Designation: D5867 – 12$^{\varepsilon 1}$

Standard Test Methods for Measurement of Physical Properties of Raw Cotton by Cotton Classification Instruments[1]

This standard is issued under the fixed designation D5867; 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.

ε[1] NOTE—Reference to a research report was added editorially in January 2013.

1. Scope

1.1 This test method covers the measurement of color, trash content, micronaire, upper half mean length (length), uniformity index and breaking tenacity (strength) of raw cotton for cotton marketing using a cotton classification instrument.

1.2 This test method is applicable to Upland and Extra Long Staple (ELS) raw cotton.

1.3 This test method is applicable to roller and saw ginned raw cottons.

1.4 This test method contains the following sections.

	Section
Color	8-11
Trash Content	12-15
Micronaire Reading	16-19
Upper Half Mean Length (Length) and Uniformity Index	20-23
Breaking Tenacity (Strength)	24-27

1.5 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.

1.6 *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
D1441 Practice for Sampling Cotton Fibers for Testing
D1445 Test Method for Breaking Strength and Elongation of Cotton Fibers (Flat Bundle Method)
D1447 Test Method for Length and Length Uniformity of Cotton Fibers by Photoelectric Measurement
D1448 Test Method for Micronaire Reading of Cotton Fibers
D1776 Practice for Conditioning and Testing Textiles
D2253 Test Method for Color of Raw Cotton Using the Nickerson-Hunter Cotton Colorimeter (Withdrawn 1995)[3]
D2495 Test Method for Moisture in Cotton by Oven-Drying
D2812 Test Method for Non-Lint Content of Cotton
D3025 Practice for Standardizing Cotton Fiber Test Results by Use of Calibration Cotton Standards
D4848 Terminology Related to Force, Deformation and Related Properties of Textiles
D7139 Terminology for Cotton Fibers
E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

3. Terminology

3.1 For all terminology related to D13.11, refer to D7139.

3.1.1 The following terms are relevant to this standard: micronaire reading, particle count (trash), percent area (trash), Rd (color reflectance) and +b (color yellowness), breaking tenacity (strength), uniformity index, upper-half-mean length.

3.2 For all other terminology related to textiles, refer to Terminology D123 and Terminology D4848.

4. Significance and Use—General

4.1 This test method is accepted for testing of bales of raw cotton in commercial shipments.

4.2 This test method describes acceptable practices for testing of raw cotton using cotton classification instruments that are capable of testing the fiber properties of micronaire reading, length, uniformity index, strength, Rd (color), +b (color), percent area (trash) and particle count (trash).

[1] These test methods are under the jurisdiction of ASTM Committee D13 on Textiles and are the direct responsibility of Subcommittee D13.11 on Cotton 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.

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

5. Sampling

5.1 *Bale Sample*—For a bale sample, take a 4 oz (100 g) subsample of cotton from each of two opposite sides of the bale and combine the two subsamples into a single bale sample weighing 8 oz (200 g).

6. Conditioning

6.1 Condition the cotton samples to the temperature and relative humidity levels of 21 ± 1°C (70 ± 2°F) and 65 ± 2 % until moisture equilibrium is reached.

6.2 Accelerated conditioning is an acceptable practice for this test method.

6.3 Moisture content (dry basis) measured by resistance technique referenced to oven method Test Method D2495 shall be within 6.75 to 8.25 %.

NOTE 1—This range covers the equilibrium moisture content range for all cottons.

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.

7. Calibration

7.1 Follow instrument manufacturers' procedures for sample placement.

7.2 *Calibration of Rd (color reflectance) and +b (color yellowness):*

7.2.1 For color calibration of Rd and +b, calibrate using USDA color materials in accordance with instrument manufacturers' recommendations to establish a testing level consistent with the industry accepted Universal HVI Rd/+b Cotton Color Standards.

7.3 *Calibration of Percent Area (trash) and Particle Count (trash):*

7.3.1 For trash calibration of percent area and particle count calibrate using USDA trash materials in accordance with instrument manufacturers' recommendations.

7.4 *Calibration of Micronaire:*

7.4.1 For calibration of micronaire, cotton calibration or orifice calibration methods are accepted practices within the industry.

7.4.2 For cotton calibration of micronaire, calibrate using Universal HVI Micronaire Calibration Cotton Standards in accordance with instrument manufacturers' recommendations.

7.4.3 For orifice calibration of micronaire, calibrate using USDA micronaire materials in accordance with instrument manufacturers' recommendations to establish a testing level consistent with the industry accepted Universal HVI Micronaire Calibration Cotton Standards.

7.5 *Calibration of Upper Half Mean Length, Uniformity Index and Breaking Tenacity (Strength):*

7.5.1 For Upland saw ginned and roller ginned raw cotton testing, calibrate the instrument with Universal HVI Calibration Cotton Standards (Short/Weak and Long/Strong).

7.5.2 For ELS saw ginned and roller ginned raw cotton testing, calibrate the instrument with Universal HVI Short/Weak Calibration Cotton Standard and Extra Long Staple HVI Long/Strong Calibration Cotton Standard.

7.6 The calibration materials can be obtained from the USDA, AMS, Cotton Division's Standardization and Engineering Branch. The contact information is provided below:

USDA, AMS, Cotton Division
Standardization and Engineering Branch
3275 Appling Road, Room #5
Memphis, TN 38133 USA
http://www.ams.usda.gov/cotton/
phone: 901-384-3030 / fax: 901-384-3032

COLOR

8. Scope

8.1 This section describes the measurements of Rd (color reflectance) and +b (color yellowness) for raw cotton. The Rd and +b measurements are based upon standards established by USDA.

9. Summary of Test Method

9.1 A smooth representative surface of a cotton sample is placed in the color measurement area and pressed flat with a minimum force of 4 lb/in.^{2} (0.3 kg/cm^2).

10. Significance and Use

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

11. Procedure

11.1 One or more test replications shall be made on each subsample of the bale sample.

11.2 The surface of each subsample shall be large enough to completely cover the instrument's measurement area and thick enough to be opaque (no light transmitted through the sample). An uncompressed minimum thickness of 2 in. (50 cm) and a minimum surface area of 9 in.^{2} (58 cm^2) of each subsample are required.

11.3 For the bale sample, report the average Rd (color reflectance) of the test replications to the nearest one tenth of a unit.

11.4 For the bale sample, report the average +b (color yellowness) of the test replications to the nearest one tenth of a unit.

TRASH CONTENT

12. Scope

12.1 This section describes the measurements of percent area (trash) and particle count (trash) for raw cotton. The percent area and the particle count measurements are based upon standards established by USDA.

13. Summary of Test Method

13.1 A smooth representative surface of a cotton sample is placed in the trash measurement area and pressed flat with a minimum force of 4 lb/in.^{2} (0.3 kg/cm^2).

14. Significance and Use

14.1 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.

15. Procedure

15.1 One or more test replications shall be made on each subsample of the bale sample.

15.2 The surface of each subsample shall be large enough to completely cover the instrument's measurement area and thick enough to be opaque (no light transmitted through the sample). An uncompressed minimum thickness of 2 in. (50 cm) and a minimum surface area of 9 in.^{2} (58 cm^2) of each subsample are required.

15.3 For the bale sample, report the average percent area (trash) of the test replications to the nearest one hundredth of a unit.

15.4 For the bale sample, report the average particle count (trash) of the test replications to the nearest whole number.

MICRONAIRE READING

16. Scope

16.1 This section describes the measurement of the micronaire of raw cotton that is based upon standards established by USDA.

17. Summary of Test Method

17.1 A predetermined mass of raw cotton is placed in the measurement area and compressed. The resistance to air flow through the cotton using constant air pressure is measured.

18. Significance and Use

18.1 The micronaire reading of raw cotton is a function of both fineness and maturity and is related to environmental conditions during the growth of cotton, variety of cotton, 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.

19. Procedure

19.1 Take one specimen from the bale sample and place the specimen into the instrument's micronaire measurement area for testing.

19.2 The specimen can be taken from either subsample or a portion can be taken and combined from each subsample.

19.3 For the bale sample, report the micronaire reading to the nearest one hundredth of a unit.

UPPER HALF MEAN LENGTH (LENGTH) AND UNIFORMITY INDEX

20. Scope

20.1 This section describes the measurement of the upper half mean length (length) and uniformity index of raw cotton that is based upon standards established by USDA.

21. Summary of Test Method

21.1 The measurements of length and uniformity index of cotton fibers in a tapered beard are derived from the measured length distribution of cotton fibers. Fibers are caught at random along their lengths to form a tapered beard. The tapered beard is scanned from base to tip to form the fiber length distribution.

22. Significance and Use

22.1 The length and uniformity index of cotton is related to environmental conditions during the growth of cotton, variety of cotton, ginning of cotton, mill processing performance, and to the quality of end products.

23. Procedure

23.1 Take one specimen from each subsample of the bale sample for Upland saw ginned raw cotton and place the specimen into the instrument's length measurement area.

23.2 Take two specimens from each subsample of the bale sample for ELS or roller ginned Upland raw cottons.

23.3 For the bale sample, report the average of the specimens for upper half mean length to the nearest one thousandth of an inch (one hundredth of a millimeter).

23.4 For the bale sample, report the average of the specimens for uniformity index to the nearest one tenth of a unit.

BREAKING TENACITY (STRENGTH)

24. Scope

24.1 This section describes the measurement of the breaking tenacity (strength) of raw cotton that is based upon standards established by USDA.

25. Summary of Test Method

25.1 This test method describes the determination of the breaking tenacity at the breaking force of cotton fibers in a specimen in which fibers are distributed randomly in a specimen comb and broken using ⅛-inch (3.2-mm) clamp spacing.

26. Significance and Use

26.1 The measurement of strength of raw cotton is related to environmental conditions during the growth of cotton, variety of cotton, ginning of cotton, mill processing performance, and to the quality of end products.

27. Procedure

27.1 Take one specimen from each subsample of the bale sample for Upland saw ginned raw cotton and place the specimen into the instrument's strength measurement area.

27.2 Take two specimens from each subsample of the bale sample for ELS or roller ginned Upland raw cottons.

27.3 For the bale sample, report the average of the specimens for strength to the nearest one tenth of a gram per tex unit.

PRECISION AND BIAS

28. Precision and Bias

28.1 The precision of this test method is based on an interlaboratory study of ASTM D5867 - Standard Test Methods for Measurement of Physical Properties of Cotton Fibers by High Volume Instruments, conducted in 2011. Nine laboratories participated in this study, testing five different types of cotton. Every "test result" represents an individual determination. Every laboratory reported 30 replicate test results for each material. Practice E691 was followed for the analysis of the data; the details are given in an ASTM Research Report.[4]

28.1.1 *Repeatability limit (r)*—Two test results obtained within one laboratory shall be judged not equivalent if they differ by more than the "*r*" value for that material; "*r*" is the interval representing the critical difference between two test results for the same material, obtained by the same operator using the same equipment on the same day in the same laboratory.

28.1.1.1 Average repeatability limits are listed in Tables 1-6.

28.1.2 *Reproducibility limit (R)*—Two test results shall be judged not equivalent if they differ by more than the "*R*" value for that material; "*R*" is the interval representing the critical difference between two test results for the same material, obtained by different operators using different equipment in different laboratories.

28.1.2.1 Average reproducibility limits are listed in Tables 1-6.

28.1.3 The above terms (repeatability limit and reproducibility limit) are used as specified in Practice E177.

28.1.4 Any judgments in accordance with 28.1.1 have an approximate 95 % probability of being correct. However, due to the limited number of laboratories reporting replicate results, there may be times when differences greater than predicted by the ILS results will arise, sometimes with greater or smaller frequency than the 95 % probability limit would imply.

28.2 *Bias*—At the time of the study, there was no accepted reference material suitable for determining the bias for this test method, therefore no statement on bias is being made.

28.3 The precision statement was determined through statistical examination of 8130 results, from nine laboratories, analyzing the physical properties of the five cotton fiber materials described below.

Cotton 1	US Upland Cotton
Cotton 2	US Upland Cotton
Cotton 3	US Upland Cotton
Cotton 4	US Upland Cotton
Cotton 5	US Upland Cotton

[4] Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D13-1136. Contact ASTM Customer Service at service@astm.org.

TABLE 1 Color Yellowness (b)

Material	Average[A] $\bar{x}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
Cotton 1	11.468	0.185	0.323	0.517	0.904
Cotton 2	10.303	0.126	0.210	0.352	0.588
Cotton 3	8.413	0.136	0.214	0.382	0.600
Cotton 4	13.145	0.156	0.245	0.438	0.687
Cotton 5	9.044	0.143	0.192	0.401	0.536

[A] The average of the laboratories' calculated averages.

TABLE 2 Color Reflectance (Rd)

Material	Average[A] $\bar{x}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
Cotton 1	80.118	0.203	0.402	0.568	1.126
Cotton 2	79.300	0.202	0.361	0.564	1.011
Cotton 3	71.521	0.344	0.505	0.963	1.415
Cotton 4	77.009	0.214	0.456	0.599	1.277
Cotton 5	78.957	0.202	0.388	0.567	1.086

[A] The average of the laboratories' calculated averages.

TABLE 3 Uniformity (%)

Material	Average[A] $\bar{x}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
Cotton 1	77.179	0.503	0.545	1.407	1.526
Cotton 2	80.299	0.518	0.539	1.449	1.509
Cotton 3	82.309	0.493	0.622	1.381	1.741
Cotton 4	82.224	0.481	0.566	1.348	1.586
Cotton 5	82.661	0.538	0.629	1.507	1.762

[A] The average of the laboratories' calculated averages.

TABLE 4 Length (inches)

Material	Average[A] $\bar{x}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
Cotton 1	0.9613	0.0094	0.0129	0.0264	0.0360
Cotton 2	1.0456	0.0100	0.0120	0.0279	0.0337
Cotton 3	1.1390	0.0090	0.0101	0.0252	0.0282
Cotton 4	1.2037	0.0103	0.0110	0.0288	0.0307
Cotton 5	1.1401	0.0093	0.0110	0.0262	0.0308

[A] The average of the laboratories' calculated averages.

TABLE 5 Strength (gpt)

Material	Average[A] $\bar{x}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
Cotton 1	21.88	0.53	0.61	1.47	1.72
Cotton 2	29.51	0.61	0.69	1.70	1.95
Cotton 3	27.37	0.53	0.81	1.48	2.27
Cotton 4	33.13	0.67	0.73	1.88	2.04
Cotton 5	29.26	0.65	0.86	1.83	2.40

[A] The average of the laboratories' calculated averages.

TABLE 6 Micronaire

Material	Average[A] $\bar{x}$	Repeatability Standard Deviation s_r	Reproducibility Standard Deviation s_R	Repeatability Limit r	Reproducibility Limit R
Cotton 1	2.511	0.023	0.038	0.064	0.107
Cotton 2	4.259	0.034	0.051	0.096	0.143
Cotton 3	4.330	0.038	0.060	0.107	0.169
Cotton 4	3.850	0.037	0.048	0.104	0.133
Cotton 5	4.182	0.049	0.068	0.137	0.189

[A] The average of the laboratories' calculated averages.