative test should be performed to determine if there is a statistical bias between them, using competent statistical assistance. As a minimum, use the samples for such a comparative tests that are as homogeneous as possible, drawn from the same lot of material as the samples that resulted in disparate results during initial testing and randomly assigned in equal numbers to each laboratory. The test results from the laboratories involved should be compared using a statistical test for unpaired data, 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 *Fibrosampler,*[3] Model 335A of 335B (Fig. 1), equipped with the following:

6.1.1 *Combs,*[3] Model 336 (Fig. 2).

6.1.2 *Spacing Gage.*

6.1.3 *Specimen Board,* board covered with short pile or plush surface on one side, for displaying the test specimen.

6.1.4 *Brush,* for brushing the test specimen.

6.1.5 *Tweezers,* for removing the long fibers from the specimen board for verification.

NOTE 2—Fibrosampler Model 192, which is used for sampling cotton, (Method D1447) has been used successfully with this method, but the above listed models and combs yield better results because long fibers are less likely to be pulled from the combs during beard preparation.

6.2 *Laboratory Carding Machine* or Opener/Blender Model 338[3] is needed for use with Fibrosampler Model 335A.

6.3 *Analytical Balance,* capable of weighing the specimen to within 0.01 % of its mass.

6.4 *Scale,* graduated to the nearest 1 mm (1⁄16-in.).

7. Sampling

7.1 *Lot Sampling*—As a lot sample for acceptance testing, take at random the number of shipping containers directed in the applicable material specification or other agreement between the purchaser and supplier, such as an agreement to use Practice D3333 or Practice D2258. Consider shipping containers to be the primary sampling units.

NOTE 3—An adequate specification or other agreement between the purchaser or supplier requires taking into account the variability between shipping units, between packages, ends or other laboratory sampling unit within a shipping unit if applicable, and within specimens from a single package, end or other laboratory sampling unit to provide a sampling plan with a meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quantity level.

7.2 *Laboratory Sample*—As a laboratory sample for acceptance testing, take at random from each shipping container in the lot sample the number of laboratory sampling units as directed in an applicable material specification or other agreement between purchaser and supplier such as an agreement to use Practice D3333 or Practice D2258. Preferably, the same number of laboratory sampling units are taken from each

[3] The sole source of supply of the apparatus known to the committee at this time is Special Instruments Laboratory, Inc., 312 W. Vine Ave., P.O. Box 1950, Knoxville, TN. 37901. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

shipping container in the lot sample. If differing numbers of laboratory sampling units are to be taken from shipping containers in the lot sample, determine at random which shipping containers are to have each number of laboratory units drawn.

7.2.1 Take 100-g samples of staple fiber, sliver or top for each laboratory sampling unit.

7.3 *Test Specimens*—From each laboratory sampling unit, take one specimen. If the standard deviation determined for the laboratory sample is more than a value agreed upon between the purchaser and supplier, continue testing one specimen from each unit in the laboratory sample until the standard deviation for all specimens tested is not more than the agreed to value or, by agreement, stop testing after a specified number.

8. Preparation of Test Specimens

8.1 Clean the card clothing on the Fibrosampler before or after the preparation of each beard to maintain effective combing action. To do this, raise the release button (*F,* Fig. 1) to allow the doffer roller to fall into the cleaning position. Rotate the pivot arm clockwise while holding the doffer against the card clothing. At the bottom of the pivot arm a cleaner comb may be rotated into the doffer clothing by the left hand while the doffer roll is rotated clockwise by the right hand.

8.2 Remove a 25 ± 5-g test specimen from each laboratory sample.

8.3 Prepare a fiber beard specimen from each test specimen as directed in 8.4 using Fibrosampler Model 335A, or in 8.5 using Fibrosampler Model 335B.

8.4 *Fibrosampler Model 335A:*

8.4.1 Process the test specimen through a laboratory blender such as a laboratory carding machine, or a Model 338 Opener/Blender.

8.4.2 Place an empty comb in the comb holder.

8.4.3 With the left hand, place the test specimen in the cylinder and press it against the curved perforated sample plate.

8.4.4 With a 10 to 20-mm diameter circular motion of the left hand work the fibers until they protrude through the holes of the sample plate. Then relax the hand pressure against the plate to prevent fiber damage or breakage.

8.4.5 With the right hand, turn the pivot arm one complete counterclockwise revolution. This carries the comb teeth across the face of the protruding test sample and allows a fiber beard to be drawn from the test specimen.

NOTE 4—Excessive hand pressure on the test specimen during this step will require excessive force to turn the pivot arm and will not allow the fibers to be drawn onto the comb properly and cause excessive fiber damage during comb loading.

8.4.6 Withdraw the comb from its holder.

8.5 *Fibrosampler 335B:*

8.5.1 Place an empty comb in the comb holder.

8.5.2 With the left hand, place the test specimen in the cylinder and press a small segment of the specimen across and against the lower area of the perforated sample plate.

8.5.3 With a 10 to 20-mm diameter circular motion of the left hand, work the fibers until they protrude through the holes of the sample plate. Then relax the hand pressure against the plate to prevent fiber damage or breakage.

8.5.4 With the right hand, turn the pivot arm one complete counterclockwise revolution. This carries the comb teeth across the face of the protruding test sample and allows a segment of the fiber beard to form on the comb. See Note 4.

8.5.5 Ease the test specimen from the plate. Rotate the test specimen to present a new surface and move it up the sample plate.

8.5.6 Continue as directed in 8.5.3 through 8.5.4 until the comb is uniformly loaded with a milligram mass of 160 to 190 times the nominal staple length.

NOTE 5—The comb can usually be loaded in three to five turns around the cylinder.

8.5.7 Withdraw the comb from its holder.

9. Preparation and Adjustment of Apparatus

9.1 Set up and adjust the Fibrosampler as directed in the manufacturer's instruction manual.

9.1.1 Check the clearance between comb and sampling holes in the sampler drum, using the supplied gage. Adjust as necessary.

9.1.2 Test the Fibrosampler comb clamp mechanism for fiber beard holding capability. This may be accomplished by withdrawing the dog (*c,* Fig. 2) to open the clamp manually, placing a small tuft of fiber under the teeth of the comb, closing the clamp mechanism by forcing the dog into the comb, and then pulling the fibers. The clamp holding capacity should be high enough to allow the comb to be picked up by a tuft of 50 to 100 fibers.

10. Procedure

10.1 Place the comb, with the fiber beard firmly clamped, on the specimen board. Brush the beard to lay flat against the board surface. The density of the beard will be observed to taper and end at a line representing the nominal cut length of the staple.

10.2 Measure the distance (to the nearest 1 mm) from the base of the comb to the line, representing the nominal cut staple, observed in 10.1. Overlength fibers will be observed to extend beyond this well-defined line.

10.3 Establish a line, located to the nearest 1 mm and parallel to the face of the comb, that is 1.1 times the distance measured in 10.2.

10.4 Unclamp the fibers by withdrawing the dog (*E,* Fig. 2). With tweezers, remove those fibers that extend beyond the line established in 10.3. Determine, by measurement to the nearest 1 mm (1/16 in.), whether the fibers are actually overlength, or multiple length, or extending across the line because fiber ends are entangled in a nep, or tied.

NOTE 6—Overlength fibers by definition include multiple-length fibers. When determining the cause of overlength fibers, however, it is advisable to exclude multiple-length fibers from the overlength count. It may also be advisable to count the number, but not measure the length, of neps or tied fibers since they are indicative of other processing problems.

10.4.1 Measure the fiber lengths as directed in Test Method D1447.

10.5 Count the number of overlength fibers verified in 10.4.

10.6 Count the number of multiple length fibers verified in 10.4.

10.7 Remove the fiber beard from the comb and weigh the specimen to the nearest 0.01 % of its mass. Include the weight of fibers removed from the beard if there is a sufficient number to affect the fiber beard weight.

11. Calculation

11.1 Using the stated value of the linear density and the nominal cut length, calculate the number of fibers in the fiber beard, using

$$N = 10^4\, M/(L \times T) \quad (1)$$

where:

N = number of fibers in the fiber beard,
M = mass of the test specimen, mg,
T = fiber linear density, decitex, and
L = nominal fiber length, mm.

NOTE 7—To convert denier to decitex divide denier by 0.9.

11.2 Calculate the percent overlength fiber, using Eq 2:

$$\text{Overlength, fiber, \%} = 100\, n/N \quad (2)$$

where:

n = number of overlength fibers in the fiber beard as determined in 10.5 and
N = number of fibers in the fiber beard as calculated in 11.1.

11.3 Calculate the percent multiple length fiber, using Eq 3:

$$\text{Multiple} - \text{length fiber, \%} = 100\, p/N \quad (3)$$

where:

p = number of multiple length fiber as determined in 10.6 and
N = number of fibers in the fiber beard as calculated in 11.1.

NOTE 8—The Fibrosampler produces a length-biased beard.[4] For example, the probability of a double-length fiber appearing in the test beard is twice as great as that of a unity length fiber.

11.4 If requested, calculate the average of the measurements made in 10.4 for the overlength fibers and for the multiple length fibers for each specimen.

[4] "A Method of Fiber-Length Analysis Using the Fibrograph" by Dr. K. L. Hertel, *Textile Research,* Vol X, No. 12, October 1940.

12. Report

12.1 State that the specimens were tested as directed in Test Method D3513. Describe the material or product sampled and the method of sampling used.

12.2 Report the following information:

12.2.1 Report the type Fibrosampler used in the test and, in the case of the Model 335A, the method of sample opening and blending,

12.2.2 Percent overlength fiber for each specimen,

12.2.3 Percent multiple length for each specimen,

12.2.4 The average overlength measurement for each specimen, if calculated,

12.2.5 The average multiple length measurement for each specimen, if calculated, and

12.2.6 The individual overlength and multiple length measurements, if requested.

13. Precision and Bias

13.1 *Precision*—The distribution of overlength fibers in commercial production is highly skewed, rendering such samples unsatisfactory for interlaboratory tests. Consequently, two series of samples were prepared in which seven known levels of multiple-length fiber were added in amounts ranging from zero to 4.0 %. A 3.3-dtex, 80-mm (31/8-in.) rayon was added to a 3.3-dtex, 40-mm (19/16-in.) rayon and blended on a cotton carding machine. A 3.3-dtex, 100-mm (4-in.) polyester was added to a 3.3-dtex, 50-mm (2-in.) polyester and blended on a Spinlab Model 338 Opener/Blender.

13.1.1 Within a laboratory the correlation between the known amount of overlength contaminant in a prepared specimen and the overlength count by this procedure was good. This relationship does not hold with between-laboratory tests. Therefore, new laboratory tests will be undertaken by this method.

13.2 *Bias*—No justifiable statement on the bias of this test method can be made using normally manufactured cut staple. The occurrence of overlength fiber is an incident of seldom occurrence and is therefore nonuniformly distributed in the manufactured product.

14. Keywords

14.1 length; multiple—length staple fibers; overlength staple fibers ; staple fibers