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Member of the FM Global Group

Examination Standard for Anchors for Roof Mounted Equipment

Class Number 4481

December 2020

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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.

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Purpose

1.1.1 This standard states testing and certification requirements for anchors for roof mounted equipment.

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 anchors intended to secure roof mounted equipment to a substrate except as noted in Section 1.2.5.

1.2.2 The performance of an anchor depends on all components that make up the anchor system including the substrate and the anchor securement.

1.2.3 This standard is intended to evaluate only those hazards investigated and is not intended to determine suitability for the end use of a product.

1.2.4 This standard evaluates anchors systems for their performance in regard to simulated wind uplift, leakage and corrosion of metal parts.

1.2.5 This standard shall not be used to qualify roof mounted anchors used to secure rigid photovoltaic module systems. Rigid Photovoltaic module systems and their securement are evaluated per Standard 4478.

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 roof mounted anchors for the purpose of obtaining certification. Roof mounted anchors having characteristics not anticipated by this standard may be certified if performance equal, or superior, to that required by this standard is demonstrated.

1.4 Basis for Certification

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

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

- the suitability of the roof mounted anchor when used with a certified roof assembly.
- the performance of the product 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 of the certification agency's 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 the date of publication.

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.

ANSI/IEEE/ASTM SI 10, *American National Standard for Metric Practice*

ASTM International (American Society for Testing and Materials)

- *Standard Test Method for Corrosion Resistance of Ferrous Metal Fastener Assemblies Used in Roofing and Waterproofing, ASTM D6294*
- *Standard Test Method for Determining Water Migration Resistance Through Roof Membranes, ASTM D7281*

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- FM 4478, *Examination Standard for Roof-Mounted Rigid Photovoltaic Module Systems*
- Test Procedure, *Roof Mounted Equipment Load Tests using Tensile Loading*

EOTA, European Organisation for Technical Approvals.

- *Guideline for European Technical Approval of Systems of Mechanically Fastened Flexible Roof Waterproofing Membranes*, EAD 030551- 00- 0402-2019

1.9 Terms and Definitions

For purposes of this standard, the following terms apply:

Deck - The structural component of the roof assembly to which the roof system is secured.

External Seam Clamps – A securement device for attaching roof mounted equipment to the seam of a standing seam roof, the clamps are usually specific to the seams of the standing seam roof.

Fastener - A mechanical securement device used alone or in combination with a stress distributor to secure various components of a roof assembly.

Mechanically Fastened - Describes components that have been attached to the substrate, deck or structure at defined intervals using fasteners with or without stress distributors.

Roof Assembly - A group of interacting roof components (including the roof deck) designed to weatherproof and, normally, to insulate a building's top surface.

Roof Cover - The layer of a roof assembly designed to protect the building components from the weather.

Roof Mounted Anchor – A device used to secure equipment to substrates such as standing seam roof cover, roof decks, structures, etc.

Standing Seam Roof Cover - The standing seam roof cover generally consists of metal sheets or panels, field seamed to adjacent sheets by a special roll-forming machine to create an upstanding seam (rib) of folded metal along the sheet sidelaps. The panels are secured to the building framing with clips. The clip, which contains metal tabs, is roll-formed into the panel seam.

Stress Distributor (Plate/Batten Bar) - A metal or plastic disk or bar which is used in conjunction with a fastener to secure roof components and designed to distribute a concentrated load over a larger surface area.

Structure - Is the building framework to which the roof deck, or in some instances the roof cover, is fastened.

Weld - A type of securement whereby metal or plastic products are joined together through heat or solvent fusion.

Wind Uplift - The force generated by wind on a roof system or components in a roof system resulting from wind-induced pressure.

2 GENERAL INFORMATION

2.1 Product Information

Anchors for roof mounted equipment are provided as seam clamps, clips or stress plates. They can be installed using either mechanical fasteners, mounting brackets, adhesives or welds. Other designs meeting the criteria of this standard may also be considered for certification.

2.2 Certification Application Requirements

The manufacturer shall provide the following preliminary information with any request for certification consideration:

- A complete list of all models, types, sizes, and options for the products or services being submitted for certification consideration;
- The components that make up each anchor assembly including the roof assembly and the substrate to which the anchors are secured. All components must be identified by manufacturer, product trade name and method of installation;
- The number and location of manufacturing facilities;
- All documents shall identify the manufacturer's name, document number or other form of reference, title, date of last revision, and revision level. All documents shall be provided with English translation.
- Manufacturer's Specifications and Technical Bulletins may be needed to confirm certifications requested are in compliance with Paragraph 3.3.2.

2.3 Requirements for Samples for Examination

2.3.1 Following authorization of an certification examination, the manufacturer shall submit samples for examination and testing based on the following:

- Sample requirements to be determined by the certification agency

2.3.2 Requirements for samples may vary depending on design features, results of prior or similar testing and results of any foregoing tests.

2.3.3 The manufacturer shall submit samples representative of production. Any decision to use test data generated using prototypes is at the sole discretion of the certification agency.

2.3.4 It is the manufacturer's responsibility to provide any special tools, such as those which may be required to evaluate the products for certification.

3 GENERAL REQUIREMENTS

3.1 Review of Documentation

3.1.1 During the initial investigation and prior to physical testing, the manufacturer's specifications and details shall be reviewed to assess the ease and practicality of installation and use. The certification investigation shall define the limits of the final certification.

3.2 Markings

3.2.1 Marking on the product or, if not possible due to size, on its packaging or label accompanying the product, shall include the following information:

- name and address of the manufacturer or marking traceable to the manufacturer;
- date of manufacture or code traceable to date of manufacture or lot identification;
- model number or trade name.

3.2.2 The model or type identification shall correspond with the manufacturer's catalog designation and shall uniquely identify the certification agency's mark of conformity.

3.2.3 The certification agency's mark of conformity shall be displayed visibly and permanently on the product and/or packaging as appropriate and in accordance with the requirements of the certification agency. The manufacturer shall exercise control of this mark as specified by the certification agency and the certification scheme.

3.2.4 All markings shall be legible and durable.

3.3 Manufacturer's Installation Instructions

3.3.1 The manufacturer shall

- prepare instructions for the installation, maintenance, and operation of the product;
- provide facilities for repair of the product and supply replacement parts, if applicable; and
- provide services to ensure proper installation, inspection, or maintenance for products of such nature that it would not be reasonable to expect the average user to be able to provide such installation, inspection, or maintenance.

3.3.2 No certification will be granted if it is in conflict with the manufacturer's specifications and/or other written documentation such as technical bulletins.

3.4 Calibration

3.4.1 Each piece of equipment used to verify the test parameters shall be calibrated within an interval determined on the basis of stability, purpose, and usage. A copy of the calibration certificate for each piece of test equipment is required. The certificate shall indicate that the calibration was performed against working standards whose calibration is certified and traceable to an acceptable reference standard and certified by an ISO/IEC 17025 accredited calibration laboratory. The test equipment shall be clearly identified by label or sticker showing the last date of the calibration and the next due date. A

copy of the service provider's accreditation certificate as an ISO/IEC 17025 accredited calibration laboratory should be available.

3.4.2 When the inspection equipment and/or environment is not suitable for labels or stickers, other methods such as etching of control numbers on the measuring device are allowed, provided documentation is maintained on the calibration status of thus equipment.

3.5 Test Sample Production

All products submitted for testing shall be representative of production run material. The need to monitor the manufacturer of the test specimens shall be at the sole discretion of the certification agency.

4 PERFORMANCE REQUIREMENTS

4.1 Wind Uplift Resistance and Lateral Load Resistance

4.1.1 Roof Anchors shall be evaluated for resistance in two directions, perpendicular and parallel to the roof surface. Certification ratings shall state the ultimate failure loads in lbf (N), and include the substrate and all securement details.

4.1.2 Tensile testing of the roof anchor attached to various substrates shall be conducted to verify the ultimate uplift forces in both the perpendicular and parallel directions. Testing shall be in accordance with *Roof Mounted Equipment Load Tests using Tensile Loading*, FM Approvals LLC.

1) The result shall be the highest force attained by the sample during the test.

2) The overall sample results shall be determined based on the average of three (3) tests. If the coefficient of variation is greater than 20%, up to two (2) additional tests shall be conducted to bring the coefficient of variation to less than, or equal to, 20%. If after five (5) tests the coefficient of variation remains greater than 20%, the results of all five (5) tests shall be used to determine the final average.

4.2 Water Leakage Resistance Test

4.2.1 If the anchor for roof mounted equipment penetrates the roof cover, then testing for water leakage resistance shall be required and conducted in accordance with Standard Test Method for Determining Water Migration Resistance Through Roof Membranes, ASTM D7281, ASTM International.

4.2.2 There shall be no signs of water leakage during the 7 day period. In addition, there shall be no signs of water leakage during, or after, the pressure cycles.

4.3 Corrosion Resistance Test

4.3.1 Fasteners used to secure roof anchors to steel deck shall be tested for Corrosion Resistance.

Through visual inspection, the amount of red rust is determined. Staining is not considered red rust. A sample passes the corrosion test when no specimen has a corrosion area of greater than 15%. Any sign of coating blistering, peeling, or cracking is cause for failure.

1) For threaded fasteners, the measure of rust is based on the fastener area above the substrate through which the threads are driven.

2) For hammered fasteners, the measure of rust is based on the fastener area above the substrate into which the fastener is hammered. It excludes the portion impacted by the hammering device.

3) For stress plates, the measure of rust is based on the top and bottom surfaces. It excludes 1/16 in. (1.6 mm) inward from the outside perimeter of the top and bottom surfaces and 1/32 in. (0.8 mm) concentrically outward from the perimeter edge of the center hole on the top and bottom surface.

4) For batten bars, the measure of rust is based on the top and bottom surfaces. It excludes 1/16 in. (1.6 mm) inward from the outside perimeter of the top and bottom surfaces and 1/32 in. (0.8 mm) concentrically outward from the perimeter edge of all holes on the top and bottom surface.

4.3.2 Testing for corrosion resistance shall be in accordance with *Standard Test Method for Corrosion Resistance of Ferrous Metal Fastener Assemblies Used in Roofing and Waterproofing*, ASTM D6294, ASTM International or *Guideline for European Technical Approval of Systems of Mechanically*

Fastened Flexible Roof Waterproofing Membranes, EAD 030551- 00- 0402-2019, EOTA, European Organisation for Technical Approvals.

5 OPERATIONS REQUIREMENTS

5.1 Demonstrated Quality Control Program

5.1.1 A quality assurance program is required to assure that subsequent products produced by the manufacturer shall present the same quality and reliability as the specific products examined. Design quality, conformance to design, and performance are the areas of primary concern.

- Design quality is determined during the examination and tests and may be documented in the certification report.
- Continued conformance to this standard is verified by the certifiers surveillance program.
- Quality of performance is determined by field performance and by periodic re-examination and testing.

5.1.2 The manufacturer shall demonstrate a quality assurance program which specifies controls for at least the following areas:

- existence of corporate quality assurance guidelines;
- incoming quality assurance, including testing;
- in-process quality assurance, including testing;
- final inspection and tests;
- equipment calibration;
- drawing and change control;
- packaging and shipping; and
- handling and disposition of non-conforming materials.

5.1.3 Documentation/Manual

There should be an authoritative collection of procedures/policies. It should provide an accurate description of the quality management system while serving as a permanent reference for implementation and maintenance of that system. The system should require that sufficient records are maintained to demonstrate achievement of the required quality and verify operation of the quality system.

5.1.4 Records

To assure adequate traceability of materials and products, the manufacturer shall maintain a record of all quality assurance tests performed, for a minimum period of two years from the date of manufacture.

5.1.5 Drawing and Change Control

- The manufacturer shall establish a system of product configuration control that shall allow no unauthorized changes to the product. Changes to critical documents, identified in the certification report, may be required to be reported to, and authorized by the certification agency prior to implementation for production.
- Records of all revisions to all certified products shall be maintained.

5.2 Surveillance Audit

5.2.1 An audit of the manufacturing facility may be part of the certification agencies surveillance requiremetns to verify implementation of the quality assurance program. Its purpose is to determine that the manufacturer's equipment, procedures, and quality program are maintained to insure a uniform product consistent with that which was tested and certified.

5.2.2 Certified products or services shall be produced or provided at, or provided from, location(s) disclosed as part of the certification examination. Manufacture of products bearing a certification mark is not permitted at any other location prior to disclosure to the certification agency.

5.3 Installation Inspections

Field inspections may be conducted to review an installation. The inspections are conducted to assess ease of application, and conformance to written specifications. When more than one application technique is used, one or all may be inspected at the sole discretion of the certification agency.

5.4 Manufacturer's Responsibilities

The manufacturer shall notify the certification agency of changes in product construction, components, raw materials, physical characteristics, coatings, component formulation or quality assurance procedures prior to implementation.

6 BIBLIOGRAPHY

ISO/IEC 17025, *General Requirements for the Competence of Testing and Calibration Laboratories*.