



## Test Method for Wet Insulation Integrity Testing of Photovoltaic Arrays<sup>1</sup>

This standard is issued under the fixed designation E 2047; 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 a procedure to determine the insulation resistance of a photovoltaic (PV) array (or its component strings), that is, the electrical resistance between the array's internal electrical components and is exposed, electrically conductive, non-current carrying parts and surfaces of the array.

1.2 This test method does not establish pass or fail levels. The determination of acceptable or unacceptable results is beyond the scope of this test method.

1.3 There is no similar or equivalent ISO standard.

1.4 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 *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 Conversion<sup>2</sup>

E 1328 Terminology Relating to Photovoltaic Solar Energy Conversion<sup>2</sup>

E 1462 Standard Test Methods for Insulation Integrity and Ground Path Continuity of Photovoltaic Modules<sup>2</sup>

### 3. Terminology

3.1 *Definitions*—Definitions of terms used in this test method may be found in Terminologies E 772 and E 1328.

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

3.2.1 *insulation resistance, n*—the electrical resistance of a photovoltaic array's insulation, measured between the photo-

voltic circuit and exposed, electrically conductive non-current-carrying parts and surfaces of the array.

3.2.2 *metal oxide varistor MOV, n*—a surge protection device.

3.2.3 *photovoltaic circuit*—the active electrical circuit that conducts the photovoltaic generated power.

### 4. Summary of Test Method

4.1 A procedure is provided for testing the electrical isolation between the array's internal electrical components and its exposed, electrically conductive, non-current carrying parts and surfaces of the array.

4.2 The procedure offers two ways to connect the array during the test, either open-circuited or short-circuited. Each option has advantages and disadvantages (see 5.5).

4.3 A wetting solution is applied to the array, then a voltage is applied between the PV circuit and the exposed, electrically conductive, non-current carrying parts and surfaces of the array, while monitoring the current or resistance, to find localized regions where the insulation resistance is significantly reduced by the wetting solution. The array is then inspected for evidence of possible arcing.

### 5. Significance and Use

5.1 The design of a PV module or system intended to provide safe conversion of the sun's radiant energy into useful electricity must take into consideration the possibility of hazard should the user come into contact with the electrical potential of the array. In addition, the insulation system provides a barrier to electrochemical corrosion, and insulation flaws can result in increased corrosion and reliability problems. This test method describes a procedure for verifying that the design and construction of the array provides adequate electrical isolation through normal installation and use. At no location on the array should the PV-generated electrical potential be accessible, with the obvious exception of the output leads. The isolation is necessary to provide for safe and reliable installation, use, and service of the PV system.

5.2 This test method describes a procedure for determining the ability of the array to provide protection from electrical hazards. Its primary use is to find insulation flaws that could be dangerous to persons who may come into contact with the array. Corrective action taken to address such flaws is beyond the scope of this test method.

<sup>1</sup> 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 Conversion.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 12.02.