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Test Method for Transmittance or Blocking of Erythemally Weighted Ultraviolet Radiation through Fabrics

Foreword

AATCC TM183 may be used in conjunction with two other standards developed by ASTM D13 Textiles to meet voluntary requirements for labeling UV protective clothing or products in the United States. A joint effort by AATCC and ASTM produced *Information and Standards for UV Protective Textiles* including a history of the evolution of the development of UV protection and labeling, the three pertinent standards, and a flow chart to assist with use of the standards to produce a UPF label. Appendix B of this standard is a summary of the methodology for textile UV testing and labeling.

1. Purpose and Scope

1.1 This standard test method is used to determine the ultraviolet radiation transmitted or blocked by textile fabrics intended to be used for UV protection.

1.2 This method provides procedures for measuring this fabric property with specimens in either the dry or wet states.

1.3 Preparation and labeling of products with a UV protection (UPF) value are described in ASTM D6544 and ASTM D6603. Refer to Appendix B for a summary of methodology.

2. Principle

2.1 The transmission of ultraviolet radiation (UVR) through a specimen is measured on a spectrophotometer or spectroradiometer at known wavelength intervals.

2.1.1 The ultraviolet protection factor (UPF) is computed as the ratio of the erythemally weighted ultraviolet radiation (UVR) irradiance at the detector with no specimen to the erythemally weighted UVR irradiance at the detector with a specimen present. A higher UPF indicates more UV protection.

2.1.2 The erythemally weighted UVR irradiance at the detector with no specimen present is equal to the summation between wavelength intervals of the measured spectral irradiance times the relative spectral effectiveness for the relevant erythral action spectra times the UVR weighting function of the appropriate solar radiation spectrum times the appropriate wavelength interval.

2.1.3 The erythemally weighted UVR irradiance at the detector with a specimen

present is equal to the summation between wavelength intervals of the measured spectral irradiance times the relative spectral effectiveness for the relevant erythral action spectrum times the spectral transmittance for the specimen times the wavelength interval.

2.1.4 The percent blocking of UVA and UVB radiation is also calculated.

3. Referenced Documents

3.1 ASTM D1776, Standard Practice for Conditioning and Testing Textiles (see 15.2).

3.2 ASTM D6544 Standard Practice for Preparation of Textiles Prior to Ultraviolet (UV) Transmission Testing (see 15.2).

3.3 ASTM D6603, Standard Specification for Labeling of UV-Protective Textiles (see 15.2).

3.4 ASTM E275, Practice for Describing and Measuring Performance of Ultraviolet, Visible and Near-Infrared Spectrophotometers (see 15.2).

3.5 CIE 106/4-1993, A reference action spectrum for ultraviolet induced erythema in human skin. (see 15.3).

3.6 *Information and Standards for UV Protective Textiles*; AATCC & ASTM International, 2017. (see 15.1).

3.7 Sayre, R. M., et al., "Spectral Comparison of Solar Simulators and Sunlight," *Photodermatol Photoimmunol. Photomed.*, 7, 159-165 (1990).

4. Terminology

4.1 **erythema**, n.—abnormal redness of the skin (sunburn) due to capillary congestion (as in inflammation).

4.2 **percent UV blocking**, n.—100 minus the UV transmittance.

4.3 **percent UV transmittance**, n.—that fraction of the incident ultraviolet radiation that is not reflected or absorbed, but passes through a substance.

4.4 **ultraviolet protection factor (UPF)**, n.—the ratio of the average effective ultraviolet radiation (UVR) irradiance transmitted and calculated through air to the average effective UVR irradiance transmitted and calculated through fabric.

4.5 **ultraviolet radiation**, n.—radiant energy for which the wavelengths of the monochromatic components are smaller than those for visible radiation and more than about 100 nm.

NOTE: The limits of the spectral range of ultraviolet radiation are not well defined and may vary according to the user. Committee E-2.1.2 of the International Commission on Illumination (CIE) distinguishes in the spectral range between 400 and 100 nm:

UVA	315-400 nm
UVB	280-315 nm
UVR	280-400 nm

5. 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. Users MUST consult manufacturers on specific details such as safety data sheets and other recommendations. Consult and follow all applicable OSHA standards and rules.

5.1 Under any circumstances, do not look directly at the equipment and materials that may increase the light source intensity, such as mirrors.

5.2 Follow good laboratory practices. Wear prescribed safety glasses in all laboratory areas.

6. Uses and Limitations

6.1 UV-protective textiles may be worn in such a manner that stretching of the fabric over the shoulders, back, and arms of users will occur. This method can be used to determine the UPF of fabrics in a stretched state; however, there is no standardized technique known to replicate for stretching of specimens during testing.

7. Apparatus and Materials (see 15.4)

7.1 A spectrophotometer or spectroradiometer equipped with an integrating sphere (see Appendix A).

7.2 Filter, Schott Glass UG11 (see 15.5).

7.3 Clear plastic food wrap for use with wet samples (polyvinylidene chloride or polyvinylchloride film).

7.4 AATCC Blotting Paper (see 15.1).

7.5 AATCC Light Transmission Verification Fabric (see 15.1) or in-house fabric with known predictable and repeatable light transmission behavior and a UPF between 15 and 50.