



# Standard Test Method for Electrical Performance of Concentrator Terrestrial Photovoltaic Modules and Systems Under Natural Sunlight<sup>1</sup>

This standard is issued under the fixed designation E2527; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method covers the determination of the electrical performance of photovoltaic concentrator modules and systems under natural sunlight using a normal incidence pyrheliometer.

1.2 The test method is limited to module assemblies and systems where the geometric concentration ratio specified by the manufacturer is greater than 5.

1.3 This test method applies to concentrators that use passive cooling where the cell temperature is related to the air temperature.

1.4 Measurements under a variety of conditions are allowed; results are reported under a select set of concentrator reporting conditions to facilitate comparison of results.

1.5 This test method applies only to concentrator terrestrial modules and systems.

1.6 This test method assumes that the module or system electrical performance characteristics do not change during the period of test.

1.7 The performance rating determined by this test method applies only at the period of the test, and implies no past or future performance level.

1.8 *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:<sup>2</sup>

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee E44 on Solar, Geothermal and Other Alternative Energy Sources and is the direct responsibility of Subcommittee E44.09 on Photovoltaic Electric Power Conversion.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- D6176 Practice for Measuring Surface Atmospheric Temperature with Electrical Resistance Temperature Sensors
- E772 Terminology of Solar Energy Conversion
- E816 Test Method for Calibration of Pyrheliometers by Comparison to Reference Pyrheliometers
- E1036 Test Methods for Electrical Performance of Nonconcentrator Terrestrial Photovoltaic Modules and Arrays Using Reference Cells

### 2.2 IEEE Standard:

- IEEE 929-2000 Recommended Practice for Utility Interface of Photovoltaic (PV) Power Systems

## 3. Terminology

3.1 *Definitions*—Definitions of terms used in this test method may be found in Terminology E772, and IEEE Standard 929.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *Concentrator Reporting Conditions, n*—the ambient temperature, wind speed, and direct normal solar irradiance to which concentrator module or system performance data are corrected..

3.2.2 *system, n*—a photovoltaic module or array connected to an inverter.

3.3 *Symbols*:The following symbols and units are used in this test method:

- $E$  = direct normal irradiance,  $\text{Wm}^{-2}$
- $E_o$  = reporting direct normal irradiance of  $850 \text{ Wm}^{-2}$
- $P$  = maximum power, W
- $P_o$  = maximum power at concentrator reporting conditions ( $E_o$ ,  $T_o$ , and  $V_o$ ), W
- $T_a$  = ambient temperature,  $^{\circ}\text{C}$
- $T_o$  = reporting ambient temperature of  $20^{\circ}\text{C}$
- $v$  = wind speed,  $\text{ms}^{-1}$
- $v_o$  = reporting wind speed of  $4 \text{ ms}^{-1}$

## 4. Summary of Test Method

4.1 Determining the performance of a photovoltaic module or system under natural sunlight consists of measuring the maximum power over a range of irradiance and air temperature.