

SEMI PV77-0817 (Reapproved 0922) GUIDE FOR CALIBRATION OF PHOTOVOLTAIC (PV) MODULE UV TEST CHAMBERS

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NOTICE: The section symbol (§) is used to reference a numbered section, paragraph, or header and all subordinate paragraphs, headers, and embedded material (i.e., EXCEPTIONS, lists) therein. The paragraph symbol (§) is used to reference a particular numbered paragraph and embedded material therein. When duplicated (i.e., §§ and §§§) the symbols are used to reference more than one section or paragraph, respectively.

1 Purpose

1.1 This Standard is intended to provide guidance for the calibration of photovoltaic (PV) module UV test chambers.

2 Scope

2.1 This Standard provides the calibration method of UV spectral distribution, UV irradiance, nonuniformity of UV irradiance and temperature deviation for PV module UV test chambers.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Limitations

3.1 This Standard applies only to the calibration of the UV test chambers intended to conduct UV precondition test or UV accelerating aging test for PV modules.

4 Reference Standards and Documents

4.1 ISO® Standards¹

ISO 9370 — Plastics – Instrumental Determination of Radiant Exposure in Weathering Tests – General Guidance and Basic Test Method

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 Refer to the SEMI Standards Compilation of Terms (COTS) for a list of the current Abbreviations, Acronyms, Definitions, and Symbols.

5.2 Definitions

5.2.1 *PV module UV test chamber* — an enclosure that reproduces the UV part of natural sunlight in order to verify the ability of the PV modules to resist UV radiation.

5.2.2 *temperature deviation* — deviation between the indicated temperature of the UV test chamber and the measured temperature at the geometric center inside the UV test chamber, calculated by:

$$\Delta t = t_d - t_0 \quad (1)$$

where:

Δt = the temperature deviation,

¹ International Organization for Standardization, ISO Central Secretariat, Chemin de Blandonnet 8, CP 401-1214 Vernier, Geneva, Switzerland; Telephone: +41.22.749.01.11, Fax: +41.22.733.34.30, <http://www.iso.org>. ISO trademark is owned by International Organization for Standardization.

t_d = the average of the indicated temperature of the UV test chamber, and

t_0 = the average of measured temperature at the geometric center inside the UV test chamber.

5.2.3 UV irradiance — radiant flux received by a surface of unit area during a unit period of time, covering the wavelength of 280 to 400 nm.

5.2.4 UV irradiance non-uniformity — spatial inconsistency of the UV irradiance on the designated test plane is calculated by:

$$\text{UV irradiance non-uniformity} = \frac{(\text{max. UV irradiance} - \text{min. UV irradiance})}{(\text{max. UV irradiance} + \text{min. UV irradiance})} \times 100\% \quad (2)$$

where, max. UV irradiance and min. UV irradiance are the maximum UV irradiance and the minimum UV irradiance measured on the designated test plane respectively.

5.2.5 UV spectral distribution — UV spectral distribution falls within the wavelength range specified in § 5.2.3. UVA spectral is within 320 to 400 nm. UVB spectral is within 280 to 320 nm.

6 Calibration Methods

6.1 Calibration Conditions

6.1.1 Temperature Inside of the UV Test Chamber — 60°C.

6.1.2 The actual UV irradiance on the designated test plane inside the UV test chamber: not higher than 250 W/m².

6.1.3 Preparation: For reaching a stable condition, warm up the light source for at least 30 minutes after being lit up.

6.1.4 Other conditions: The fluctuation of the mains may fulfill the operation requirement of the UV test chamber and the calibration equipment. There should not be any electromagnetic field or mechanical vibration influencing the operation of the UV test chamber and calibration equipment. There should not be any stray light that affects the measurement of the irradiance and spectral distribution.

6.2 Calibration Equipment

6.2.1 UV Radiometer

6.2.1.1 UV radiometers with rated operating temperature higher than 65°C are preferable. The standard light source used in calibration for the UV radiometer is suggested to be of the same type of the light source in the UV test chamber. Refer to ISO 9370 for other technical requirements.

6.2.2 Spectrometer

6.2.2.1 Technical requirements for the spectrometer are: minimum measurement range: 250 to 800 nm; wavelength measurement error ≤1 nm; wavelength resolution ≤1 nm; sampling interval ≤1 nm. Refer to ISO 9370 for other technical requirements.

6.2.3 Temperature Measurement Equipment

6.2.3.1 Temperature measurement equipment consists of temperature sensor(s) and indicator. The time constant is suggested to be ≤15 seconds while the measurement accuracy of the measurement equipment less than or equal to ±0.2°C.

6.3 Calibration Items and Calibration Methods

6.3.1 Spectral Distribution of the UV Irradiance

6.3.1.1 Place the detector of the spectrometer onto the geometric center of the designated test plane towards the direction of the UV irradiance. The spectral distribution measurement is suggested covering at least the wavelength range of 250 to 400 nm. The sampling interval of the spectrometer could not be wider than 1 nm. Integration time should be selected to properly accommodate the characteristics of the UV light source. A fiber with anti-UV protection is strongly recommended to be used as a coupler; therefore, the spectrometer would be able to be placed out of the UV test chamber in order to avoid heat hazardous.