



Designation: D 4604 – 95

Standard Test Methods for Measurement of Cotton Fibers by High Volume Instruments (HVI) (Motion Control Fiber Information System)¹

This standard is issued under the fixed designation D 4604; 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 procedures for the operation of several instruments measuring various properties of cotton fibers; specifically micronaire, color, trash content, length, length uniformity, strength, and fiber elongation. These instruments are connected through a computer communications network and collectively are known as the Motion Control HVI Fiber Information System (See Fig. 1).² These methods are applicable to loose cotton fibers taken from raw or partially processed cotton or some types of cotton wastes.

1.1.1 The micronaire reading of loose cotton fibers is determined by measuring the resistance of a “plug” of cotton fibers to air flow under prescribed conditions.

1.1.2 The measurement of length and length uniformity is made by an air flow measuring instrument outputting a voltage directly proportional to the amount of fiber in the prepared specimen at a given distance from the base of the prepared test beard, which is held in a clamp.

1.1.3 The measurements of tensile strength or breaking tenacity and elongation are made by an instrument in which the fibers are clamped between jaws with 1/8-in. (3.2-mm) spacing. A strain-gage device is used to measure breaking force, and a displacement measuring device is used to determine the fiber elongation at breaking load.

1.1.4 The measurement of the color of raw cotton is done by means of a cotton color meter of the Nickerson-Hunter type. It can be used to measure color of any type of raw cotton.

1.1.5 The measurement of the surface trash content of raw cotton is accomplished through optical analysis of the sample by a computer governing the scanning action of the sample through a video camera.

1.2 These test methods may exhibit shifts in the levels of the instrument outputs depending on the stage of processing at which the cotton fiber exists for testing.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are for information only; the conversion may be approximate.

1.4 This standard contains the following sections:

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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.* Specific precautionary statements are given in Note 6 and Section 16.

2. Referenced Documents

2.1 ASTM Standards:

- D 123 Terminology Relating to Textiles³
- D 1441 Practice for Sampling Cotton Fibers for Testing³
- D 1445 Test Method for Breaking Strength and Elongation of Cotton Fibers (Flat Bundle Method)³
- D 1448 Test Method for Micronaire Reading of Cotton Fibers³
- D 1776 Practice for Conditioning Textiles for Testing³
- D 2253 Test Method for Color of Raw Cotton Using the Nickerson-Hunter Cotton Colorimeter³
- D 3025 Practice for Standardizing Cotton Fiber Test Results by Use of Calibration Cotton Standards³

3. Terminology

3.1 Definitions:

3.1.1 *breaking tenacity, n*—the tenacity corresponding to the breaking load, for example, grams-force per tex or grams-force per denier.

3.1.2 *calibration cotton standards, n*—cotton samples taken from a blended bulk source on which fiber properties have been determined under the International Calibration Cotton Standards Program.

3.1.2.1 *Discussion*—Currently there are ten such cottons,

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² Equipment is available from Motion Control, Inc., P.O. Box 29218, 2615 Brenner Dr., Dallas, TX 75220.

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



FIG. 1 Motion Control HVI Fiber Information System

which cover the range of the micronaire scale.⁴

3.1.3 *cotton color diagram, n*—a diagram showing the color ranges of standards officially established by the U.S. Department of Agriculture for the various grades of cotton in relation to scales of reflectance, R_d , on the vertical axis, and yellowness, $+b$, on the horizontal axis.

3.1.3.1 *Discussion*—Delineations also exist showing boundary values of G and C (see Fig. 2 and 31.1). Cotton color diagrams based on grade standards for American Pima cotton and for cotton linters are also available.

3.1.4 *elongation, n*—the ratio of the extension of a material to the length of the material prior to stretching, expressed as a percent.

3.1.4.1 *Discussion*—Elongation may be measured at any specified force or at rupture and is usually expressed in percent.

3.1.5 *elongation at breaking load, n*—in *fiber strength testing of cotton*, the elongation corresponding to the maximum load, and expressed as a percentage of the $\frac{1}{8}$ -in. (3.2-mm) gage length.

3.1.6 *fibrogram, n*—in *testing cotton fibers for length*, the curve representing the second cumulation of the length distribution of the fibers sensed by the length measuring instrument in scanning the fiber beard.

3.1.7 *fineness, n*—a relative measure of size, diameter, linear density, or mass per unit length expressed in a variety of units.

3.1.7.1 *Discussion*—For cotton, the weighted mean linear density is expressed in micrograms per inch or in millitex.

3.1.8 *linters, n*—the short, fibrous material adhering to a cotton seed after the spinnable lint has been removed by ginning and which is subsequently recovered from the seed by a process called “delinting.”

3.1.9 *micronaire reading, n*—a relative measurement of fiber fineness derived from the porous plug air-flow method.

3.1.10 *mote, n*—a whole, immature cotton seed.

3.1.11 *number of pieces of trash, n*—in *testing cotton with the Trash Meter*, a number correlated with the total number of pieces of trash on the surface of the sample of cotton over the viewing window.

3.1.12 *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 a percentage of the area of the viewing window.

3.1.13 *seed coat fragment, n*—in *cotton*, a portion of a cotton seed, usually black or dark brown in color, broken from a mature or immature seed, and to which fibers or linters may or may not be attached.

3.1.13.1 *Discussion*—Seed coat fragments are distinct from certain other imperfections found in cotton, such as neps, motes, leaf trash, and pieces of the stem. Seed coat fragments do not include “motes” or whole immature seeds; however, motes are one source of seed coat fragments when the motes are crushed or broken.

3.1.14 *standard atmosphere for preconditioning textiles, n*—an atmosphere having a relative humidity of 5 to 25 % and a temperature not over 122°F (50°C).

3.1.15 *standard atmosphere for testing textiles, n*—air maintained at a relative humidity of $65 \pm 2\%$ and at a temperature of $70 \pm 2^\circ\text{F}$ ($21 \pm 1^\circ\text{C}$).

3.1.16 *tenacity, n*—in *a tensile test*, the force exerted on the specimen based on the linear density of the unstrained specimen.

3.1.17 *tensile strength, n*—the strength shown by a specimen subjected to tension, as distinct from torsion, compression, or shear.

3.1.18 *test beard, n*—in *length testing of cotton*, the portion of the test specimen that has been combed and brushed into a

⁴ The International Calibration Cottons are available from the Cotton Division, Agricultural Marketing Service, USDA, 4841 Summer Ave., Memphis, TN 38122.

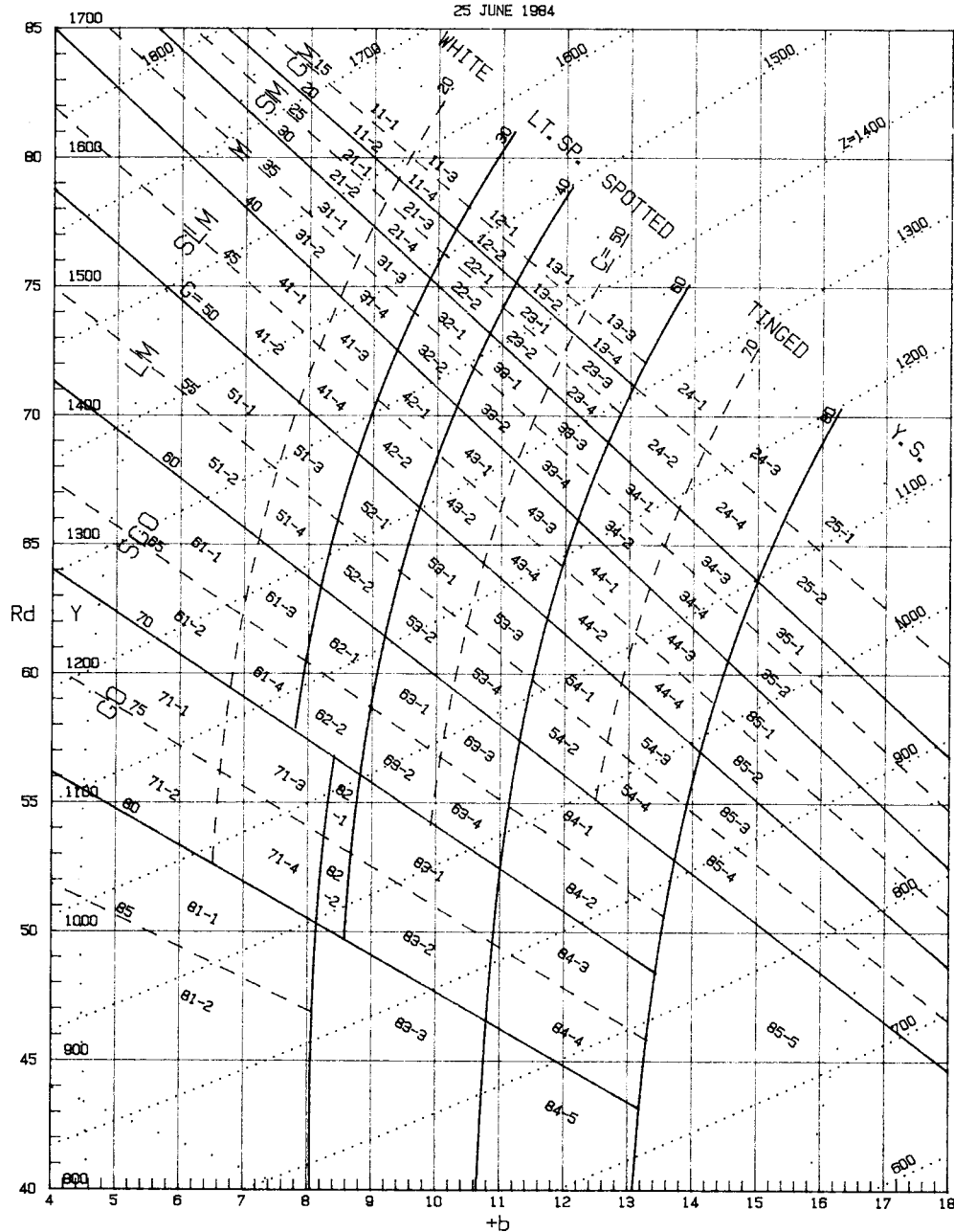


FIG. 2 Cotton Color Diagram

“beard” which protrudes from the outside of the comb(s) or the clamp(s).

3.1.19 *trash, n*—in testing cotton with the Trash Meter, foreign matter having a distinct difference, as seen by a video camera, between light and dark color from that of cotton.

3.1.20 *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.

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

3.1.22 For definitions of other textile terms used in these test methods, refer to Terminology D 123.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *amount, n*—in cotton fiber testing with a Length Analyzer, a measure of the thickness or pneumatic density of the test beard, proportional to the number of fibers present at various distances from the base of the specimen clamp jaws.

3.2.2 *color lamp, n*—in color determination of cotton with a Color Meter, a lamp with a specific energy output function used in conjunction with special tristimulus filters to obtain a desired response function.

3.2.3 *Color Meter, n*—an instrument which measures the

fiber sample color as presented in the viewing window, in terms of the tristimulus values Y and Z and transmits these values to the IC/TC for further processing.

3.2.4 *Comber/Brusher, n*—an instrument which prepares the test beard of fibers for length, length uniformity, strength, and elongation measurements by combing the test specimen to remove loose or unclamped fibers and paralleling the individually clamped fibers, and by brushing the clamped fibers to remove fiber crimp and smooth the test beard of cotton.

3.2.5 *control limits, n*—predetermined ranges based on the variability of past observations between which the instrument data for a test must fall to be considered valid.

3.2.6 *elevator, n*—a general term describing a mechanical device on the Motion Control, Inc. Fiber Information System which moves the specimen clamp while preparing the specimen or while taking a length/uniformity index or strength/elongation measurement.

3.2.6.1 *Discussion*—Specifically, elevators are used on the Comber/Brusher unit and Length/Strength Analyzers.

3.2.7 *Fiberweigh, n*—an instrument having a capacity for weighing a 51 grain (3.30 g) specimen with a sensitivity of at least 0.2 % of the mass being weighed.

3.2.8 *Fibronaire, n*—an instrument which determines the micronaire reading of raw cotton fibers using the “porous-plug” air flow technique.

3.2.9 *grain, n*—a unit of mass equal to 1/7000 of a pound or 0.0648 g.

3.2.10 *IC/TC, n*—abbreviation for Intelligent Color/Trash Coordinator.

3.2.10.1 *Discussion*—The IC/TC computes the color and surface trash content of the fiber sample being tested using the information obtained from the Color Meter and Trash Meter.

3.2.11 *IDT, n*—abbreviation for Intelligent Data Terminal.

3.2.11.1 *Discussion*—The IDT contains software which enables the HVI 3000 Fiber Information System to communicate with a host processing device, and where decisions are made regarding control limits, output of data, format of data, and sample identification.

3.2.12 *Length Analyzer, n*—an instrument which determines the upper-half-mean length and length uniformity index of a test beard of cotton.

3.2.12.1 *Discussion*—The Length Analyzer also determines a point of constant mass on the test beard of cotton to which the strength analyzer indexes for breaking. Units of length are in hundredths of an inch and units of uniformity index are in percentage points of upper-half-mean length.

3.2.13 *specimen clamp, n*—the device which is used to transport the fiber test beard of cotton through the gathering, combing, brushing, length, length uniformity, strength, and elongation measurement operations.

3.2.14 *specimen loader, n*—an instrument which obtains the test specimen by lowering an open specimen clamp onto the surface of the raw cotton samples, closing the jaws of the specimen clamp and ascending with a portion of the fibers retained in the jaws awaiting the combing and brushing procedure.

3.2.15 *status switches, n*—switches located on the main-frame electronic chassis in the console used to set the number

of specimens tested on each laboratory sample and turn off instruments not being used in operating the system.

3.2.16 *Strength Analyzer, n*—an instrument which determines tensile strength and elongation at breaking load for a test beard of cotton.

3.2.16.1 *Discussion*—Units of strength are expressed in grams-force/tex, and elongation is expressed as a percentage.

3.2.17 *test specimen, n*—in cotton length tests with the Length Analyzer, the cotton fibers protruding randomly from the base of a Motion Control Inc. specimen clamp for fiber length measurement before being combed or brushed.

3.2.18 *Trash Meter, n*—an instrument which optically measures the amount of trash on the surface of a raw cotton sample as presented to the viewing window.

3.2.19 *tristimulus filters, n*—in cotton fiber color testing with the Color Meter, optical filters used in conjunction with specific color lamps to obtain a response function approximating the tristimulus functions of the CIE Standard Observer for Source C.

3.2.19.1 *Discussion*—These filters will provide as outputs, values defining the yellowness and reflectance of the sample. These values, in turn are used for color determination of raw cotton samples.

4. Sampling

4.1 *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 and containers of sliver. Consider bales or shipping containers to be the primary sampling units.

NOTE 1—An adequate specification or other agreement between the purchaser and the supplier requires taking into account the variability between the 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.

4.2 *Laboratory Sample*—For fiber in bales, or sliver in containers, systematically take laboratory sample units from each bale or container in the lot sample as directed in Practice D 1441.

4.3 *Test Specimens*—Take test specimens as directed in each of the individual test methods.

5. Conditioning

5.1 Bring the laboratory sample to moisture equilibrium for testing in the standard atmosphere for testing textiles (see Practice D 1776).

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

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