

Test Method for Light Blocking Effect of Textiles: Spectrophotometric

Foreword

AATCC TM148-1989, Light Blocking Effect of Curtain Materials, was discontinued in 1994. During the time of its discontinuance, it was found that a standard laboratory sphere spectrophotometer used in transmission mode could be used to measure the light blocking effect of textiles used in end uses such as partial and full blackout curtains in both residential and contract applications. This method uses spectrophotometric measuring equipment that provides precise, reproducible and traceable light measurements. These instruments are currently in wide industrial use.

1. Purpose and Scope

1.1 This test method is intended to spectrophotometrically measure the light blocking properties of window covering textiles against light passing through them and being seen by a standard observer on the darkened side of the textile (typically a curtain or drape).

1.2 This method is applicable to all types of fabrics, including knits, wovens, and non-wovens, as well as to fabrics taken from end product items. However, it is not recommended for mesh structures with mesh holes greater than 3 mm across.

2. Principle

2.1 The test method assesses the percentage of light from a light source blocked by a textile material by measuring the original light and subtracting from it the light passing through the materials. The amount of light transmitted through the fabric is compared on a percentage basis, to the amount of light transmitted without any blocking of the light (total transmission). The percent of light that is not transmitted, out of the total transmission, represents the material's light blocking capability.

2.2 The method uses the CIE *Y* tristimulus value, calculated using illuminant D65 and the 10° observer as the measure of total transmission.

3. Terminology

3.1 **diffuse transmission**, *n.*—process by which incident light, while being transmitted through an object, is redirected or scattered over a range of angles.

3.2 **light blocking**, *n.*—the ability of a textile to prevent the transmission of

light.

3.3 **regular transmission**, *n.*—process by which incident light is transmitted through an object in a rectilinear, straight-through manner, without diffusion.

3.4 **spectrophotometer**, *n.*—an instrument used for measuring the transmittance and/or reflectance of specimens as a function of wavelength.

3.5 **total transmission**, *n.*—the amount of light transmitted comprising diffuse plus non-diffuse transmission.

3.6 **transmission**, *n.*—process by which incident light is transmitted through an object.

4. Safety Precautions

NOTE: These safety precautions are for information purposes only. The precautions are ancillary to the testing procedures and are not intended to be all inclusive. It is the user's responsibility to use safe and proper techniques in handling materials in this test method. Manufacturers MUST be consulted for specific details such as safety data sheets and other manufacturer's recommendations. All OSHA standards and rules must also be consulted and followed.

4.1 Good laboratory practices should be followed. Wear eye protection in all laboratory areas.

4.2 The manufacturer's safety recommendations should be followed when operating laboratory testing equipment.

5. Uses and Limitations

5.1 This test is performed under controlled laboratory temperature and relative humidity conditions. While the test may be performed at alternative conditions, such as household ambient temperature and relative humidity, for comparison of results, the same conditions must be used.

5.2 The light this test is performed with is from a xenon lamp. Different light sources may be used and results may, therefore, also be different, such as with spectrophotometric instruments with band width infrared (IR) capacity.

6. Apparatus and Materials

6.1 Spectrophotometer with transmission measuring capability with a means of precisely mounting and anchoring a specimen in the transmission holding clamp.

6.2 Means of covering reflectance or

external port with a white standard tile to establish the one-hundred percent transmission standard and to complete the sphere for further transmission readings.

6.3 Means of blocking transmission to determine zero percent transmission.

6.4 If the spectrophotometer is equipped with adjustable ultraviolet energy, standardize the amount of ultraviolet energy in the spectrophotometer light source (see 14.1).

7. Sampling

7.1 Take five representative test specimens from the sample. Increase the number of specimens accordingly to include different areas that may have varying light transmission characteristics within the total sample area. Textiles such as long repeat jacquards may require a larger number of specimens in order to obtain a more representative sample. Textiles containing large repeats of alternating diaphanous and opaque areas may have the light blocking effect of each area sampled separately.

8. Test Specimens

8.1 Each specimen should be large enough to fit onto the specimen holding frame and completely cover the transmission port of the spectrophotometer.

8.2 Take multiple specimens to provide an appropriate random sample from different width and length areas of the fabric, not taking any specimens from within 10% of the width from the selvage or machine edge.

9. Conditioning

9.1 Prior to testing, condition test specimens as directed in ASTM D1776, Standard Practice for Conditioning and Testing Textiles. (Condition the specimens adequately in an atmosphere of $21 \pm 2^\circ\text{C}$ ($70 \pm 4^\circ\text{F}$), $65 \pm 5\%$ RH, by laying each specimen separately on a screen or perforated shelf of a conditioning rack. Conditioning time will be dependent on factors indicated in ASTM D1176.)

9.2 Perform all tests in the standard atmosphere for testing.

10. Procedure (see Fig. 1)

10.1 Operational check of total transmission with no light blocking.

10.1.1 Block the external/reflectance port with a white standard to complete the sphere.

10.1.2 Set the machine to transmission



Fig. 1—Specimens Mounted in Two Different Instrument Manufacturers' Spectrophotometers

measuring mode without any sample in the transmission holder.

10.1.3 Measure and record total transmission, using the CIE Y_{D65-10} tristimulus value, which should result in a measurement of 100.

10.2 Operational check of total trans-

mission with opaque light blocking.

10.2.1 Keep the white standard in place at the external/reflectance port to maintain the completed sphere.

10.2.2 Block the transmission port with an opaque, black standard, such as a metal plate.

10.2.3 Measure and record total transmission. The CIE Y_{D65-10} value of the measurement should be 0.

10.3 Record transmission through the specimen material.

10.3.1 Keep the white standard in place to maintain the completed sphere.

10.3.2 Place the specimen to be measured in the transmission holder clamp.

10.3.3 Measure and record the light transmission using the CIE Y_{D65-10} tristimulus value.

11. Calculation

11.1 Calculate the light blocking effect (x) in percent (%), using Equation 1:

$$x = 100 - A \text{ (Equation 1)}$$

where:

A = CIE Y_{D65-10} tristimulus value as measured in 10.3

11.2 Average the calculated values from each of the five specimens.

12. Report

12.1 Cite this test method as having been used.

12.2 Report the light source used and whether or not the amount of ultraviolet energy in the spectrophotometer light source has been standardized.

12.3 Report the average light blocking effect for all of the specimens tested.

12.4 Report the number of specimen tested.

12.5 Report the standard deviation for the resultant data.

12.6 Report the temperature and relative humidity during testing.

13. Precision and Bias

13.1 A piece-dyed woven polyester fabric of blue color, designed as a partial light blocking curtain, coated and flocked subsequent to dyeing, was measured ($n=5$) in single, double and triple layers on two different manufacturers' instruments in one lab and on the same type of one manufacturer's instrument in a second lab (see Table I).

To provide more detailed information on single operator, single instrument repeatability and sample size at a 95% confidence level, 30 specimens of the same fabric were measured at Lab 2, with the instrument from Manufacturer A (see Table II).

13.2 Thirty crock squares of 100% cotton plain weave sheeting from the same lot were measured at Lab 1, with the instrument from Manufacturer A (see Table III).

13.3 *Bias.* Light blocking capacity of fabrics by the spectrophotometric method can be defined only in terms of a test method. There is no independent method for determining the true value. As a means of estimating this property, the method has no known bias.

14. Notes and References

14.1 See AATCC EP11, Evaluation Procedure for Spectrophotometer UV Energy Calibration Procedure for Optically Brightened Textiles, as included in the AATCC *Manual of International Test Methods and Procedures*, for details regarding ultraviolet energy standardization of spectrophotometer light sources. EP11 is available from AATCC, P.O. Box 12215, Research Triangle Park NC 27709; tel: +1.919.549.8141; fax: +1.919.549.8933; email: ordering@aatcc.org; web site: www.aatcc.org.

15. History

15.1 Revised in 2021 for clarity and to add history section per the AATCC style guide.

15.2 Revised in 2016.

15.3 Developed in 2014 by AATCC Committee RA36.