

Test Method for Light Blocking Effect of Textiles and Related Materials: Photodetector

Foreword

AATCC TM148-1989, Light Blocking Effect of Curtain Materials, was discontinued in 1994. During the time of its discontinuance, the need for a method to measure this property continued. The method has now been rewritten and retitled for reactivation, in parallel with an alternative method using a standard laboratory sphere spectrophotometer used in transmission mode (see AATCC TM203, Test Method for Light Blocking Effect of Textiles: Spectrophotometric). The two methods are not equivalent (see 14.1).

1. Purpose and Scope

1.1 The test method measures the light blocking properties of textile and related materials using a photometer.

1.2 This method is applicable to all types of fabrics, including coated textiles and other textile-based constructions.

2. Principle

2.1 By measuring the amount of light from a test lamp, and the amount of light from the same lamp transmitted through a test material, the percent of light blocked by the material is determined. This represents the material's light blocking effect.

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** *n.*—electromagnetic radiation weighted by the luminosity function of the human eye.

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

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

3.5 **photometer**, *n.*—an instrument used for measuring light

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

3.7 **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 materials 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 safety glasses 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 The results may depend on the specific light source used in the instrument. This is quoted as part of the report.

5.2 For materials of high light blocking effect, the method is limited by the ability of the system to measure very small amounts of light, in turn depending on the sensitivity of the instrument, together with the output of the light source used (see 14.3).

5.3 The test measures non-diffuse transmission through the material under test. It is designed to exclude diffuse transmission (scattered light) (see 14.1).

6. Calibration

6.1 The measurement is of an SI-based quantity (lux), and the instrument should be calibrated to traceable standards at intervals recommended by the manufacturer, typically on an annual basis.

7. Apparatus

7.1 The apparatus (see Fig. 1) consists of a rectilinear box constructed of light-impermeable materials with internal dimensions of 360 ± 20 mm high, 280 ± 20 mm wide, and 200 ± 20 mm deep with matte black internal surfaces. On one side is a circular opening of dimensions to fit the sensor of a photometer with a clamp to hold the sensor in place at the internal surface of the box. Directly opposite is a circular opening 50 ± 3 mm in diameter. A sliding shutter of opaque material allows this opening to be completely blocked. Magnetic bars provide a convenient means of clamping a fabric speci-

men in close contact with the outside wall of the opening, but other means of fixing a specimen against the opening may be used. A lamp housed within a metal reflector is mounted so that it is aligned with the two holes in the box. The distance from the lamp to the surface of the test fabric is 300 mm. To accommodate different lamps, it is convenient to have the housing mounted on a track so that the distance to the specimen can remain constant.

8. Test Specimens

8.1 For a (purportedly) evenly-blocking material, cut or mark three representative test specimens from the sample. Do not take specimens from within 10% of the width from the selvage or machine edge of the fabric.

8.2 If testing a complete curtain or roll of fabric, test three locations across the width.

8.3 If testing reveals that the transmission characteristics vary excessively between specimens, even if not obvious to the eye, increase the number of specimens (see section 11 and 14.2).

8.4 Materials with small-scale (less than the 50 mm size of the specimen exposed) variation in transmission characteristics (based on fabric structure, or printed decoration, for example) may require additional specimens to be cut.

8.5 Materials with large (greater than the 50 mm size of the specimens exposed) repeats of varying transmission characteristics may have the light blocking effect of each area measured separately.

8.6 Include sampling information in the test report.

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 for at least 4 h 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.

9.2 Perform all tests in the standard atmosphere for testing. Alternatively, conditions of testing may be adjusted to correspond to conditions of use. Report the use of alternative test conditions.

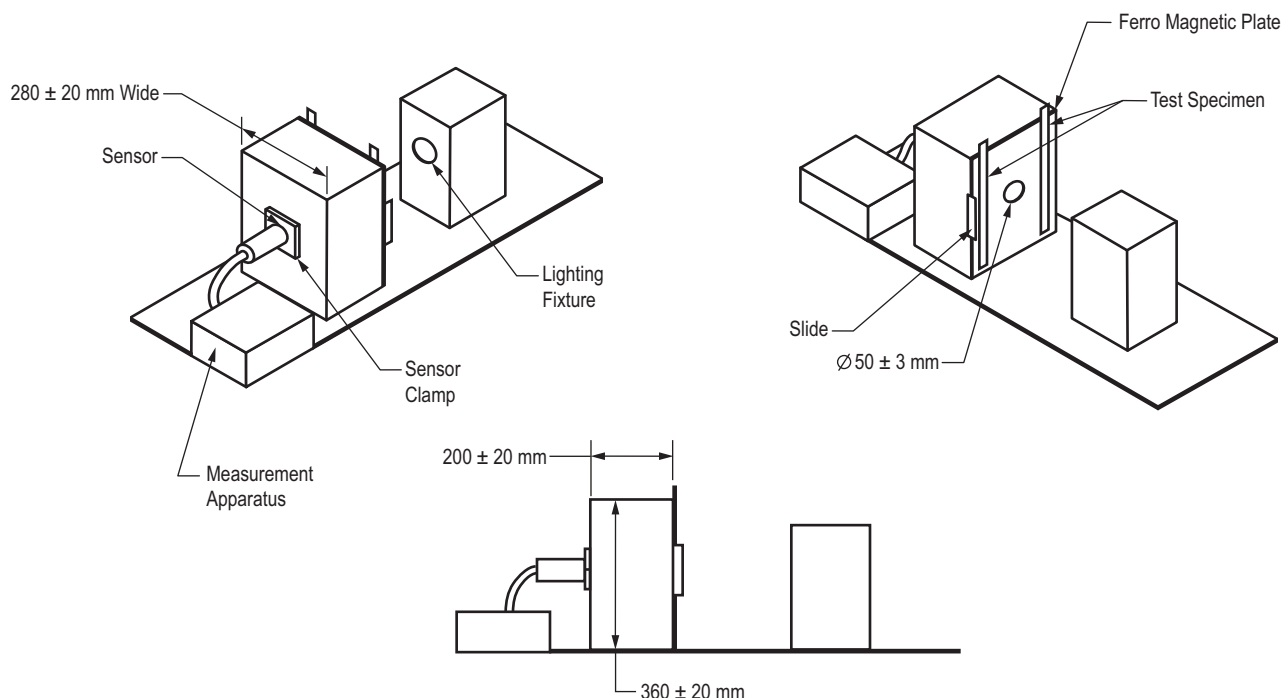


Fig. 1—Photometer

10. Procedure

10.1 Mount light source, box and photometer in a room with consistent and low ambient light (see 14.1). Close the slider over the specimen port.

10.2 Turn on the light source. Allow light to warm up to constant output.

10.3 Zero the instrument. This will take account of any ambient light, which should be low, and held constant while measurements are taken.

10.4 Adjust the instrument sensitivity (if applicable) to low sensitivity for measurement of high light levels.

10.5 Open the sliding aperture.

10.6 Measure and record the amount of light reaching the photometer (in units of lux, or foot candles) with no material in place ("A").

10.7 Close the sliding aperture.

10.8 Place the test specimen at the specimen aperture and clamp it in place.

10.9. Open the sliding aperture.

10.10 Measure and record the light transmitted by the material ("B") that reaches the photometer. If necessary and applicable, increase the instrument sensitivity to a level appropriate for the amount of light being transmitted.

10.11 Close the aperture, remove the specimen, mount the next specimen, open the aperture and read the transmitted light ("B"). Repeat until all specimens have been measured.

10.12 Repeat the measurement of amount of light reaching the photometer from the test lamp "A" with no material in place as in 9.6.

11. Calculation

11.1 Calculate the average of the two measurements of the amount of light ("A") entering the box from the test lamp (see 10.6 and 10.12)

11.2 Calculate the light blocking by each specimen of the test material by one of the two methods as follows (see 13.6).

11.2.1 Calculate the percentage of light blocked thus:

$$\% \text{ Light Blocked} = 100 \times [1 - (B/A)]$$

where:

B = amount of light transmitted through the specimen reaching the photometer.

A = average amount of light reaching the photometer from the test lamp with no material in place.

or:

11.2.2 Calculate the Absorbance of the material thus:

$$\text{Absorbance} = -\log_{10} (B/A)$$

11.3 Calculate the average % light blocked, or average Absorbance of the three (or more) specimens.

11.4 Calculate the standard deviation of measurements averaged in 10.3.

12. Report

12.1 Cite this test method as having been used.

12.2 Cite the light source: type, wattage, nominal output and measured output ("A" as calculated in 11.1) used in the ap-

paratus.

12.3 Report the average light blocking capacity for all measurements of the specimens tested, either as % light blocked or average Absorbance (see 11.3).

12.4 Report the number of samples/specimens tested.

12.5 Report the standard deviation of the data.

12.6 Report the temperature and humidity conditions of the test.

13. Precision and Bias

13.1 *Precision.* The light blocking effect of several coated fabrics was measured. Three readings at varying positions on the fabrics as described above were recorded by the same operator three times, and by different operators. The precision (95% confidence limits) were analyzed using probability functions outlined in *Handbook of Mathematical Tables*, Richard Burington, McGraw Hill, Library of Congress 63-23531, p358-359 (Table 22).

For single operator consistency:

On 3 different fabrics, Operator #1 had 95% confidence intervals of 99.64300 to 99.66925%, 99.99996 to 99.99999%, and 99.99801% blockages.

For operator to operator consistency:

Two operators were compared on 3 fabrics giving similar results with single operator comparison. Sample B2 gave lower and upper limits of 99.65611 to