

Abstract

- NREL leads and contributes to the development of radiometric standards and associated best practices through the American Society for Testing Materials (ASTM) International and others, such as the International Energy Agency (IEA) and International Organization for Standardization (ISO).
- Development of best practices and consensus standards in solar measurement enables industry to develop widely accepted protocols for various stages of solar project development and operations. This reduces barriers to seeking financing and reduces warranty costs.
- These standards and best practices play an essential role in all aspects of weathering and durability, including standard conditions, methods and instrumentation, accelerated testing, and service lifetime of materials systems.

Standard Organization

ASTM G03 → Weathering and Durability

Promote knowledge, stimulate research in:

- Durability and performance of materials, components, and assemblies
- Nomenclature, standard conditions, calibration, methods, as well as instrumentation, natural and accelerated weathering exposure, and service life testing.

ASTM E44 → Solar, Geothermal and Alternative Energy

- Solar heating and cooling systems and materials
- Photovoltaic electric power conversion
- Geothermal field development, utilization, and materials
- Optical materials for solar applications
- Heat metering.

International Energy Agency Photovoltaic Power Systems Programme Task 16

NREL leads the IEA Photovoltaic Power Systems Programme Task 16: Subtask 1, which focuses on the evaluation of current and emerging resource assessment methodologies.

The subtask covers three areas:

- Ground-based methods
- Numerical weather prediction models
- Satellite-based methods.

Fig. 1. Best Practices Handbook published in collaboration with IEA.

CIE: International Lighting Commission

- Science and art of light and lighting, color and vision, and image technology
- Recognized by ISO as an international standardization body.

ISO/TC 180/SC 1 Climate - Measurement and data

- Calibration and specification of radiometers
- Development of reference spectral irradiance
- Radiometers recommended practice for use.

Standards

Recent Standards

- ISO 9060:2018 Solar energy: Specification and classification of instruments for measuring hemispherical solar and direct solar radiation
- ASTM G213-17: Standard Guide for Evaluating Uncertainty in Calibration and Field Measurements of Broadband Irradiance with Pyranometers and Pyrhemimeters
- ASTM G214-16: Test Method for the Integration of Digital Spectral Data for Weathering and Durability Applications

Proposed New Standards

- [WK38983](#): New Guide for Performance Classification of Solar Radiometers
- [WK57619](#): Obtaining Irradiance at the Specimen Plane in Artificial Accelerated Weathering Apparatus
- [WK57714](#): Estimation of UV Irradiance Received by Samples as a Function of Location, Orientation, and Tilt

Relevant ASTM G03 Standards:

- E816-15 Standard Test Method for Calibration of Pyrhemimeters by Comparison to Reference Pyrhemimeters
- G130-12 Standard Test Method for Calibration of Narrow- and Broad-Band Ultraviolet Radiometers Using a Spectroradiometer
- G138-12 Standard Test Method for Calibration of a Spectroradiometer Using a Standard Source of Irradiance
- G167-15 Standard Test Method for Calibration of a Pyranometer Using a Pyrhemimeter
- G173-03(2012) Standard Tables for Reference Solar Spectral Irradiances: Direct Normal and Hemispherical on 37° Tilted Surface
- G183-15 Standard Practice for Field Use of Pyranometers, Pyrhemimeters, and UV Radiometers

Relevant ASTM E44 Standards

- E424-71(2015) Standard Test Methods for Solar Energy Transmittance and Reflectance (Terrestrial) of Sheet Materials
- E972-96(2013) Standard Test Method for Solar Photometric Transmittance of Sheet Materials Using Sunlight
- E1084-86(2015) Standard Test Method for Solar Transmittance (Terrestrial) of Sheet Materials Using Sunlight
- E1175-87(2015) Standard Test Method for Determining Solar or Photopic Reflectance, Transmittance, and Absorptance of Materials Using a Large Diameter Integrating Sphere

ISO/TC 180/SC 1

- ISO 9059:1990 Solar energy -- Calibration of field pyrhemimeters by comparison to a reference pyrhemimeter
- ISO 9845-1:1992 Solar energy -- Reference solar spectral irradiance at the ground at different receiving conditions -- Part 1: Direct normal and hemispherical solar irradiance for air mass 1,5
- ISO 9846:1993 Solar energy -- Calibration of a pyranometer using a pyrhemimeter
- ISO 9847:1992 Solar energy -- Calibration of field pyranometers by comparison to a reference pyranometer
- ISO/TR 9901:1990 Solar energy -- Field pyranometers -- Recommended practice for use
- ISO 9060:2018 Solar energy -- Specification and classification of instruments for measuring

CIE TC 2-88: Standard Reference Solar Spectra for Industrial Applications

Solar Spectral Irradiance that includes increased sampling intervals based on explicit meteorological input parameters for the SMARTS 2.9.5 model.



Fig. 2. Standards and best practices activities and associations