

SEMI PV72-0316

TEST METHOD TO EVALUATE AN ACCELERATED THERMO HUMIDITY RESISTANCE OF PHOTOVOLTAIC (PV) ENCAPSULATION

This Standard was technically approved by the Photovoltaic Global Technical Committee. This edition was approved for publication by the global Audits and Reviews Subcommittee on December 4, 2016. Available at www.semiviews.org and www.semi.org in March 2016.

1 Purpose

1.1 The purpose of this Standard is to standardize the accelerated evaluation method for moisture resistance of photovoltaic (PV) encapsulation. The test is performed with designed mini modules in a pressure cooker with moisture condensing or moisture saturated steam environments.

1.2 Compared with damp heat (DH) tests, a pressure cooker test (PCT) is a highly accelerated test which employs high pressure, humidity and temperature under condensing conditions to accelerate moisture penetration into laminated mini modules.

1.3 PV encapsulant suppliers, PV module manufacturers and buyers, or any other interested party, can thus have common standards to quickly test and select PV encapsulation materials for PV modules.

2 Scope

2.1 This Test Method applies primarily to evaluate moisture and temperature resistance of the encapsulation.

2.2 This Test Method is used to evaluate the performance of PV encapsulation. The PV encapsulation includes lamination properties and encapsulated materials used in in PV modules such as ethylene vinyl acetate (EVA), backsheets or any other materials that protect crystalline Si cells in PV modules.

2.3 Some cautions should be considered when performing this test and evaluating test results. Failure mechanisms, both internal (e.g., due to embrittlement of polyethylene terephthalate (PET) and external (e.g., moisture ingress from a non-sealed edge), may be produced which are not applicable to the intended application use conditions.

2.4 This Standard defines the specific structure of PV encapsulant samples for different failure mode evaluation.

2.5 This Standard defines the specific testing methods, testing conditions and evaluation method for PV encapsulation.

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 does not predict the lifetime of PV modules.

3.2 This Standard is not designed to completely simulate an extended damp heat test.

4 Referenced Standards and Documents

4.1 IEC Standards¹

IEC 61215 — Crystalline Silicon Terrestrial Photovoltaic (PV) Modules – Design Qualification and Type Approval

4.2 JEDEC Standard²

JESD22-A102-C — Accelerated Moisture Resistance – Unbiased Autoclave

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

¹ International Electrotechnical Commission, 3 rue de Varembe, Case Postale 131, CH-1211 Geneva 20, Switzerland; Telephone: 41.22.919.02.11, Fax: 41.22.919.03.00, <http://www.iec.ch>

² Joint Electron Device Engineering Council, 3103 North 10th Street, Suite 240-S, Arlington, VA 22201, USA; Telephone: 703.907.7560, Fax: 703.907.7583, <http://www.jedec.org>

5 Terminology

5.1 Abbreviations and Acronyms

5.1.1 *DH* — damp heat

5.1.2 *EL* — electroluminescence

5.1.3 *EVA* — ethylene vinyl acetate

5.1.4 *HAST* — high accelerated stressed test

5.1.5 *I-V* — current-voltage

5.1.6 *PCT* — pressure cooker test

5.1.7 *PET* — polyethylene terephthalate

5.1.8 *Si* — silicon

5.2 Symbols

5.2.1 *I* — current (A)

5.2.2 *V* — voltage

5.2.3 *T* — temperature (°C)

5.2.4 *E* — irradiance ($\text{W} \cdot \text{m}^{-2}$)

5.2.5 P_{max} — maximum power (W)

5.2.6 V_{oc} — open-circuit voltage

6 Sample Preparation

6.1 In order to evaluate power degradation caused by aged encapsulation, mini modules with Si-cells are needed. Figure 1 shows the layup of a single-cell laminate. Figure 2 shows a schematic view of laminated mini modules sealed with aluminum foil tapes. For each test with different encapsulation conditions (different materials or lamination processes), three samples are required, one for reference and the others for testing.

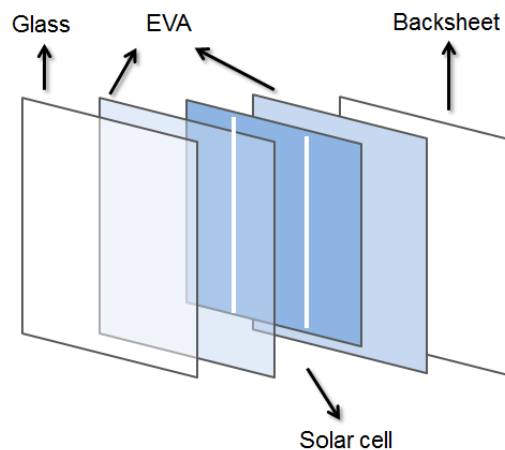


Figure 1
Schematic Layup of a Single-Cell Laminate

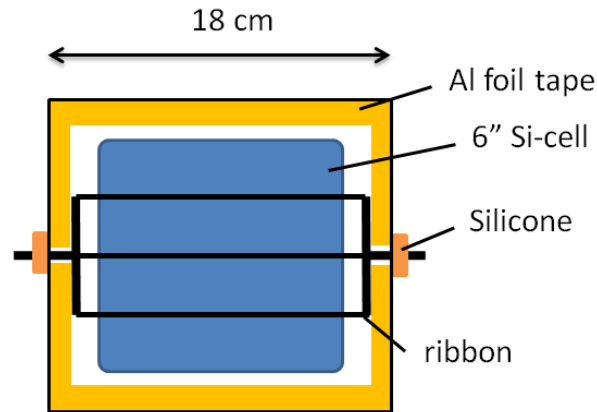


Figure 2
Schematic View of a Laminated Mini Module Wrapped with Aluminum Foil

7 Procedure

7.1 The measured performance result of a PCT for PV modules is highly responsive to the encapsulated method of the mini-modules. A reasonable evaluation result requires the same encapsulated method as shown in § 6. The details of the current-voltage (IV) and electroluminescence (EL) measurement after PCT should be clearly described in the report. Figure 4 is the testing procedure for a PCT test.

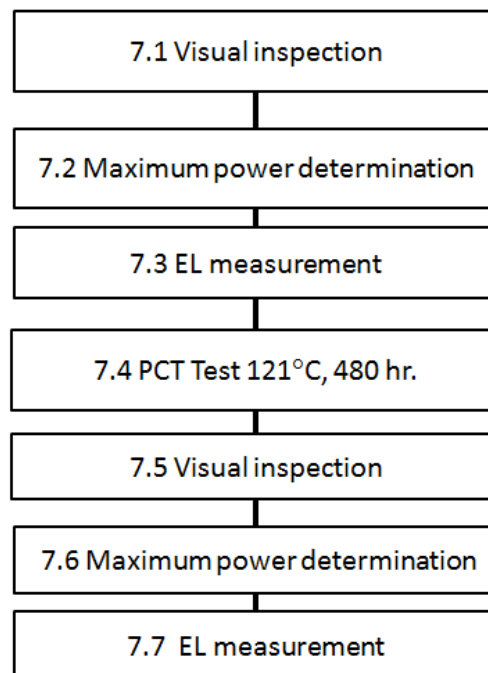


Figure 3
Testing Procedure

7.2 Visual Inspection

7.2.1 Visually inspect the modules to detect any visual defects in the module according to IEC 61215.