



Standard Test Methods for Photovoltaic Modules in Cyclic Temperature and Humidity Environments¹

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1. Scope

1.1 These test methods provide procedures for determining the ability of photovoltaic modules to withstand simulated temperature and humidity environments. Environmental testing is used to simulate aging of module materials on an accelerated basis.

1.2 Three individual environmental test procedures are defined by these test methods: a thermal cycling procedure, a humidity-freeze cycling procedure, and an extended duration damp heat procedure.

1.3 These test methods define mounting methods for modules undergoing environmental testing, and specify parameters that must be recorded and reported.

1.4 These test methods do not establish pass or fail levels. The determination of acceptable or unacceptable results is beyond the scope of these test methods.

1.5 Any of the individual environmental tests may be performed singly, or may be combined into a test sequence with other environmental or non-environmental tests, or both. Certain pre-conditioning tests such as annealing or light soaking may also be necessary or desirable as part of such a sequence. The determination of any such sequencing and pre-conditioning is beyond the scope of this test method.

1.6 There is no similar or equivalent ISO standard.

1.7 *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 772 Terminology Relating to Solar Energy Conversion²
- E 1036 Methods of Testing Electrical Performance of Non-concentrator Terrestrial Photovoltaic Modules and Arrays Using Reference Cells²
- E 1328 Terminology Relating to Photovoltaic Solar Energy Conversion²

¹ This test method is under the jurisdiction of ASTM Committee E-44 on Solar, Geothermal, and Other Alternative Energy Sources and is the direct responsibility of Subcommittee E44.09 on Photovoltaic Electrical Power Systems.

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² *Annual Book of ASTM Standards*, Vol 12.02.

E 1462 Test Methods for Insulation Integrity and Ground Path Continuity of Photovoltaic Modules²

E 1799 Practice for Visual Inspections of Photovoltaic Modules²

E 1830M Test Methods for Determining the Mechanical Integrity of Photovoltaic Modules²

3. Terminology

3.1 *Definitions*—definitions of terms used in this standard may be found in Terminology E 772 and in Terminology E 1328.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *ground fault*—a module fault where any portion of the module circuitry between the output terminals becomes electrically connected to the module grounding point.

3.2.2 *open circuit*—a module fault where any portion of the module circuitry between the output terminals becomes electrically discontinuous.

4. Significance and Use

4.1 The useful life of photovoltaic modules may depend on their ability to withstand repeated temperature cycling with varying amounts of moisture in the air. These test methods provide procedures for simulating the effects of cyclic temperature and humidity environments. An extended duration damp heat procedure is provided to simulate the effects of long term exposure to high humidity.

4.2 These test methods describe procedures for mounting test modules, conducting the environmental tests, and reporting the results.

4.2.1 Test modules are mounted so that they are electrically isolated from each other, and in such a manner to allow free air circulation around the front and back surfaces of the modules.

4.3 Data generated using these test methods may be used to evaluate and compare the effects of simulated environment on test specimens. These test methods require determination of both visible effects and electrical performance effects.

4.3.1 Effects on modules may vary from none to significant changes. Some physical changes in the module may be visible when there are no apparent electrical changes in the module. Similarly, electrical changes may occur with no visible changes in the module.

4.3.2 All conditions of measurement, effects of cycling, and any deviations from this test method must be described in the