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Transmittance or Blocking of Erythemally Weighted Ultraviolet Radiation through Fabrics

Developed in 1998 by AATCC Committee RA106; reaffirmed 1999, 2000, 2014; revised 2004, 2010.

1. Purpose and Scope

1.1 This standard test method is used to determine the ultraviolet radiation blocked or transmitted 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 The labeling of products with a UV protection (UPF value) is specified in ASTM D6603, Standard Guide for Labeling of UV-Protective Textiles. Refer to Appendix B of AATCC Test Method (TM) 183 for a summary of methodology.

2. Principle

2.1 The transmission of ultraviolet radiation (UV-R) 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 (UV-R) irradiance at the detector with no specimen to the erythemally weighted UV-R irradiance at the detector with a specimen present.

2.1.2 The erythemally weighted UV-R 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 UV-R weighting function of the appropriate solar radiation spectrum times the appropriate wavelength interval.

2.1.3 The erythemally weighted UV-R 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. Terminology

3.1 erythema, *n.*—abnormal redness of the skin (sunburn) due to capillary

congestion (as in inflammation).

3.2 percent UV blocking, *n.*—100 minus the UV transmission.

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

3.4 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) (see 15.4) distinguishes in the spectral range between 400 and 100 nm:

UV-A	315-400 nm
UV-B	280-315 nm
UV-R	280-400 nm

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 on specific details such as material safety data sheets and other manufacturer's recommendations. All OSHA standards and rules must also be consulted and followed.

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

4.2 Good laboratory practices should be followed. Wear prescribed safety glasses in all laboratory areas.

5. Uses and Limitations

5.1 This method can also be used to determine the UPF of fabrics in a stretched state. However, the techniques for stretching the specimens are not part of this method and are addressed in a separate test procedure. It must be noted that stretching the specimens could change the UPF properties.

6. Apparatus and Materials

6.1 A spectrophotometer or spectroradiometer equipped with an integrating sphere (see 15.1 and, for a more complete description of an instrument, Appendix A).

6.2 As indexed in catalogues: Filter, Schott Glass UG11 (see 15.2).

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

6.4 White AATCC Textile Blotting Paper (see 15.5).

7. Instrument Verification and Calibration

7.1 Calibration. Calibrate the spectrophotometer or spectroradiometer according to manufacturer instructions. The use of physical standards are recommended for validating the measurement of spectral transmittance.

7.1.1 When running a wet sample place the plastic wrap over the port and repeat calibration.

7.2 Wavelength scale. Calibrate the wavelength scale of the spectrophotometer or spectroradiometer using the spectral emission lines of an electrical discharge in mercury vapor. The wavelength calibration of a spectrophotometer can be performed using the absorption spectra of a holmium oxide glass filter. Reference wavelengths for both mercury arc emission and holmium oxide absorption are provided in ASTM E275, Standard Practice for Describing and Measuring Performance of Ultraviolet, Visible and Near-Infrared Spectrophotometers.

7.2.1 Transmittance scale. Set the transmittance scale to a 100% value by operating the instrument without a sample in the optical path; therefore, referenced to air. The 0% value can be subsequently verified by fully obstructing the sample beam path with an opaque material. Validate the linearity of the transmittance scale by means of either calibrated neutral density filters or calibrated perforated screens supplied by the instrument manufacturer or standardizing laboratories.

8. Specimens

8.1 Test a minimum of two (2) specimens from each sample for the wet and the dry testing. Cut each specimen at least 50 × 50 mm (2.0 × 2.0 in.) or 50 mm (2.0 in.) in diameter. Avoid distorting the specimen during preparation and handling.