

Approval Standard for Windstorm Resistant Fenestrations

Class Number 4350

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Foreword

Approvals are 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 Approvals Standards is to present the criteria for Approval of various types of products and services, as guidance for FM Approvals personnel, manufacturers, users and authorities having jurisdiction.

Products submitted for Approval shall demonstrate that they meet the intent of the Approvals Standard, and that quality control in manufacturing and/or applications shall ensure a consistently uniform and reliable product or service. FM Approval Standards strive to be performance-oriented and to facilitate technological development.

For examining equipment, materials and services, Approvals Standards:

- a) must be useful to the ends of property conservation by preventing, limiting or not causing damage under the conditions stated by the Approval listing; and
- b) must be readily identifiable.

Continuance of Approval and Listing depends on compliance with the Master Agreement, satisfactory performance in the field, on successful re-examinations of equipment, materials, and services as appropriate, and on periodic follow-up audits of the manufacturing facility or service/application.

FM Approvals LLC reserves the right in its sole judgment to change or revise its standards, criteria, methods, or procedures.

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1. INTRODUCTION

1.1 Purpose

- 1.1.1 This standard states Approval requirements for Windstorm Resistant Fenestrations such as doors, windows, storm shutters and impact resistant film and other materials. Fenestrations are exposed to a number of natural hazards and must reject wind, hail, water infiltration and other deleterious affects caused from everyday exposure to heat, cold, building movement and sunlight. Damage to a building's outer protective layer compromises its ability to provide the functions it has been designed to deliver. Compromised openings can pave the way for serious damage to the building contents and to the building structure itself due to storms and the long term effects of water and air infiltration. Damage to the building envelope during high wind events such as hurricanes, tropical cyclones or typhoons will produce costly undesirable effects and possible business interruptions. Products that receive Approval recognition have been evaluated to provide assurance that they will perform their intended functions and maintain the integrity of the building envelop for the stated design conditions.
- 1.1.2 Approval criteria may include, but are not limited to, performance requirements, marking requirements, examination of manufacturing facility(ies), audit of quality assurance procedures, and a follow-up program.

1.2 Scope

- 1.2.1 This standard sets performance requirements for windstorm resistant fenestrations under simulated laboratory conditions when exposed to various natural hazards such as the cyclic nature of wind in high wind events, the impact of simulated hail and where required, the impact of windborne debris during hurricanes, tropical cyclones and typhoons.
- 1.2.2 This standard is intended to qualify all types of fenestrations including, but not limited to doors, windows, storm shutters and impact resistant film and other materials.
- 1.2.3 This standard is not intended to qualify exterior wall panels nor does it address quality of workmanship or ease of or need for maintenance.
- 1.2.4 This standard is not intended to determine the suitability for all end use conditions of a product. Conditions under which fenestration systems are used vary widely. It is the responsibility of the manufacturer and building owner to determine the suitability of the fenestration products for the intended location.

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 FM Approvals and other organizations. The advice of manufacturers, users, trade associations and loss control specialists was also considered.
- 1.3.2 Meeting these requirements qualifies a product as an FM Approved windstorm resistant fenestration system. Requirements prohibit component substitution without prior authorization by FM Approvals.

1.3.3 The requirements of this standard reflect tests and practices used to examine characteristics of windstorm resistant fenestrations for the purpose of obtaining Approval. These requirements are intended primarily as guides and strict conformity is not always mandatory. Windstorm resistant fenestration systems having characteristics not anticipated by this standard may be FM Approved if performance equal or superior to that required by this standard is demonstrated, or if the intent of the standard is met. Alternatively, windstorm resistant fenestration systems that meet all the requirements identified in this standard may not be FM Approved if other conditions that adversely affect performance exist or if the intent of this standard is not met.

1.4 Basis for Approval

Approval 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 product;
- the performance of the product as specified by the manufacturer and required by FM Approvals; 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 is 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. These examinations may be repeated as part of FM Approvals' product follow-up program.

1.5 Basis for Continued Approval

Continued Approval is based upon:

- production or availability of the product as currently FM Approved;
- the continued use of acceptable quality assurance procedures;
- satisfactory field experience;
- compliance with the terms stipulated in the Approval report;
- satisfactory re-examination of production samples for continued conformity to requirements; and
- satisfactory Facilities and Procedures Audits (F&PAs) conducted as part of FM Approvals' product follow-up program.

Also, as a condition of retaining Approval, manufacturers may not change a product or service without prior authorization by FM Approvals.

1.6 Effective Date

The effective date of an Approval standard mandates that all products tested for Approval after the effective date shall satisfy the requirements of that standard. Products that were FM Approved under a previous edition shall comply with the new version by the effective date or else forfeit Approval.

The effective date of this Standard is **April 1, 2007** 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. Appendix A lists the selected units and conversions to SI units for measures appearing in this standard. Conversion of U.S. customary units is in accordance with the American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)/American Society for Testing Materials (ASTM) SI 10-02, "Standard for Use of the International System of Units (SI): The Modern Metric System."

1.8 Applicable Documents

The following are standards, test methods and practices referenced in this standard:

American Society for Testing and Materials (ASTM) International

ASTM E 330-02, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

ASTM E 1233-00, Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls and Doors by Cyclic Static Air Pressure Differential

ASTM E 1886-05, Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials

ASTM E 1996-05, Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes

FM Approvals/FM Global

Approval Standard 4470, Class 1 Roof Covers (1986 with addenda)

Approval Standard 4880, "Approval Standard for Class 1 Fire Rating of Insulated Wall or Wall and Roof Ceiling Panels, Interior Finish Materials or Coatings and Exterior Wall Systems (October 2005)

Approval Standard 4881, Class 1 Exterior Wall Panels (June 2005)

Test Standard 4473, Specification Test Protocol for Impact Resistance Testing of Rigid Roofing Materials by Impacting with Freezer Ice Balls (July 2005)

Structural Test Method for Windstorm Resistant Fenestration Systems Using Static Air Pressure Differentials (Appendix C)

Structural Test Method for Windstorm Resistant Fenestration Using Cyclic Air Pressure Differentials (Appendix D)

Test Method for Windstorm Resistant Fenestration Impacted by Windborne Debris (Appendix E)

Simulated Hail Resistance Test Using Freezer Ice Balls. (Appendix F)

FM Global Property Loss Prevention Data Sheet 1-28, Design Wind Loads (September 2005)

FM Global Property Loss Prevention Data Sheet 1-29, Roof Deck Securement and Above-Deck Roof Components (May 2006)

Building Codes

Florida Building Code, 2004 Edition

Testing Application Standard (TAS) 201-94, Impact Test Procedures

Testing Application Standard (TAS) 203-94, Criteria for Testing Products to Cyclic Wind Pressure Loading

1.9 Definitions

For purposes of this standard, the following terms apply:

Inward Wind Pressure – a condition created on the windward side of a building. It is caused by wind forces and places forces toward the fenestration system. It is referred to by some entities as positive pressure.

Outward Wind Pressure – a condition created on the leeward side of a building. It is caused by wind forces and places forces away from the fenestration system. It is referred to by some entities as negative pressure.

Pressure Coefficient – a factor accounting for variations in inward and outward wind pressure on fenestration systems at different locations and elevations of the same building.

Windborne Debris – objects and pieces of broken materials that have become airborne projectiles due to the high winds caused by hurricanes, tropical cyclones and typhoons.

2. GENERAL INFORMATION

2.1 Product Information

- 2.1.1 The selection of a windstorm resistant fenestration system is a critical component in the overall effectiveness of a building's ability to perform the functions for which it has been designed. It is the first line of defense in combating the effects of natural hazards and protecting the contents of the building. The system selected must be durable, cost effective and aesthetically pleasing. It must be able to withstand the design conditions that will be placed on the system from internal sources for which it has been constructed as well as natural external sources such as rain, wind and hail. Selection of a system that has not demonstrated that it can withstand the design conditions over long periods of time can lead to a loss of property as well as a loss of business.
- 2.1.2 Design conditions vary widely throughout the world. The selection of a windstorm resistant fenestration system should be based, in part, on the geographical location where it will be constructed, its surroundings as well as the historical meteorological events that have occurred and are likely to occur in the future.
- 2.1.3 Anticipated design conditions at a particular location vary depending on the intensity of the event, the surrounding terrain and elevation. Components on the windward side of a building are subjected to design wind pressures [P^{inward}] which increase as the elevation of the building increases. Pressures on the leeward side [P^{outward}] of a building can reach twice the wind pressure normally found on the windward face of the building at the same elevation but acting in the opposite direction. Approval ratings will show both inward and outward pressures for which the system has been successfully tested. In an effort to allow for economic building construction, Approval will be granted for two ratios of inward and outward pressure. The ratio of the inward and outward pressures shall be (+)1.0 to (-)1.4 or (+)1.0 to (-)2.0
- 2.1.4 In an effort to allow for economic building construction, in addition to the wind load ratings shown above, Approval categories have been developed for the most common windstorm zones likely to be encountered. These zones, as explained elsewhere, shall be designated as Zones HM, H and NH. The zones have been established to Approve products intended for use in areas that require protection against a) hurricane force winds and missile impacts resulting from windborne debris (HM), b) hurricane force winds only (H) and c) non-hurricane areas (NH) that do not require either a) or b).
- 2.1.5 Windstorm resistant fenestration systems that meet the requirements of this Approval Standard will maintain the integrity of the building envelope for the stated design conditions. While the performance requirements contained in this Approval Standard would indicate that FM Approved windstorm resistant fenestration systems will not suffer permanent deformation or physical damage (except as otherwise noted in Paragraph 2.1.5.1) after windstorms or hail storms, the systems should be examined after each storm for damage that could adversely effect its performance in future storms.
- 2.1.5.1 In the case where a system has been FM Approved for use in areas prone to missile impacts from windborne debris, the system may sustain permanent physical damage. As such, the systems should be examined after each storm for damage that could adversely affect its performance in future storms. Repairs should be made as soon as possible to any damaged areas.
- 2.1.5.2 Because the acceptance criteria for systems impacted by windborne debris vary throughout the country, two (2) levels of both large and small missile Approval have been created. This will assist manufacturers and end users in determining if the system will meet local codes requirements.
- 2.1.6 The requirements of this standard shall be used to measure and describe the performance of windstorm resistant fenestrations to simulated wind loads and hail impact under controlled laboratory conditions.
- 2.1.7 The performance of windstorm resistant fenestration systems can be greatly affected by the quality of the workmanship, exposure to sunlight, heat, building movement and the normal aging process. These items have not been considered in developing the test methods included in this Standard.

2.2 Approval Application Requirements

To apply for an Approval examination the manufacturer, or its authorized representative, should submit a request to

Materials - Director
FM Approvals
1151 Boston-Providence Turnpike
PO Box 9102
Norwood, MA 02062
U.S.A.

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

- A complete list of all models, types, sizes, desired Approval ratings, pressure coefficients and options for the products or services being submitted for Approval consideration;
- general assembly drawings, complete set of manufacturing drawings, materials list, anticipated marking format, installation and any maintenance procedures;
- 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.

2.3 Requirements for Samples for Examination

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

- Maximum size opening (width and height) for which Approval is desired
- Minimum thickness of materials
- Most critical orientation, if applicable

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 data generated using prototypes is at the discretion of FM Approvals.

2.4 Approval Categories and Ratings

2.4.1 Wind Load Ratings

2.4.1.1 All FM Approved Windstorm Resistant Fenestration systems shall have a wind load rating. The rating shall be expressed as a pair of inward and outward acting pressures (P^{inward} and P^{outward}) using a static pressure test and a cyclic pressure test. The FM Approved rating shall be the lowest pair of pressures (inward and outward) from the static pressure test or the cyclic pressure test. The ratings shall be given in increments of 5 lbs/ft² (0.25 kPa) based on the inward pressure. The minimum rating needed for Approval shall be 30 lbs/ft² (1.45 kPa) for the inward pressure.