

SEMI PV92-0120

TEST METHOD FOR EXTENSION OF FLEXIBLE THIN FILM PHOTOVOLTAIC (PV) MODULES

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1 Purpose

1.1 This Standard provides a test method to assess extension performance of flexible thin-film photovoltaic (PV) module.

2 Scope

2.1 This Standard specifies apparatus, specimens, test procedures, requirements and test report of tensile test for flexible thin-film PV modules.

2.2 This Standard is applicable only for flexible thin-film PV modules.

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 Referenced Standards and Documents

3.1 IEC Standards¹

IEC 60904-3 — Photovoltaic Devices – Part 3: Measurement Principles for Terrestrial Photovoltaic (PV) Solar Devices with Reference Spectral Irradiance Data

IEC 60904-9 — Photovoltaic Devices – Part 9: Solar Simulator Performance Requirements

IEC 61215-1 — Terrestrial Photovoltaic (PV) Modules-Design Qualification and Type Approval – Part 1: Test Requirements

IEC 61215-2 — Terrestrial Photovoltaic (PV) Modules-Design Qualification and Type Approval – Part 2: Test Procedures

IEC TS 60904-12 — Photovoltaic Devices – Part 12: Infrared Thermography of Photovoltaic Modules

IEC TS 60904-13 — Photovoltaic Devices – Part 13: Electroluminescence of Photovoltaic Modules

IEC TS 62782 — Photovoltaic (PV) Modules – Cyclic (Dynamic) Mechanical Load Testing

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

4 Terminology

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

4.2 Abbreviations and Acronyms

4.2.1 *STC* — standard test condition (according to IEC 60904-3)

4.3 Definitions

4.3.1 *flexible thin-film photovoltaic module* — thin-film photovoltaic module that is designed to be intentionally and repetitively twisted, curved or otherwise bent without physical, electrical or visual damage.

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>

4.3.2 *speed of testing* — the relative rate of motion of test fixtures during the test, expressed in mm/min.

4.3.3 *tensile stress* — the amount of stress (force per unit area) that causes material to elongate, expressed in MPa.

4.3.4 *long axis of test module* — the line across the center and parallel to the long side of PV module.

5 Summary of Test Method

5.1 The tensile test is undertaken through an equipment which can apply horizontal tensile force to PV module. The failure of a flexible thin-film module is determined by comparing maximum output power, visual inspection, electroluminescence (EL) scan of the module. The insulation function is determined by performing wet leakage current test before and after tensile test. The function of internal diodes is determined by performing an IR scan before and after tensile test.

6 Apparatus

6.1 *A Radiant Source* — Natural sunlight or a class BBA (or better) solar simulator conforming to IEC 60904-9.

6.2 EL equipment with constant current power supply capable of providing 0.1 and 1 times the STC short circuit current of the module in the forward direction. (See IEC TS 60904-13.)

6.3 Infrared camera (IR camera) with constant current power supply capable of providing one and two times the standard test condition (STC) maximum power current of the module in the forward direction. (See IEC TS 60904-12.)

6.4 Means for monitoring the continuity of the internal circuit of each module throughout the test.

6.5 A test machine with constant rate of movement and comprising a fixed member, a movable member and support part, see Figure 1. The fixed member as well as the moveable member carries one fixture respectively. The support part should hold the module horizontally facing up. The tensile force provided should be parallel to one edge of PV modules. The device should extend PV module freely when module is applied an electric current. The installation should not cause any damage to the module.

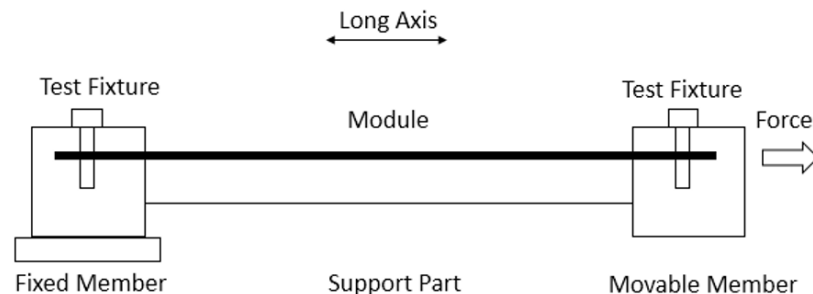


Figure 1
Typical Arrangement for Tensile Property of Flexible Thin-Film PV Module

7 Test Specimens

7.1 Take six modules at random from a production batch or batches with no evidence of major visual defects. Choose one of the six modules as control module to detect drifts.

8 Procedure

8.1 Show the full test flow as Figure 2.

8.2 Perform the following procedure before tensile test.

8.2.1 Measure the width of each module. Width accuracy is of ± 1 mm, repeatability is of ± 0.5 mm.

8.2.2 Measure the thickness of the non-cell area of each module. Thickness accuracy is of ± 0.01 mm, repeatability is of ± 0.005 mm.