



Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres¹

This standard is issued under the fixed designation E 903; 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.

1. Scope

1.1 This test method covers the measurement of spectral absorptance, reflectance, and transmittance of materials using spectrophotometers equipped with integrating spheres.

1.2 Methods of computing solar weighted properties from the measured spectral values are specified.

1.3 This test method is applicable to materials having both specular and diffuse optical properties. Except for transmitting sheet materials that are inhomogeneous, patterned, or corrugated, this test method is preferred over Test Method E 1084.

1.4 *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:

E 275 Practice for Describing and Measuring Performance of Ultraviolet, Visible, and Near Infrared Spectrophotometers²

E 424 Test Methods for Solar Energy Transmittance and Reflectance (Terrestrial) of Sheet Materials³

E 490 Solar Constant and Air Mass Zero Solar Spectral Irradiance Tables⁴

E 772 Terminology Relating to Solar Energy Conversion³

E 891 Tables for Terrestrial Direct Normal Solar Spectral Irradiance for Air Mass 1.5³

E 1084 Test Method for Solar Transmittance (Terrestrial) of Sheet Materials Using Sunlight³

E 1175 Test Method for Determining Solar or Photopic Reflectance, Transmittance, and Absorptance of Materials Using a Large Diameter Integrating Sphere³

2.2 Other Document:

Federal Test Method Standard No. 141, Method 6101⁵

3. Terminology

3.1 *Definitions*—The following definitions are consistent with Terminology E 772. Additional terms appropriate to this test method are included in Terminology E 772.

3.1.1 *absorptance*, α , n —the ratio of the absorbed radiant flux to the incident radiant flux.

3.1.2 *diffuse*, *adj*—indicates that flux propagates in many directions, as opposed to direct beam, which refers to collimated flux. When referring to reflectance, it is the directional-hemispherical reflectance less the specular reflectance.

3.1.3 *integrating sphere*, n —an optical device used to either collect flux reflected or transmitted from a sample into a hemisphere or to provide isotropic irradiation of a sample from a complete hemisphere. It consists of a cavity that is approximately spherical in shape with apertures for admitting and detecting flux and usually having additional apertures over which sample and reference specimens are placed.

3.1.4 *irradiance*, E , n —a radiometric term for the radiant flux that is incident upon a surface ($\text{W}\cdot\text{m}^{-2}$).

3.1.5 *near normal-hemispherical*, *adj*—indicates irradiance to be directional near normal to the specimen surface and the flux leaving the surface or medium is collected over an entire hemisphere for detection.

3.1.6 *radiant flux*, Φ , n —a radiometric term for the time rate of flow of energy in the form of electromagnetic energy (watts).

3.1.7 *reflectance*, ρ , n —the ratio of the reflected radiant flux to the incident radiant flux.

3.1.8 *solar*, *adj*—(1) referring to radiometric quantities, indicates that the radiant flux involved has the sun as its source, or has the relative spectral distribution of solar flux, and (2) referring to an optical property, indicates a weighted average of the spectral property, with a standard solar spectral irradiance distribution as the weighting function.

3.1.9 *spectral*, *adj*—(1) for dimensionless optical properties, indicating that the property was evaluated at a specific wavelength, λ , within a small wavelength interval, $\Delta\lambda$ about λ , symbol wavelength in parentheses as $L(350\text{ nm})$, or as a

¹ These test methods are under the jurisdiction of ASTM Committee E44 on Solar, Geothermal, and Other Alternative Energy Sources and is the direct responsibility of Subcommittee E44.05 on Solar Heating and Cooling Subsystems and Systems.

Current edition approved April 10, 1996. Published May 1996. Originally published as E 903 – 82. Last previous edition E 903 – 82 (1992) ϵ^1 .

² *Annual Book of ASTM Standards*, Vol 03.06.

³ *Annual Book of ASTM Standards*, Vol 12.02.

⁴ *Annual Book of ASTM Standards*, Vol 14.02.

⁵ Available from Standardization Documents, Order Desk, Building 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5049, Attn: NPODS.