Designation: D 5867 – 95

Standard Test Methods for Measurement of Physical Properties of Cotton Fibers by High Volume Instruments[1]

This standard is issued under the fixed designation D 5867; 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 These test methods cover the color, trash content, micronaire, length, length uniformity, strength and elongation of cotton fibers using the Spinlab System HVI 900 SA[2] or the Motion Control, Inc. Systems HVI 3500 and HVI 4000[2] that are a series of instruments connected to single dedicated programmed computers.

1.2 These test methods are applicable to loose fibers taken from raw or partially processed cotton and some types of cotton waste.

1.3 These test methods contain the following sections:

	Section
Color of Cotton	7-15
Trash Content of Samples of Cotton Fibers	16-24
Micronaire Reading of Cotton Fibers	25-33
Length and Length Uniformity of Cotton Fibers	34-42
Breaking Tenacity and Elongation of Cotton Fibers	43-51
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1.4 The values stated in both inch-pound and SI units are to be regarded separately as the standard. The values given in parentheses are for information only.

1.5 *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[3]

D 1441 Practice for Sampling Cotton Fibers for Testing[3]

D 1445 Test Method for Breaking Strength and Elongation of Cotton Fibers (Flat Bundle Method)[3]

D 1447 Test Method for Length and Length Uniformity of Cotton Fibers by Fibrograph Measurement[3]

D 1448 Test Method for Micronaire Reading of Cotton Fibers[3]

D 1776 Practice for Conditioning Textiles for Testing[3]

D 2253 Test Method for Color of Raw Cotton Using the Nickerson-Hunter Cotton Colorimeter[4]

D 2812 Test Method for Non-Lint Content of Cotton[3]

D 3025 Practice for Standardizing Cotton Fiber Test Results by Use of Calibration Cotton Standards[3]

D 4848 Terminology of Force, Deformation and Related Properties of Textiles[5]

3. Terminology

3.1 *Definitions:*

3.1.1 *breaking tenacity, n*—the tenacity at the breaking force.

3.1.1.1 *Discussion*—Cotton breaking tenacity is expressed as grams-force per tex or grams-force per denier. Standard SI units in newtons can be calculated by multiplying grams-force per tex by 0.0098.

3.1.2 *elongation at break, n*—the elongation corresponding to breaking force.

3.1.2.1 *Discussion*—Cotton elongation is the elongation at the maximum force and expressed as a percentage of a ⅛-in. (3.2-mm) gage length.

3.1.3 *mean length, n*—in testing cotton, the average length by number of all of the fibers in the test specimen.

3.1.4 *micronaire reading, n*—in testing cotton, a measure of specific surface area that is influenced by fiber perimeter and fiber wall thickness determined by the resistance to air flow through a known mass of cotton fiber compressed to a fixed volume.

3.1.4.1 *Discussion*—During growth of the cotton fiber, the fiber wall thickens as layers of cellulose are deposited daily on the inner surface. When wall thickening ultimately ceases, there remains a center void called the lumen. Both the wall thickness, or volume of cellulose, and the fiber perimeter, or fiber surface area, are important in textiles because they significantly affect yarn strength and dyeing behavior. In early development of an instrument to measure cotton fineness, the instrument scale was calibrated using measuredμ g/in. linear densities of a group of test cottons. Later experiences with the instrument on a broader range of cotton samples showed that its scale did not represent gravimetric fineness. However, use of the tester became so widespread that the early scale was retained and named micronaire reading.

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[1] These test methods are under the jurisdiction of ASTM Committee D-13 on Textiles and are the direct responsibility of Subcommittee D13.11 on Cotton Fibers.
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[2] Equipment is available from Zellweger Uster, Inc., 456 Troy Circle, P.O. Box 51270, Knoxville, TN 37950-1270.

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

[4] Discontinued; see *1994 Annual Book of ASTM Standards*, Vol 07.01.

[5] *Annual Book of ASTM Standards*, Vol 07.02.

3.1.5 *particle count, n*—in testing cotton with the trash meter, a value that correlates to the total number of pieces of trash on the surface of a sample of cotton over the viewing window.

3.1.6 *percent area, n—in testing cotton with the trash meter*, the ratio of total area of trash on the surface of a sample of cotton to that of the area of the viewing window, expressed in percent of the area of the viewing window.

3.1.7 *span length, n—in testing cotton*, the distance a specified percent of fibers in a test beard extend from a clamp in which they are caught at random along their lengths.

3.1.8 *Rd and +b, n—for the purpose of these test methods for cotton color*, the daylight color of opaque cotton specimens as described by Hunter in terms of three color scales: reflectance, Rd, and the chromaticity coordinates for redness or greenness, ± a, and yellowness or blueness, ± b.

3.1.8.1 *Discussion*—Graphically, there are three mutually perpendicular unit vectors in which Rd is represented vertically, and the chromaticity coordinates *a* and *b* represented on a horizontal plane at right angles to each other. In the range of Rd for colors observed in cotton, the scales of the cotton colorimeter show a reasonably close relationship to the uniform perceptual spacing of the scales represented in the Munsell color space.

3.1.9 *strength, n*—the property that resists deformation induced by external forces.

3.1.10 *test beard, n—in length testing of cotton*, the portion of the test specimen that has been combed and brushed into a "beard" that protrudes from the outside of the comb(s) or the clamp(s).

3.1.11 *uniformity index, n—in fiber length testing of cotton*, the ratio between the mean length and the upper-half-mean length expressed as a percentage of the upper-half-mean length.

3.1.12 *uniformity ratio, n—in fiber length testing of cotton*, the ratio between two span lengths expressed as a percentage of the longer span length.

3.1.13 *upper-half-mean length, n—in length testing of cotton*, the mean length by number of the longer one-half of fibers by weight.

3.1.14 For definitions of other textile terms in these test methods, refer to Terminology D 123 and Terminology D 4848.

4. Significance and Use—General

4.1 These test methods are used in the trade and are considered satisfactory for acceptance testing of commercial shipments when the level of tests, of any one or several or all of the individual physical properties, in the laboratory of the purchaser and the laboratory of the supplier are controlled by the use of the same laboratory control samples.

4.1.1 In case of dispute arising from differences in reported test results when using these test methods 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 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 the light with consideration to the known bias.

4.2 Being able to measure color, particle count of trash, micronaire, length, strength, and elongation using an integrated and dedicated system has the following benefits:

4.2.1 The HVI measuring system[2] can rapidly and objectively determine the color of cotton that is an important factor in determining the end use of cotton.

4.2.2 The HVI system[2] provides a particle count of the cotton trash that is directly related to textile processing waste.

4.2.3 The HVI system[2] determines micronaire, a factor that is correlated with cleaning efficiency, neppiness, the strength and uniformity of yarn, and dyeing of fibers, yarns, and fabrics.

4.2.4 The HVI system[2] provides a reproducible and economical procedure to measure length and length uniformity of fibers.

4.2.5 The HVI system[2] can determine various stress-strain parameters that are useful for research and for relating fiber characteristics to processing performance and quality of end products.

5. Sampling

5.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of shipping containers directed in an applicable material specification or other agreement between the purchaser and the supplier, such as an agreement to use Practice D 1441 for bales of fiber or containers of sliver. Consider shipping containers or bales to be the primary sample units.

NOTE 1—An adequate specification or other agreement between the purchaser and the supplier requires taking into account the variability between sampling units, between laboratory samples within a sampling unit, and between test specimens within a laboratory sample to provide a sampling plan with a meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quality level.

5.2 *Laboratory Sample*—For acceptance testing, randomly take material from each lot sampling unit, or original material, such as: loose fibers from one or more bolls, plants, or rows in a field; bales, mixes, or blends of cotton; or any consignment, shipment, or lot of cotton; of any size or mass to yield the required test specimen(s).

5.3 *Test Specimens*—Take test specimens as directed in the description of individual test methods.

6. Conditioning

6.1 Bring the laboratory samples to moisture equilibrium for testing in these test methods atmosphere for testing textiles. See Practice D 1776.

NOTE 2—Cotton is normally received in the laboratory in a relative dry condition, making special preconditioning procedures unnecessary. Samples that are obviously damp should be preconditioned before being brought into the laboratory for conditioning.

NOTE 3—If tests are not made for moisture equilibrium, it is recommended that the samples be conditioned for at least 12 h prior to testing.

COLOR OF RAW COTTON

7. Scope

7.1 This test method covers the comparison of the color of raw cotton with the official standards of the United States Department of Agriculture for Color Grade of cotton by means of a cotton colorimeter of the Nickerson-Hunter type. It can be used to measure the color of any type of raw cotton but is particularly applicable to Upland and American Pima cotton, for which official grade Standards have been established.

7.2 The instrument employs the use of a programmable microprocessor with memory for controlling internal operations and performing required calibration, calculation, and data presentation.

NOTE 4—For another method describing the measurement of the color of raw cotton, refer to Test Method D 2253.

8. Summary of Test Method

8.1 A smooth representative surface of a cotton sample is placed over the colorimeter sample window and pressed flat. The instrument colorimeter is energized, and color values are displayed on the instrument's visual monitor in one or more of the following terms: the grayness and yellowness scale developed for cotton, the Rd and +b values, and the United States Department of Agriculture color grade code number.

9. Significance and Use

9.1 Color is the primary factor of the color grade of cotton. Since cotton is graded by visual judgment, an instrument that measures color in terms that are highly correlated with visual judgement is a decided asset. Color measurements are even more important for use as an aid in reproducing copies of the official standards for color grade of cotton.

9.2 Color is an element of cotton quality, and raw stock color measurements are useful in controlling the color of manufactured greige, bleached, or dyed yarns and fabrics.

10. Apparatus and Materials

10.1 *Cotton Colorimeter*, HVI Model,[2] with accessories.

10.2 *Calibration Tile Standards*[2]—A set of five working calibration tile standards of designated Rd and + b values.

10.3 *Cotton Color Check Standards*[2].

11. Preparation of Apparatus

11.1 Allow the instrument to warm up for at least 4 h or until it becomes electronically stable.

11.2 By keyboard entry, select the appropriate routine for calibration from the menu displayed on the monitor.

11.3 Follow the displayed instructions requiring keyboard entry of the Rd and +b values of each calibration tile. As each tile is presented to the instrument, the programmed microprocessor will cause electronic circuitry to be automatically adjusted for agreement of displayed values with the designated values of the tiles.

11.4 Perform measurements of the color check standards of cotton to verify calibration.

11.5 If unacceptable results are obtained from the measurement of the color check standards of cotton, repeat the calibration tile procedure (see 11.3) until acceptable results are obtained.

12. Test Specimens

12.1 Test two specimens, one from each side of the laboratory sample.

12.2 Select a smooth surface of the laboratory sample that is judged to be representative for color as the test specimen. The surface of the sample should be large enough to completely cover the instrument's viewing window and thick enough to be opaque (no light transmitted through the sample). From experience, a thickness of 50 cm (2 in.) or more has been found acceptable.

NOTE 5—Laboratory samples usually consist of samples cut from sides of bales or taken by an automatic sampling device. Such samples come in layers, and different surfaces can be observed easily by opening the samples in a manner similar to turning pages in a book. The surface selected should be fairly smooth and free of lumps or folds which many cause dark shadows and produce erroneous results.

13. Procedure

13.1 By keyboard entry, select the appropriate routine for testing cotton from the menu displayed on the monitor.

NOTE 6—The test routines are governed by software programs tailored for individual requirements, such as necessary for sample identification number and other identifier entries, number of tests per sample, choice of units of measure (such as millimetres or inches), selection of test parameters, necessary for statistical summary, need for hard copy printout, forwarding data to compatible external data handling systems and computers, and other parameters.

13.2 Place the surface of the specimen to be measured over the sample window and energize the instrument by pressing the appropriate switch that will cause a plate to apply pressure to the specimen.

13.3 Hold the specimen until the instrument, by display at the visual monitor, advises that the measurement is complete.

13.4 Make one observation on each side of the specimen unless it is obviously nonuniform in color.

13.4.1 If the specimen is nonuniform in color, make additional observations on it at different places in the specimen to obtain a measure of the full range of color.

14. Calculation

14.1 All calculations are performed by the instrument's internal programmed microprocessor.

15. Report

15.1 State that the samples were tested for color as directed in these test methods. Describe the material and the method of sampling used.

15.2 Report the following information:

15.2.1 The number of specimens tested for each sample.

15.2.2 The average Rd value and the average +b value to the nearest 0.1 unit.

15.2.3 The color code of the United States Department of Agriculture cotton color grade diagrams that shows the various color grades of cotton in relationship to the scale of Rd on the vertical axis and the +b on the horizontal axis.

TRASH CONTENT

16. Scope

16.1 This test method describes the measurement of the amount of trash as seen by a video camera focused on the surface of a test specimen of cotton pressed against a glass window.

NOTE 7—For another method describing the measurement of trash or non-lint content of cotton, refer to Test Method D 2812.

16.2 The instrument may be incorporated within the space occupied by and adjacent to the apparatus to measure color of raw cotton (see Sections 7-15), thus permitting simultaneous measurement of color and trash on the same test specimen.

17. Summary of Test Method

17.1 A smooth representative surface of a test specimen of cotton is placed over the colorimeter/trashmeter sample window, the specimen is pressed flat. The trash meter is energized, and test values are read directly from instrument's visual monitor trashmeter.

18. Significance and Use

18.1 Trash content is an element in determining the quality or use value of raw cotton. Trash is the primary factor of the leaf grade of cotton. Since cotton is usually graded by visual judgement, an instrument that measures trash in terms that are highly correlated with visual judgement is a decided asset.

18.2 Trash content is useful for: estimating the net amount of manufactured textile product obtainable from raw cotton, predicting the quality of cotton textile products, particularly their aesthetic properties, assembling and blending values in a mix on a trash content basis, adjusting ginning and textile processing machinery for maximum efficiency in removing trash from cotton, and relating trash content of cotton to processing efficiency and end-product quality.

19. Apparatus and Materials

19.1 *Trashmeter*, HVI model.[2]

19.2 *Calibration Tile Standards*[2]—A set of working calibration tile standards of designated value for use in instrument calibration.

20. Preparation of Apparatus

20.1 Allow the instrument to warm up for at least 1 h or until it becomes electronically stable.

20.2 By keyboard entry, select the appropriate routine for calibration from the menu displayed on the monitor.

20.3 Follow the displayed instructions requiring keyboard entry of the calibration tile values for number of pieces of trash and percent area. The programmed microprocessor will cause electronic circuitry to be automatically adjusted in order that displayed values will agree with designated values of the tiles.

20.4 Perform measurements of the tiles to verify calibration.

21. Test Specimens

21.1 The test specimen is the surface of the laboratory sample that is placed over the sample window.

22. Procedure

22.1 By keyboard entry, select the appropriate routine for testing cotton from the menu display on monitor (see Note 6).

22.2 Place the surface of the specimen to be measured over the sample window and energize the instrument by pressing the appropriate switch that will cause a plate to apply pressure to the specimen.

22.3 Hold the specimen until the instrument, by display at the visual monitor, advises that the measurement is completed.

22.4 Present to the sample window at least four different surface areas of the sample since trash within cotton is not uniformly distributed.

23. Calculation

23.1 Perform all calculations by the instrument's internal programmed microprocessor.

24. Report

24.1 State that the samples were tested for trash as directed in these test methods. Describe the material and the method of sampling used.

24.2 Report the following information:

24.2.1 The number of specimens tested for each sample, and

24.2.2 The average percent area to the nearest 0.1 unit place and the average number of pieces of trash.

MICRONAIRE READING

25. Scope

25.1 This test method describes the determination of the micronaire of loose cotton by measuring the resistance of a plug of cotton to air flow under prescribed conditions. The instrument employs a programmed microprocessor with memory for controlling internal operation and performing required calibration, adjustments, calculations, and data presentation.

NOTE 8—For another method describing the determination of micronaire, refer to Test Method D 1448.

26. Summary of Test Method

26.1 A predetermined mass of loose cotton is placed in the specimen holder and compressed to a fixed volume. The resistance to air flow, using constant pressure compressed air, is measured and the pressure drop across the plug of cotton is expressed as micronaire. The pressure drops associated with micronaire are determined by performing tests on a wide range of cottons having previously established micronaire values.

27. Significance and Use

27.1 The micronaire of cotton fibers is a function of both fineness and maturity and is related to environmental conditions during the growth of cotton, variety of cotton, yarn spinning mill processing performance, and to the quality of end products. Factors correlated with micronaire include cleaning efficiency, neppiness, the strength and uniformity of yarn, and dyeing of fibers, yarns, and fabrics.

28. Apparatus and Materials

28.1 *Air Flow Instrument*, HVI Model,[2] calibrated in micronaire values with a balance having a range of at least 20 g and a sensitivity of at least 0.2 % of the mass.

28.2 *Calibration Standards*, International Calibration Cottons.[6]

29. Preparation of Apparatus

29.1 By keyboard entry, select the appropriate routine for calibration from the menu displayed on the monitor.

29.2 Select two calibration standards, one having a designated value of 3.0 micronaire or lower, the other having a designated value of 5.0 micronaire or higher.

NOTE 9—For use in calibration for micronaire, use the International Calibration Cottons.[6] Currently (1995), there are ten such standard samples that cover a wide range of micronaire readings.

29.3 Follow the instructions displayed by the visual monitor by entering the designated values of the laboratory control samples and using the balance to obtain the correct specimen weight, within ± 0.02 g, displayed on the visual monitor.

29.4 After testing each laboratory sample, the internal computer will automatically perform the calibration.

30. Test Specimens

30.1 Take material from the laboratory sample. Remove obvious, large pieces of non-fibrous materials. Weigh a test specimen having a mass specified by the instrument. Fluff the fibers of the test specimen to eliminate knotty balls.

NOTE 10—In commercial trading, it is sometimes agreed between purchaser and supplier to test only one specimen per sample considering the classer's sample, which represents both sides of the bale, as the laboratory sample for a bale. In this case, an equal amount of fiber from the two sides of the sample is selected to form the single test specimen.

31. Procedure

31.1 By keyboard entry, select the appropriate routine for testing cotton from the menu displayed on the monitor (see Note 6).

31.2 Insert the specimen into the instrument's chamber. For the Spinlab[2] system, close the lid. For the Motion Control[2] system, depress the actuation lever adjacent to the chamber.

31.3 The instrument will automatically perform the measurement and the measured value and other pertinent information, as well as instructions for making the next test, will appear on the visual monitor.

31.4 Through connection to an optional printer, compatible data handling system, or computer, hard copy printout may be accomplished if this facility has been selected in the routine (see 31.1).

32. Calculation

32.1 All calculations are performed by the instrument's internal programmed microprocessor.

33. Report

33.1 State that the samples were tested for micronaire as directed in these test methods. Describe the material and the method of sampling used.

33.2 Report the following information:

33.2.1 The number of specimens tested for each sample,

33.2.2 The average micronaire reading to the nearest 0.1 unit, and

33.2.3 The origin, identity, and designated values of the calibration samples used to perform instrument calibration.

FIBER LENGTH AND LENGTH UNIFORMITY

34. Scope

34.1 The measurement of length and length uniformity is made by outputting a voltage directly proportional to the amount of fiber in the prepared specimen at a given distance from the base of the test beard. The Spinlab[2] system uses a fibrograph-type photo electrical instrument. The Motion Control[2] system uses a length analyzer pneumatic instrument.

NOTE 11—For another method describing the measurement of cotton fiber length, refer to Test Method D 1447.

35. Summary of Test Method

35.1 Fibers are placed on a comb in such a way that they are caught at random along their lengths to form a beard. The beard is scanned from base to tip. In the Spinlab[2] system, the amount of light passing through the beard being used as a measure of the number of fibers that extend various distances from the comb. In the Motion Control[2] system, the pressure drop across an orifice is used to measure the number of fibers that extend various distances from the comb.

36. Significance and Use

36.1 This test method provides a fast procedure for determining the length and length uniformity of the fibers in a sample of cotton in a reproducible manner.

36.2 Results of length tests do not necessarily agree with those obtained by other methods of measuring lengths of cotton fibers because of the effect of fiber crimp and other factors.

36.3 These instrument tests are more objective than commercial staple length classifications and also provide information on length uniformity of cotton fibers. The cotton quality information provided by these results is used for such purposes as: research studies and quality surveys, checking commercial staple length classifications, identifying cottons for use in preparation of staple length standard samples, assembling bales of cotton into uniform lots, and evaluating the performance of certain machinery for fiber preparation preceding spinning yarn.

36.4 Measurements are based on two assumptions: that a fiber is caught on a comb in proportion to its length as compared to the total length of all fibers in the sample and, that the point of catch for a fiber is at random along its length.

37. Apparatus and Materials

37.1 *Fibrograph Plus*, HVI Model,[2] with accessories for measurement of test specimens by the Spinlab[2] system.

37.2 *Length Analyzer*, HVI model,[2] with accessories for measurement of test specimens by the Motion Control[2] system.

37.3 *Strength Analyzer*, HVI Model,[2] for measurement of test specimens by the Motion Control[2] system.

37.4 *Fibrosampler*, [2] for preparation of test specimens in the Spinlab[2] system.

[6] Available from the United States Department of Agriculture, Cotton Division, Standards Branch, 4841 Summer Avenue, Memphis, TN 38122.

37.5 *Specimen Sampler*, [2] for preparation of test specimens in the Motion Control[2] system.

37.6 *Printer*, optional, for recording test results.

37.7 *Standard Calibration Cotton Samples*, [6] for length and tenacity calibration.

37.8 *Laboratory Control Samples*, for length and tenacity calibration.

38. Preparation of Apparatus

NOTE 12—For use in calibration for length, uniformity and tenacity (strength), use the HVI Calibration Cottons[6] available from the United States Department of Agriculture. Currently (1995) there are two such HVI Calibration Cottons,[6] that cover a wide range of length, uniformity and tenacity. Other cottons may be used for routine adjustment after extensive tests, in comparison with the United States Department of Agriculture HVI Calibration Cottons,[6] have established the test values and uniformity of the material (see Practice D 3025).

38.1 Both the Spinlab[2] and Motion Control[2] systems measure cotton fiber length, length uniformity, strength, and elongation simultaneously and are calibrated following engineering principles using hardware devices. After proper calibration, adjustments can be made, if needed, by means of software manipulation to cause test values to agree with designated values of laboratory control cotton samples.

38.2 As directed in the manufacturer's instruction, calibrate the instrument after it has been allowed to warm up and become electronically stable.

38.2.1 Select at least two samples of standard calibration cottons, or laboratory control samples of cotton, with designated values that cover a wide range of fiber length, length uniformity, strength, and elongation, and having established micronaire values.

38.2.2 By keyboard entry, select the appropriate routine for calibration from the menu displayed on the monitor.

NOTE 13—The routine makes simultaneous adjustment of the instrument's measurement of length, length uniformity, and strength, including the influence of micronaire on the determination of cotton fiber strength.

38.2.3 Follow the instructions displayed by the visual monitor, entering the designated values of the standard calibration samples or the laboratory control samples. Measure at least eight specimens from each of the samples in order that the instrument's programmed software will automatically perform the calibration adjustments, if any are necessary.

38.2.4 If adjustments are made, the instructions displayed by the visual monitor will require measurement of another set of specimens from each of the samples in order to verify that performed adjustments result in acceptable measured values of the laboratory control samples.

39. Test Specimens

39.1 For acceptance testing, prepare and test at least two or more test specimens per laboratory sample, as agreed upon by the purchaser and supplier.

39.2 For the Spinlab[2] system, place a comb in the fibrosampler with teeth uppermost. Place the laboratory sample in the cylinder and press it against the curved and perforated sample plate. Rotate the pivot arm for one complete counterclockwise revolution while maintaining evenly distributed pressure over the surface of the sample to load and comb the specimen of cotton fibers. Take the loaded comb with the test beard from the Fibrosampler[2] and present it to the Fibrograph Plus[2] for measurement.

39.2.1 Clean the card clothing on the Fibrosampler[2] periodically to maintain effective combing action. To clean, raise the release button to put the doffer roll in the cleaning position, rotate the doffer one-half revolution clockwise to clean the clothing section, and return it counterclockwise the remaining half revolution to its original position. Then clean the doffer roll by using the left hand to move the needle bar into the doffer roll while rotating the doffer roll counterclockwise with the right hand. Moving the needle bar away from the doffer roll will cause fibers to fall free, leaving a clean doffer roll.

39.3 For the Motion Control[2] system, place a specimen clamp in the specimen sampler according to manufacturer's instructions. Place the laboratory sample underneath the sampler platen and push the actuator button. Hold the button until the sampler has completed the sampling process. Take the loaded clamp with the test beard from the sampler and present it to the comber/brusher for further automatic preparation.

39.3.1 The comber/brusher will automatically comb and brush the beard, then present it to the operator (HVI3500)[2] or robotic transfer system (HVI4000).[2]

40. Procedure

40.1 By keyboard entry, select the appropriate routine for testing cotton from the menu displayed on the monitor.

40.2 For the Spinlab[2] system, insert the prepared specimen into the comb holder of the Fibrograph Plus.[2] The instrument will automatically brush the fibers, transport the comb to the measuring head, and make the necessary measurements.

40.3 For the Motion Control[2] system, place the prepared specimen onto the clamp holder of the Length Analyzer.[2] This is done manually on the HVI3500,[2] and automatically on the HVI4000.[2] The instrument automatically scans the beard and makes the necessary measurements.

40.4 The measured values and other pertinent information will be displayed on the visual monitor as well as instructions for the purpose of making the next test.

40.5 Through connection to an optional printer, or optional host computer, hard copy printout may be accomplished if this facility has been selected in the routine (see 40.1).

41. Calculation

41.1 Perform all calculations by the instrument's internal programmed microprocessor.

42. Report

42.1 State that the samples were tested for length or length uniformity, or both, as directed in these test methods. Describe the material and the method of sampling used.

42.2 Report the following information as directed in an applicable material specification or contract order:

42.2.1 The number of specimens tested for each sample,

42.2.2 The selected length or length uniformity values, or both, and the chosen units of measurement,

42.2.3 The span length 50 and 2.5 % values, or the mean length and the upper half-mean length values to 0.1 mm (0.01 in.),

42.2.4 The length uniformity ratio or the length uniformity index to the nearest 0.1 %, and

42.2.5 The origin and identity and designated values of the standard calibration the laboratory control sample used.

BREAKING TENACITY AND ELONGATION

43. Scope

43.1 This test method describes the determination of the breaking tenacity and elongation at the breaking force of cotton fibers in a test specimen in which fibers have been placed randomly in a specimen comb or clamp and broken using (3.2-mm) ⅛-in. clamp spacing. In the cotton textile industry, this physical property is usually called "strength".

NOTE 14—For other methods covering the measurement of cotton fiber strength, refer to Test Method D 1445.

44. Summary of Test Method

44.1 For the Spinlab[2] system, the measurement of cotton fiber strength and elongation is made by the same apparatus that measures fiber length and length uniformity (see 34.1, 35.1, and 36.4, that are applicable to this measurement of cotton fiber tenacity).

44.2 For the Motion Control[2] system, the measurement of cotton fiber strength and elongation is made by the Strength Analyzer[2].

44.3 Elongation is measured directly from the displacement of clamps at maximum force on the fibers.

44.4 Testing routines and choice of test units are selected from a menu displayed by a visual monitor. Test values and pertinent information are also displayed, can be recorded by an optional printer, and can be relayed to compatible external data handling systems and computers.

45. Significance and Use

45.1 This test method is useful in research to determine various stress-strain relationships and their influence on variety and environment and to study the relationship between these fiber properties, processing performance, and quality of end product.

45.2 Studies have shown that strength measurements obtained with different types of instruments are highly correlated, but the results are on different levels.

45.3 By use of tests made on standards calibration samples of established test HVI values, the results obtained with different types of instruments at a specified gage length can be adjusted to comparable levels. Due to the differences in cottons, strength test results for one gage length cannot be reliably estimated from tests made at a different gage length.

46. Apparatus and Materials

46.1 Apparatus and materials are the same as described in Section 37.

47. Adjustment of Apparatus

47.1 In addition to the procedures described in Section 38, calibration for fiber strength measurement is performed by suspending from a force transducer calibration weights of known values and by making certain electronic circuit adjustments to give a direct reading of a voltage change linear with suspended weights.

48. Preparation of Test Specimens

48.1 Follow the procedures described in Section 39.

49. Procedure

49.1 Follow the procedures described in Section 40.

50. Calculation

50.1 Perform all calculations by the instrument's internal microprocessor.

51. Report

51.1 State that the samples were tested for breaking tenacity and elongation, as directed in these test methods. Describe the material and the method of sampling used.

51.2 Report the following information:

51.2.1 The number of specimens tested for each sample,

51.2.2 The average breaking tenacity value in grams per tex to 0.1 gf/tex and the average elongation at break to the nearest whole percent, and

51.2.3 The original identity, and designated values of the standard calibration sample of laboratory control samples used to perform required adjustments described in Section 38.

PRECISION AND BIAS

52. Precision and Bias

52.1 *Interlaboratory Test Data*—Interlaboratory tests were carried out in March 1992 for cotton color, trash area, micronaire reading, upper half-mean length, length uniformity index, and ⅛ in. (3.2 mm) gage fiber strength. Tests were not made for elongation. The design of the tests and the components of variance, calculated from the results of these tests, expressed as standard deviations and the critical differences are shown in Tables 1 and 2.

52.2 *Precision*—For the components of variance reported in Tables 1 and 2, the averages of observed values should be considered significantly different at the 95 % probability level if the differences equal or exceed the critical differences.

52.3 *Bias*—The procedure in these test methods for measuring the properties of cotton using high volume instruments has no bias because the values of the properties involved can be defined only in terms of the test method.

53. Keywords

53.1 color; cotton; elongation; fineness; HVI; length; micronaire; strength; tenacity; trash; uniformity

TABLE 1 Components of Variance and Critical Differences—Spinlab System[2]

Physical Property	Components of Variance (Standard Deviations)	Critical Differences[A]
Upper half mean length[B]		
Within-lab	0.011 in.	0.030 in.
Between-lab	0.011 in.	0.039 in.
Uniformity index[B]		
Within-lab	0.60 %	1.66 %
Between-lab	0.60 %	2.28 %
⅛-in. (3.2-mm) gage strength[B]		
Within-lab	0.65 gf/tex	1.81 gf/tex
Between-lab	0.73 gf/tex	2.72 gf/tex
Micronaire[C]		
Within-lab	0.04 rdg.	0.11 rdg.
Between-lab	0.07 rdg.	0.22 rdg.
Color (Rd)[B]		
Within-lab	0.15 %	0.41 %
Between-lab	0.60 %	1.72 %
Color (+b)[B]		
Within-lab	0.05 units	0.11 rdg.
Between-lab	0.07 rdg.	0.22 rdg.
Trash area[C]		
Within-lab	0.05 %	0.14 %
Between-lab	0.46 %	1.29 %

[A] Based on $z = 1.960$ for the 95 % probability level.
[B] Based on three replications of eight cotton samples tested at six laboratories. Two-specimen length, length uniformity and strength tests were made for each replication.
[C] Based on three one-specimen replications of six cotton samples tested at six laboratories.

TABLE 2 Components of Variance and Critical Differences—Motion Control Systems[2]

Physical Property	Components of Variance (Standard Deviations)	Critical Differences[A]
Upper half mean length[B]		
Within-lab	0.012 in.	0.032 in.
Between-lab	0.012 in.	0.036 in.
Uniformity index[B]		
Within-lab	0.58 %	1.61 %
Between-lab	0.66 %	2.44 %
⅛-in. (3.2-mm) gage strength[B]		
Within-lab	0.65 gf/tex	2.32 gf/tex
Between-lab	0.84 gf/tex	2.72 gf/tex
Micronaire[C]		
Within-lab	0.05 rdg.	0.15 rdg.
Between-lab	0.06 rdg.	0.23 rdg.
Color (Rd)[B]		
Within-lab	0.43 %	1.18 %
Between-lab	1.28 %	3.73 %
Color (+b)[B]		
Within-lab	0.14 units	0.38 units
Between-lab	0.55 units	1.56 units
Trash area[C]		
Within-lab	0.14 %	0.38 %
Between-lab	0.23 %	0.74 %

[A] Based on $z = 1.960$ for the 95 % probability level.
[B] Based on three replications of eight cotton samples tested at six laboratories. Two-specimen length, length uniformity and strength tests were made for each replication.
[C] Based on three one-specimen replications of six cotton samples tested at six laboratories.