



Member of the FM Global Group

Examination Standard for Roof-Mounted Rigid Photovoltaic Module Systems

Class Number 4478

December 2021

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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 the testing and certification requirements for rigid photovoltaic modules that are installed with a certified roof assembly.
- 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:
- Mechanically fastened through a single-ply, polymer-modified bitumen sheet, built-up roof, or liquid applied roof cover certified per FM Approvals Standard 4470.
 - Adhered to a single-ply, polymer-modified bitumen sheet, built-up roof, or liquid applied roof cover certified per FM Approvals Standard 4470.
 - Mechanically fastened through a steep slope roof assembly certified per FM Approvals Standard 4475.
 - Mechanically fastened to a panel roof cover assembly certified per FM Approvals Standard 4471 (using clamps or other types of fasteners).
 - Loose laid and ballasted over a fully adhered single-ply, polymer-modified bitumen sheet or built-up roof cover assembly certified per FM Approvals Standard 4470.
 - Secured to racks and/or rack framing which are independently secured to the building structure, roof deck, or metal roof cover or ballasted. It also applies to the rack itself and its securement.
- 1.2.2 This standard evaluates rigid roof-mounted photovoltaic module systems as part of a finished roof assembly for their performance in regard to fire from above the structural deck, simulated wind uplift, susceptibility from hail damage, seismic performance requirements and gravity load resistance. The standard is intended to evaluate only those hazards investigated and is not intended to determine suitability for the end use of a product.
- 1.2.3 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.
- 1.2.4 This standard does not qualify flexible photovoltaic modules. Flexible photovoltaic systems are evaluated per FM Approvals Standard 4476.

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. Products having characteristics not

anticipated by this standard may be certified if performance is equal, or superior, to that required by this standard, or if the intent of the standard is demonstrated.

1.4 Basis for Certification

Certification is based upon satisfactory evaluation of the product when used as part of a certified roof assembly:

1.4.1 Examination and tests on production samples shall be performed to evaluate:

- the suitability of the product for use in a roof assembly;
- the performance of the product as part of a roof assembly as specified by the manufacturer and required for certification; and as far as practical,
- the durability and reliability of the product.

1.4.2 An examination of the manufacturing facilities and audit of quality control procedures may be made 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, but is not limited to, 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 agencies product surveillance program.

1.6 Effective Date

The effective date of this certification 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 eighteen (18) months after 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 Approvals 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

American Iron and Steel Institute

- *North American Specification for the Design of Cold-Formed Steel Structural Members*, AISI S100
- American Society of Civil Engineers

- *Minimum Design Loads and Associated Criteria for Buildings and Other Structures*, ASCE/SEI 7

American Society for Testing Materials

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

International Electrotechnical Commission

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

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- *Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Systems for use in Class 1 and Noncombustible Roof Deck Construction*, Class Number 4470
- *Standard for Class 1 Panel Roofs*, Class Number 4471
- *Standard for Class 1 Steep Slope Roof Covers*, Class Number 4475

Structural Engineers Association of California

- *Wind Design for Solar Arrays*, PV2-2017