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Standard Practice for
Standardizing Cotton Fiber Test Results by Use of
Calibration Cotton Standards[1]

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1. Scope

1.1 This practice covers the use of reference standard cottons for the standardization of instruments and techniques used to test cotton fibers in various laboratories.

1.2 Standardization may be achieved by application of a correction factor based on the reference standards, or by modification of the technique in use.

NOTE 1—When reference standards are used to develop correction factors, or to adjust an operator's technique, no instrument calibration processes are involved. The term "Calibration" is properly used for the application or assignment of permanent scales or marks to an instrument. Adjustments can be made to specific instruments and accessories such as orifices, metallic strips, or cellophane sheets, in order to obtain the prescribed values with a specific instrument. Since an operator's technique or the interpretation of a method or procedure is inherently variable, it cannot be calibrated, that is, assigned a permanent, definite value. The use of reference standards, however, affords a means for standardizing techniques and checking the reliability of observed results.

1.3 This practice recognizes two types of reference standards: (*1*) calibration cotton standards (see 6.1) and (*2*) working cotton standards (see 6.2).

1.4 The instructions included in this practice can be used with cotton fibers in any form suitable for testing with the particular instrument to be used.

1.5 The instructions in the practice are applicable to cotton fibers but can also be applied to specific blends of cotton and other fibers, or to other fibers that can be tested with the instruments designed for testing cotton fibers. No information is available, however, to show that test procedures standardized with reference cotton samples are equally reliable with various cotton fiber blends or with other fibers.

NOTE 2—Standardization procedures covered in this practice are recommended for use with the following: Test Methods D 1440, D 1445, D 1447, and D 1448.

1.6 *This standard does not purport to address all of the safety ~~problems,~~ concerns, if any, associated with its use. It is the responsibility of the user of this standard to consult and 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[2]
D 1440 Test Method for Length and Length Distribution of Cotton Fibers (Array Method)[2]
D 1445 Test Method for Breaking Strength and Elongation of Cotton Fibers (Flat Bundle Method)[2]
D 1447 Test Method for Length and Length Uniformity of Cotton Fibers By Fibrograph Measurement[2]
D 1448 Test Method for Micronaire Reading of Cotton Fibers[2]

3. Terminology

3.1 *Definitions:*

3.1.1 *calibration cotton standard, n*—cotton samples taken from blended bulk source on which fiber properties have been determined under the International Calibration Cotton Standards Program. (*Syn.* international calibration cotton)

3.1.2 *reference standard, n*— *in cotton testing*, a homogeneous lot of cotton having a known or accepted value for one or more physical properties.

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

3.1.3 *working cotton standard*, *n*—a reference standard developed primarily for use within a specific laboratory. (*Syn.* within-laboratory cotton standard)

3.2 For definitions of other terms used in this practice, refer to Terminology D 123.

4. Summary of Practice

4.1 Testing instruments are adjusted in accordance with engineering principles to ensure that they correspond properly to the manufacturer's calibration scales and instructions for the operation of the instrument.

4.2 Technicians are instructed to operate testings instruments in a consistent manner utilizing appropriate prescribed ASTM methods.

4.3 Specimens of the working cotton standard or calibration cotton standard are tested before and periodically during the routine testing of cotton samples using the same techniques for all specimens tested.

4.4 Observed values for samples tested are adjusted through use of a correction factor calculated from observed values obtained on reference standards to secure comparative level of measurement.

5. Significance and Use

5.1 The purpose of this practice is to provide guiding principles for the use of reference standard cottons for the standardization of instruments and techniques to obtain reproducible test results (within statistical limits) when the tests are performed on samples of cotton fibers by the same or different operators at the same or different times, both within the same laboratory and in different laboratories.

5.2 Results obtained on cotton fiber tests on the same sample may vary widely due to differences in instruments and operator techniques. Some variation in test result levels can be controlled by the physical adjustment of instruments in accordance with manufacturers' instruction. Instrument adjustments are made only to cause instrument values to coincide with specified calibration points established by the manufacturer. Other variations in cotton fiber test results are caused by differences in technique used in specimen preparation, errors in reading test values from scales, variation in the reference standard, and sampling errors in specimen selection. It is necessary that the mean value of at least four sets of determinations per operator-instrument be used in order to form a sound basis for any adjustment of technique or for the use of correction factors.[3]

5.3 In comparing results of different operators and different laboratories, for example, between the purchaser and the seller, it is essential that all results be obtained on replicate specimens. Values obtained on individual samples, as well as on a reference standard are never absolute, but have a normal variation about their mean due to heterogeneity of the sample. Therefore confidence limits of a test value are dependent upon the within laboratory variance for the test and the sampling error. The level of the results in different laboratories will be comparable only to the extent of the use of the same reference standards in both laboratories.

5.4 Any one set of determinations on a reference standard may be within the statistical limits of this reference standard cotton approximately 67 % of the time. The mean of a minimum of four sets of tests, as set out in the specific test procedure, is required to establish a reliable mean value for the determination of the test level. Caution should be exercised in the adjustment of instrument or technique on the basis of preliminary results on the working cotton standard or calibration cotton standard because of the variation within these reference standards.

5.5 When the mean value of the initial test results on a reference standard cotton falls within one unit standard deviation of the established values, testing may be started on samples of cotton fiber to be tested. If the mean value does not fall within two standard deviation units, recheck the instrument adjustments and test an additional set of test specimens from the reference standard cotton. The mean value of these two sets of determinations, where instrument checks have shown the adjustments (instruments) to be in order, may then be used as a basis for modification of technique, or if correction factors are to be used, the basis for the initiation of testing of unknown samples. Correction factors should be based on determinations made before, during, and at the completion of routine testing.

6. Reference Samples

6.1 *Calibration Cotton Standards*:

6.1.1 Calibration cotton standards are furnished with a statement of the mean values for one or more physical characteristics, along with the precision of the quoted mean value.[4] Such standards should be used only for those physical characteristics for which mean values have been furnished.

6.2 *Working Cotton Standards*:

6.2.1 Using working cotton standards conserves the supply of the more expensive calibration cotton standards. Well before the supply of a working cotton standard has been depleted, a new working cotton standard should be prepared. It is good laboratory practice to run the old and new working cotton standards in parallel for a period of time sufficient to ensure that no changes in test result levels will occur at the time of changing to the new supply of working cotton standard.

6.2.2 Working cotton standards would be so well blended that there is a minimum variation in the property of interest. Blending should be completed before determining the accepted value for the property of interest.

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[3] Worley, S., Jr. and Krowicki, R. S. Quality Control in Fiber Testing, Proceedings, 1968 Cotton Research Clinic. *Textile Bulletin,* April 1968, pp 32–35.

[4] Calibration cotton standards are available from the Cotton Division, Agriculture Marketing Service, USDA, 4841 Summer Ave., Memphis, TN 38122.

6.2.3 The accepted value of a physical characteristic of a working cotton standard should be based on extensive comparisons with a calibration cotton standard having a reported mean value for that physical characteristic. The comparisons should be made (*1*) on the specific instruments with which the working cotton standard is to be used, (*2*) by the specific operators who will be using those instruments, and (*3*) with the specific test procedure to which the working cotton standard is to be applied.

7. Adjustments of Instruments

7.1 Verify the calibration or adjustment of a specific instrument in accordance with the instructions of the manufacturer. Check the physical condition and adjustment of the instrument at least twice daily, at the beginning and at the middle of the test period, or more frequently if specified by the manufacturer.

Note 3—If experience indicates a need for more frequent checks, perform the checks as indicated.

7.2 If instrument malfunctions should occur, discontinue testing until the cause of such malfunction has been corrected.

Note 4—Data from periodically tested calibration samples will indicate instrument difficulties and the need for repeating sample measurements.

8. General Procedure

8.1 Prepare four test specimens taken from either of the reference standards (Section 6) and test them as directed in the appropriate ASTM method. It is important that the instrument be operated in a consistent manner and that the level of results is within the limits established for the particular operator and instrument (Note 5). Where results are not within acceptable limits, recheck instrument adjustments and test an additional set of specimens of a reference standard. If after making any necessary adjustments to the instruments in use, the observed test results are still outside the prescribed limits, check the operator's technique carefully and make any indicated adjustments or consider using a correction factor, if no adjustments are indicated.

Note 5—Operator limits are established by the operator's mean and standard deviation of test results obtained on the particular standard. These test results may be from testing standards only, or may be cumulative statistics over a period of time for the particular operator. In either case the mean and standard deviation should be based on at least 100 sets of determinations.

8.1.1 If adjustment is made in the instrument, or operator technique is changed to obtain a different level of results, test additional specimens of a reference cotton sample to determine that the mean of the additional observations fall within the prescribed limits before testing any unknown samples.

9. Procedure for the Calculation and Use of Correction Factors

9.1 Test and record the pertinent values for each property on at least two test specimens of a reference standard cotton at the beginning and at intervals during the test period. Make a minimum of four complete tests to obtain results to be used to calculate a reliable correction factor. Make similar tests on specimens from the routine samples.

9.2 Calculate the mean of the observed values for the specimens from the reference standard cotton and calculate the correction factor using Eq 1:

$$F = S/V \tag{1}$$

where:
F = the correction factor calculated to three decimal places,
S = the established mean value for the reference standard cotton, and
V = the observed mean value of all tests performed by one operator—instrument on the reference standard cotton during the test period.

9.3 Calculate the corrected or adjusted value for a specific test result using Eq 2:

$$A = O \times F \tag{2}$$

where:
A = adjustedvalue,
O = observed values for specimens tested, and
F = correction factor calculated in 9.2.

10. Keywords

10.1 calibration cotton; cotton