ASHRAE STANDARD

Method of Measuring Solar-Optical Properties of Materials

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AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

1791 Tullie Circle, NE · Atlanta, GA 30329

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CONTENTS

This Foreword is not part of this Standard but is provided for information purposes only.

FOREWORD

The purpose of this Standard is to describe a method for measuring and reporting the solar optical properties of sheet-like materials. These properties include spectral transmittance, reflectance, and absorptance for wavelengths between 320 and 3000 nanometers and total radiant and luminous transmittance and reflectance. This Standard falls under the Standards Committee classification of standard method of measurement for test.

This Standard is a revision of the standard originally published in 1973. The principal changes incorporated in the revision of this Standard are associated with the addition of a method to determine the luminous (photometric) transmittance, reflectance, and absorptance of sheet materials. Also, more detailed information has been added to improve the accuracy and repeatability of the measurement procedures. These revisions were necessary to respond to increased interest in the daylighting performance of sheet materials and improvements in sensing elements used for tests.

1. PURPOSE

1.1 To develop a standard method for measuring and reporting the following solar optical properties of materials: spectral transmittance, reflectance, and absorptance between 320 nm and 3000 nm in wavelength, and total radiant and luminous transmittance and reflectance.

2. SCOPE

2.1 Procedure A of this method covers the measurment of spectral absorptance, reflectance, and transmittance of materials using spectrophotometers equipped with integrating spheres. Procedure C of this method covers the measurement of solar transmittance (terrestrial) of materials using a pyranometer, and enclosure, and the sun and sky as the source of radiation.

2.2 Methods of computing solar-weighted radiant and luminous properties from the measured spectral values are specified in procedures A and B, which are applicable to materials having both specular and diffuse optical properties. Except for transmitting sheet materials that are inhomogeneous, patterned, or corrugated, procedures A and B of this method are preferred over procedures C, D, and E.

2.3 Procedure B describes the calculation of luminous (photometric) transmittance and reflectance of materials from spectral radiant transmittance and reflectance data, or both, obtained from the performance of Procedure A of this method.

2.4 Procedure C of this method allows measurement of solar transmittance of materials in sheet form at normal incidence and at angles other than normal incidence and is applicable to transparent, translucent, textured, or patterned sheet materials.

2.5 Procedure D of this method covers the measurement of solar photometric transmittance of materials in sheet form. Solar photometric transmittance is measured using a photometer (illuminance meter) in an enclosure with the sun and sky as the source of radiation, the enclosure and method of test being specified in Procedure C. The purpose of Procedure D is to specify a photometric sensor to be used with Procedure C for measuring the solar photometric transmittance of sheet materials containing inhomogeneities in their optical properties.

2.6 Procedure E covers the measurement of the solar radiant and luminous reflectances at normal incidence, and at other angles, of sheet materials that are opaque and which may also be textured or patterned.

3. DEFINITIONS

radiant flux Φ**:** the time rate of flow of radiant energy (watts).

radiance at a point of a surface, $E_s = d\Phi/dA$**:** the quotient of the flux incident on in element of a surface containing the point, by the area of that element, measured in watts per square meter (W/m^2).

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 parenthesis, as L(350 nm), or is a function of wavelength, symbol $L(\lambda)$. (2) For a radiometric quantity, the concentration of the quantity per unit wavelength or frequency, indicated by the subscript lambda, as $L_\lambda = dL/d\lambda$ at a specific wavelength. The wavelength at which the spectral concentration is evaluated may be indicated by the wavelength in parenthesis following the symbol, L_λ (350 nm). *Note:* Standard solar spectral irradiance distributions generally lie within the wavelength range from 300 to 3000 nm.

solar (adj.): (1) Referring to photometric or radiometric quantities, indicates that the flux involved has the sun as a source or as characteristic of the sun. (2) Referring to an optical property, indicates a weighted average of the spectral optical property, with a standard solar spectral irradiance distribution used as the weighting function.

luminous (photometric) (adj.): Referring to a radiometric quantity, luminous indicates the weighted average of the spectral radiometric quantity, with the product of the photopic spectral luminous efficiency function[1] and the standard solar spectral irradiance distribution[2] being the weighting function.

illuminance: luminous (or photometric) irradiance

absorptance, α**:** the ratio of the absorbed radiant flux to the incident radiant flux.

radiant (or luminous) reflectance, ρ**:** the ratio of the reflected radiant (or luminous) flux to the incident radiant (or luminous) flux.

radiant (or luminous) transmittance, τ**:** the ratio of the transmitted radiant (or luminous) flux to the incident radiant flux.

*National Bureau of Standards (NBS) changed its name to National Institute of Standards and Technology.