



Examination Standard for Ground-Mounted or Elevated Photovoltaic Module Systems

Class Number 4480

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Foreword

This standard is intended to verify that the products and services described will meet stated conditions of performance, safety, and quality useful to the ends of property conservation. The purpose of this standard is to present the criteria for examination of various types of products and services.

Examination in accordance with this standard shall demonstrate compliance and verify that quality control in manufacturing shall ensure a consistent and reliable product.

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1 INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states testing and certification requirements for rigid photovoltaic modules that are installed with a ground-mounted or elevated system.
- 1.1.2 Testing and certification criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a surveillance program.

1.2 Scope

- 1.2.1 This standard applies to all rigid photovoltaic module systems that are secured to frames which are independently secured in place. This standard does not apply to the frame itself but does apply to the securement of the photovoltaic modules to the frame. The frame and its securement should be evaluated by a Registered Professional Engineer or Chartered Engineer competent in this area of practice.
- 1.2.2 This standard only addresses the photovoltaic module system and does not address any other electrical component utilized to supply the generated electrical power to the facility.
- 1.2.3 This standard addresses fire, hail resistance and simulated wind uplift applied perpendicular and shear loading applied to the photovoltaic modules and its connections. It does not evaluate torsional loading on the photovoltaic modules and should be evaluated by a Registered Professional Engineer or Chartered Engineer competent in this area of practice.
- 1.2.4 This standard does not certify roof mounted or building integrated photovoltaic modules. They are evaluated per FM 4476, *Approval Standard for Flexible Photovoltaic Modules*, FM 4478, *Examination Standard for Rigid Photovoltaic Modules* or FM 4479, *Examination Standard for Building Integrated Steep Slope Photovoltaic Roof Covers*.

1.3 Basis for Requirements

- 1.3.1 The requirements of this standard are based on experience, research, and testing, and/or the standards of other organizations. The advice of manufacturers, users, trade associations, jurisdictions, and/or loss control specialists was also considered.
- 1.3.2 The requirements of this standard reflect tests and practices used to examine characteristics of rigid photovoltaic modules for the purpose of obtaining certification.

1.4 Basis for Certification

Certification is based upon satisfactory evaluation of the product in the following major areas:

- 1.4.1 Examination and tests on production samples shall be performed to evaluate:
 - the suitability of the product;
 - the performance of the product as specified by the manufacturer and required for certification;
 - the durability and reliability of the product.
- 1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be conducted to evaluate the manufacturer's ability to consistently produce the product which is examined and tested, and the marking procedures used to identify the product. Subsequent surveillance may be

required by the certification agency in accordance with the certification scheme to ensure ongoing compliance.

1.5 Basis for Continued Certification

The basis for continual certification may include, the following based upon the certification scheme and requirements of the certification agency:

- production or availability of the product as currently certified;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated by the certification;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory surveillance audits conducted as part of the certification agency's product surveillance program.

1.6 Effective Date

The effective date of this examination standard mandates that all products tested for certification after the effective date shall satisfy the requirements of this standard.

The effective date of this standard is the publication date of the standard for compliance with all requirements.

1.7 System of Units

Units of measurement used in this standard are United States (U.S.) customary units. These are followed by their arithmetic equivalents in International System (SI) units, enclosed in parentheses. The first value stated shall be regarded as the requirement. The converted equivalent value may be approximate. Conversion of U.S. customary units is in accordance with ANSI/IEEE/ASTM SI 10.

1.8 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the cited edition applies.

American National Standard Institute

- *Evaluating the Simulated Wind Uplift resistance of Roof Assemblies Using Static Positive and/or Negative Differential Pressures*, ANSI/FM 4474
- *Impact Resistance Testing of Rigid Roofing Materials by Impacting with Freezer Ice Balls*, ANSI/FM 4473
- *Flat Plate Photovoltaic Modules and Panels*, ANSI/UL 1703

America Society of Civil Engineers

- *Minimum Design Loads and Associated Criteria for Buildings and Other Structures.*, ASCE 7-22

American Society for Testing Materials

- *Standard Test Methods for Fire Tests of Roof Coverings*, ASTM E108

International Electrotechnical Commission

- *Terrestrial Photovoltaic (PV) modules – Design qualification and type approval*, International Standard IEC/EN 61215-1, IEC/EN 61215-1-1, IEC/EN 61215-1-2, IEC/EN 61215-1-3, IEC/EN 61215-1-4 and IEC/EN 61215-2
- *Photovoltaic (PV) module safety qualifications – Part 2: Requirements for Testing*, International Standard IEC/EN 61730-2

1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

Crack – During wind uplift or hail testing, when a component is stressed to the point that it separates from itself while continuing to maintain the applied uplift pressure without catastrophic failure of the test assembly.

Critical Crack – During electroluminescence evaluation following hail testing, a critical crack is a cracking of the cells that affects between 1% and 20% of an individual cell's area.

Crease - During wind uplift testing, when a component is stressed to the point that it bends at a sharp, defined angle, without breaking. Often a crack will form on the opposite face of the component.

Elevated Photovoltaic System – The system of mounts, frames or racking use to secure photovoltaic modules above the ground or substrate such as a carport.

Fasteners - A mechanical securement device used alone or in combination with a stress distributor to secure various components.

Frame or Racking System – used to fix solar modules on surfaces.

Photovoltaic Module – A device that converts solar energy into electricity.

Rigid Photovoltaic Module –An arrangement of photovoltaic cells or material, mounted on a rigid surface with the cells exposed freely to incoming sunlight.

Service Wind Load – The uplift load resulting from a windstorm that a photovoltaic assembly must resist.

Stress Distributor/Plate - A metal or plastic disk or bar designed to distribute a concentrated load over a larger surface area.

Uncritical Crack – During electroluminescence evaluation following hail testing, an uncritical crack is a crack that affects less than 1% of an individual cell's area.

Very Critical Crack – During electroluminescence evaluation following hail testing, a very critical crack is a crack that affects greater than 20% of an individual cell's area.