



Designation: E1996 – 23

Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricanes¹

This standard is issued under the fixed designation E1996; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers exterior windows, glazed curtain walls, doors, and impact protective systems used in buildings located in geographic regions that are prone to hurricanes.

1.1.1 *Exception*—Exterior garage doors and rolling doors are governed by ANSI/DASMA 115 and are beyond the scope of this specification.

1.2 This specification provides the information required to conduct Test Method [E1886](#).

1.3 Qualification under this specification provides a basis for judgment of the ability of applicable elements of the building envelope to remain unbreached during a hurricane; thereby minimizing the damaging effects of hurricanes on the building interior and reducing the magnitude of internal pressurization. While this standard was developed for hurricanes, it may be used for other types of similar windstorms capable of generating windborne debris.

1.4 This specification provides a uniform set of guidelines based upon currently available information and research.² As new information and research becomes available it will be considered.

1.5 All values are stated in SI units and are to be regarded as standard. Values given in parentheses are for information only. Where certain values contained in reference documents cited and quoted herein are stated in inch-pound units, they must be converted by the user.

1.6 The following precautionary statement pertains only to the test method portion, Section [5](#), of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and*

environmental practices and determine the applicability of regulatory limitations prior to use.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:³

[C719](#) Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)

[C1135](#) Test Method for Determining Tensile Adhesion Properties of Structural Sealants

[D3575](#) Test Methods for Flexible Cellular Materials Made from Olefin Polymers

[E631](#) Terminology of Building Constructions

[E1886](#) Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials

2.2 ANSI/DASMA Standard:⁴

[ANSI/DASMA 115](#) Standard Method for Testing Sectional Garage Doors and Rolling Doors: Determination of Structural Performance Under Missile Impact and Cyclic Wind Pressure

2.3 ASCE/SEI Standard:⁵

[ASCE/SEI 7](#) American Society of Civil Engineers Minimum Design Loads for Buildings and Other Structures

¹ This specification is under the jurisdiction of ASTM Committee [E06](#) on Performance of Buildings and is the direct responsibility of Subcommittee [E06.51](#) on Performance of Windows, Doors, Skylights and Curtain Walls.

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² See the Significance and Use Section of Test Method [E1886](#).

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁵ Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, <http://www.asce.org>.

2.4 Other Standard:⁶ International Residential Code

3. Terminology

3.1 Definitions:

3.1.1 General terms used in this specification are defined in Terminology E631.

3.1.2 Terms common to this specification and Test Method E1886 are defined in Test Method E1886, unless defined herein.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *assembly elevation, n*—vertical dimension above adjacent mean ground level at which fenestration or impact protective system assembly is to be installed, measured to the lowest point of the assembly.

3.2.2 *basic wind speed, n*—three-second gust speeds as defined in the latest edition of ASCE/SEI 7.

3.2.3 *combination mullion, n*—a horizontal or vertical member formed by joining two or more individual fenestration units together without a mullion stiffener.

3.2.4 *impact protective system, n*—construction applied, attached, or locked over an exterior glazed opening system to protect that system from windborne debris during high wind events.

3.2.4.1 *Discussion*—Impact protective systems include types that are fixed, operable, or removable.

3.2.5 *infill, n*—glazing in a fenestration assembly or curtain wall.

3.2.6 *integral mullion, n*—a horizontal or vertical member which is bounded at both ends by crossing frame members.

3.2.7 *maximum deflection, n*—greatest deformation of an element or component under the application of an applied force.

3.2.8 *maximum dynamic deflection, n*—greatest deformation of an element or component during the missile impact.

3.2.9 *meeting rail or check rail, n*—one of the two horizontal members of a sliding sash that come together when in the closed position.

3.2.10 *meeting stile, n*—one of the two vertical members of a sliding sash that come together when in the closed position.

3.2.11 *porous impact protective system, n*—an assembly whose aggregate open area exceeds ten percent of its projected surface area.

3.2.12 *valley, n*—a pivoting axis of an impact protective system designed to rotate adjacent slats or panels outward.

4. Test Specimens

4.1 Number of Test Specimens:

4.1.1 Fenestration Assemblies:

4.1.1.1 Three test specimens shall be submitted for the large missile test.

4.1.1.2 Three test specimens shall be submitted for the small missile test.

4.1.1.3 One additional test specimen may be submitted for each of the tests should no more than one of the original three specimens fail any portion of the testing.

4.1.2 Impact Protective Systems:

4.1.2.1 A minimum of three test specimens shall be submitted for the large missile test for the largest span to be qualified.

4.1.2.2 A minimum of three test specimens shall be submitted for the small missile test.

4.1.2.3 One additional test specimen may be submitted for each of the tests should no more than one of the original specimens fail any portion of the testing.

4.1.2.4 For porous impact protective systems, the large and small missile tests shall be allowed to be performed on the same specimens, or on separate specimens. If the large and small missile tests are performed on the same specimens, the small missile impacts shall be performed first, followed by the large missile impacts.

4.2 Test specimens shall be prepared as specified in Test Method E1886.

4.3 The size of the test specimen shall be determined by the specifying authority. All components of each test specimen shall be full size.

4.4 Where it is impractical to test the entire fenestration assembly such as curtain wall and heavy commercial assemblies, test the largest size of each type of panel as required by the specifying authority to qualify the entire assembly.

4.5 Fenestration assemblies and impact protective systems intended to be mulled together shall be tested separately or tested by combining three specimens into one mounting frame separated only by the mullions.

5. Test Methods

5.1 Test specimens shall be tested according to Test Method E1886.

5.2 Determine the missile based upon building classification, wind speed, and assembly elevation according to Section 6.

5.3 Location of Impact:

5.3.1 *Large Missile Test*—Impact each impact protective system specimen and each fenestration assembly infill type once as shown in Fig. 1.

5.3.1.1 Impact one specimen with the center of the missile within a 65 mm (2½ in.) radius circle and with the center of the circle located at the center of each type of infill.

5.3.1.2 Impact a different specimen with the center of the missile within a 65 mm (2½ in.) radius circle and with the center of the circle located 150 mm (6 in.) from supporting members at a corner.

5.3.1.3 Impact the remaining specimen with the center of the missile within a 65 mm (2½ in.) radius circle and with the center of the circle located 150 mm (6 in.) from supporting members at a diagonally opposite corner.

5.3.2 Special Considerations:

⁶ Available from International Code Council (ICC), 500 New Jersey Ave., NW, 6th Floor, Washington, DC 20001, <http://www.iccsafe.org>.