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Standard Practice for Lighting Cotton Classing Rooms for Color Grading[1]

This standard is issued under the fixed designation D1684; 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.

INTRODUCTION

Until 1940, practically all cotton classing was done in daylight, much of it in specially skylighted rooms designed to provide sufficient and uniform lighting on the classing tables. Cotton classification or classing is the art and science of describing the quality of cotton according to the official standards of the United States. Grade is divided into two categories—color grade and leaf grade. Because color grade is an important quality factor in establishing the price and use of cotton, the color quality of lighting is important. The cotton classer attempts to class cotton on the basis of the color the sample and the standard would have in daylight. In classing rapidly he refers to physical standards only occasionally each day; therefore it is most important that the lighting in a classing room shall not only provide a constant color but that it shall make the color of cotton appear as nearly as possible as it would in daylight so that he can take full advantage of training and memory.

In the USA, daylight at about 7500 K is what the cotton classer (**1**,**2**,**3**),[2] (as well as color matchers in other industries (**4**,**5**,**6**)) has found in practice to be the minimum color temperature of preferred daylight.

1. Scope

1.1 This practice covers practices in general use in the United States for lighting cotton classing rooms, provides general background information regarding the development and establishment of these practices, and prescribes a test method for appraising the color quality of lamps procured for this purpose.

1.2 *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:*[3]

D123 Terminology Relating to Textiles

D7139 Terminology for Cotton Fibers

3. Terminology

3.1 For all terminology relating to D13.11, Cotton and Fibers, refer to Terminology D7139.

3.1.1 The following terms are relevant to this standard: color grading, illumination, kelvin.

3.2 For all other terminology relating to textiles, refer to Terminology D123.

4. Summary of Practice

4.1 Artificial lighting is used in cotton classing rooms to simulate ideal daylight conditions in north latitudes with a moderately overcast sky. The quality and quantity of illumination, the geometry of illumination, the type of lighting unit and pattern for installation, the color of surroundings, and maintenance of lighting equipment are specified in this practice.

5. Significance and Use

5.1 This practice is useful for establishing and maintaining standard lighting conditions in cotton classing rooms. This permits the classer to make a valid assessment of the color grade of cotton. The cotton classer attempts to classify cotton on the basis of the color the sample and the standard would have in daylight. It is essential that the lighting in a classing room is constant and that it makes the color of cotton appear as nearly as possible as it would in natural daylight.

[1] This practice is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.11 on Cotton Fibers.

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[2] The boldface numbers in parentheses refer to references listed at the end of this practice.

[3] 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.

5.2 Uniform lighting conditions permit classers to go from one classing room to another without having to make adjustments for wide differences in the amount and quality of lighting.

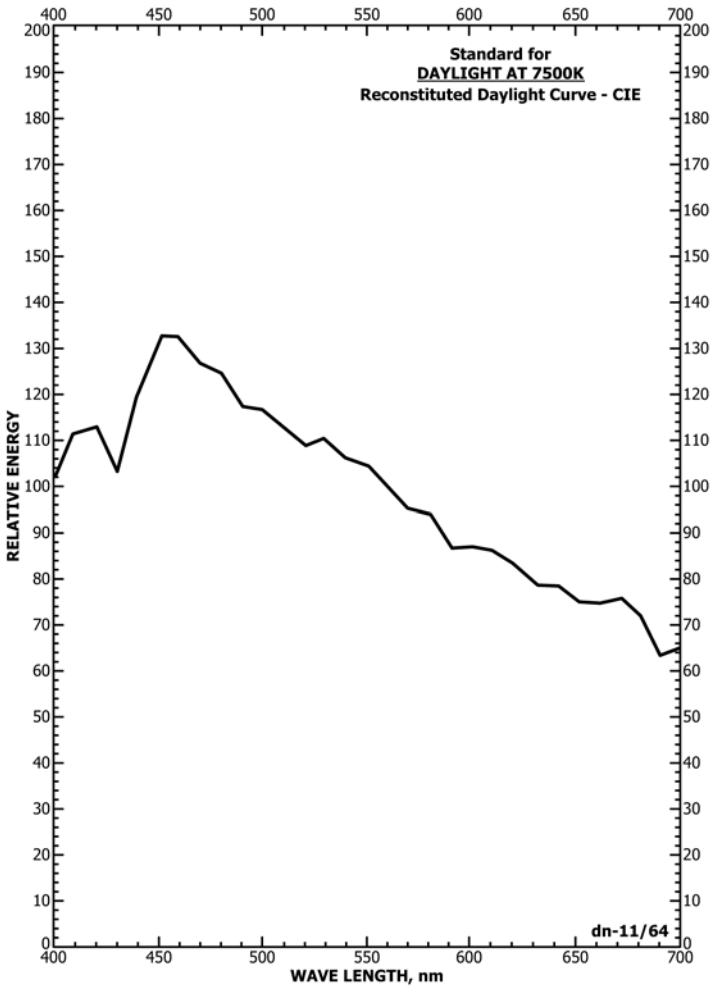
6. Quality of Illumination

6.1 The standard for color quality of illumination is the color and spectral quality of daylight of a moderately overcast northern sky, as represented by the curve and data in Fig. 1 for typical daylight at 7500 K (**7**,**8**).

6.2 Tolerances for meeting this standard for color quality are ±200 K correlated color temperature of color, and for spectral quality the spectral distribution shall be as close as possible to that shown in Fig. 1; in no case shall the color rendering index be lower than 92, as determined by the General Color Rendering Index recommended in 1965 by the International Commission on Illumination (CIE) described in References (**9**) and (**10**).

7. Quantity of Illumination

7.1 At the present time, the optimum amount of illumination for cotton classing is not known. For light sources that include the use of fluorescent lamps, the U.S. Department of Agriculture requires at the time of installation a minimum of 100



Wavelength, nm[A]	CIE Standard for Daylight at 7500 K[B] (Relative Energy)
400	101.9
10	111.9
20	112.8
30	103.1
40	121.2
450	133.0
60	132.4
70	127.3
80	126.8
90	117.8
500	116.6
10	113.7
20	108.7
30	110.4
40	106.3
550	104.9
60	100.0
70	95.6
80	94.2
90	87.0
600	87.2
10	86.1
20	83.6
30	78.7
40	78.4
650	74.8
60	74.3
70	75.4
80	71.6
90	63.9
700	65.1

[A] nm is the abbreviation for nanometre, which is a metre × 10^{-9} = mμ = millimicron.
[B] The data for 400 to 700 nm are based on Table III of August, 1965, recommendations of the CIE colorimetry committee (E-1.3.1) for an international standard to represent typical daylight (300 to 830 nm) of correlated color temperature 7500 K (**7**,**8**).

FIG. 1 Standard for Color Quality of Illumination for Color Grading Problems in Which the Equivalent of Light from a "Covered Sky" is Required or Preferred. In North Latitudes this is a sky that is moderately overcast from the north.

footcandles[4] (1076 lx) on the working surface (from center to limits of classing areas). Studies (**4,5,11**) show that illumination above 400 fc (4300 1x) may be considered "very poor." Optimum conditions lie somewhere between. Most recent installations are well above the minimum requirements, usually reaching a range of 150 to 200 fc (1614 to 2152 lx) on installation (Notes 1 and 2).

NOTE 1—The minimum range for lighting cotton classing rooms is based on data in Tables X1.1 and X1.2 in Appendix X1. Many cotton classing rooms were studied; they were lighted by daylight from the north, usually through skylights. Results demonstrate that the absolute level of lighting is not critical; the highest footcandles for each sky condition do not always rate "very good." Later studies corroborated the option, based on a study of Tables X1.1 and X1.2, that after a minimum is reached, the quality of the illumination is more important than quantity in choice of illumination for classing. The data obtained seem to be the result of averaging whatever quantities of illumination happened to be associated with the best liked quality of illuminant. For example, light from a clear blue sky often is called glaring, even though the amount of illumination on clear days is well below that of slightly cloudy or overcast days.

NOTE 2—There are reasonable wide limits within which the eye operates satisfactorily in seeing color differences, and while more light is needed to distinguish dark than light colors, originally only minimums for the range of footcandles to be required on the classing tables were specified for lighting cotton classing rooms since it was assumed that added costs would not encourage the use of higher illumination levels. Studies reported in 1958 by Blackwell to the Illuminating Engineering Society, summarized by Crouch (**12**) and by the I.E.S. Committee on Quality and Quantity of Illumination (**13**), indicate that many of the minimums to which we have become accustomed should be higher. Experience corroborates this.

8. Geometry of Illumination

8.1 The lighting should be generally diffused but with enough direction to allow a perception of depth as a classer looks into his sample. It should be as uniform over all working areas of the room as is possible; there should be no glare and no crosslighting, and the brightness contrast of the light source and its surroundings should be held at a minimum.

9. Type of Unit and Pattern for Installation

9.1 Lighting units should be designed to supply the required amount and color of illumination over the surface of a classing table when units are placed end-to-end over the tables. Installation requirements should be based on the pattern of illumination provided by the lighting units used, calculated so that the illumination will be as uniform as possible throughout the classing room. Units should be closed, they should be as light in weight as practical, and be easy to install, inspect, and maintain in good order. It is recommended that air conditioning be specified along with these lighting installations (**3**).

9.2 In classing room installations that meet the specifications of this recommendation, units about 2 by 4 ft (0.6 by 1.2 m) are widely used. They include use of spectrally neutral diffusing glass designed not only to diffuse the light but to provide a very low brightness contrast. Based on the pattern of light provided by these units, installations in which they are used usually are arranged as follows:

9.2.1 Diffusing glass at the bottom of the units is set 10 ft (3 m) from the floor and parallel to it, in rows centered 6 ft (2.1 m) apart.

9.2.2 A minimum of four rows are recommended for an average sized room. Increase the number of rows as required to allow efficient use of all space within the room. Classing tables, depending somewhat on their length, may be placed either parallel to the direction of lighting or at right angles. For full use of the room, lighting units should be extended to within 3 to 4 ft (1 to 1.2 m) of the side walls and as close to end walls as is convenient and possible.

9.2.3 For a single table, no less than three units, installed end-to-end, should be used; for a small classing room the minimum is two rows of four units each.

10. Color of Surroundings

10.1 The color on walls, ceiling, floors, furniture, and even of the cotton itself (if it covers a large area when laid out for classing) has a considerable effect on the lighting in a room, both on the amount of light reflected and on brightness contrasts that may be involved.

10.2 Classing rooms should be painted a neutral color (Note 3) so that no one chromatic color will be enhanced or discounted more than another. Neutral colors cover a range from white through a series of grays to black. All grays used in the classing room should be truly neutral, that is, show no trace of any hue, and the lightness of the gray should depend on the amount of light coming into the room and reaching the classing surface.

NOTE 3—The grays are specified in terms of the Munsell Neutral Value Scale, which consists of a series of neutral grays in visually equal steps from black, at 0/, to white; at 10/. Munsell Neutral 7.0/ is a light gray; 8.0/ and 8.5/ are lighter grays; while 9.5/ is very good white.[5]

10.3 For rooms with artificial lighting, such as those lighted with wall-to-wall lighting units, the surroundings should be a very light neutral gray, no darker than Munsell Neutral 8.5/, in order to conserve the lighting and to reduce brightness contrasts as much as possible.

10.4 The following color specifications are those used by the U.S. Department of Agriculture for surroundings in cotton classing rooms:

10.4.1 *Walls,* no darker than Munsell Neutral 9.0/.

10.4.2 *Ceilings,* white, or as near white as possible, in no case darker than Munsell Neutral 9.5/.

10.4.3 *Mats* on which a classer stands should be black.

10.4.4 *Tables for Classing,* light gray, with black top.

10.4.5 *Papers in which samples are wrapped* should not be allowed to cover large areas of the field of view. Extra areas of paper should be folded under the cotton to avoid this. Because of its naturally yellowish red hue, cotton will appear creamier against blue papers and grayer against brown papers than when viewed against a neutral background.

[4] One footcandle = 10.76391 lux; 1 lux = 0.0929 fc.

[5] An inexpensive neutral gray color scale in 18 steps may be obtained from the Munsell Color Co., 2441 N. Calvert St., Baltimore, MD 21218.

11. Maintenance of Lighting Equipment

11.1 Lamps and equipment must be properly maintained in order to hold to proper and uniform levels of lighting. It is not enough to install good lighting; it must be maintained. The following routine should be followed:

11.1.1 Daily inspection to check that all lamps are in good order.

11.1.2 Prompt replacement of deficient lamps by the proper type of lamp.

11.1.3 Use of a footcandle meter[6] to chart and record footcandle levels throughout all classing areas. The level of these data should be watched throughout the year to determine changes in illumination. Records of this sort, kept over a period of years, are a help in setting up definite cleaning and replacement schedules.

11.1.4 Regular cleaning of fixtures, recording footcandle levels before and after cleaning.

11.1.5 In fixtures that include use of fluorescent lamps, regular inspection of ballasts, at least once each year. Low voltage or lack of ventilation above the lighting units tends to cause the ballast to overheat and bleed. In fact, ballast trouble can cause considerable variation in light output.

[6] Any inexpensive pocket-size footcandle meter with a range from 0 to 500 fc (0 to 5000 1x) should be adequate.

12. Keywords

12.1 cotton; color

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