



Designation: E330/E330M – 14 (Reapproved 2021)

Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference¹

This standard is issued under the fixed designation E330/E330M; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method describes the determination of the structural performance of exterior windows, doors, skylights, and curtain walls under uniform static air pressure differences, using a test chamber. This test method is applicable to curtain wall assemblies including, but not limited to, metal, glass, masonry, and stone components.²

1.2 This test method is intended only for evaluating the structural performance associated with the specified test specimen and not the structural performance of adjacent construction.

1.3 The proper use of this test method requires a knowledge of the principles of pressure and deflection measurement.

1.4 This test method describes the apparatus and the procedure to be used for applying uniformly distributed test loads to a specimen.

1.4.1 Procedure A (see 11.2) shall be used when a load-deflection curve is not required.

1.4.2 Procedure B (see 11.3) shall be used when a load-deflection curve is required.

1.5 The text of this standard references notes and footnotes which provide explanatory materials. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.6 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be

used independently of the other, and values from the two systems shall not be combined.

1.7 *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. For specific hazard statements, see Section 7.*

1.8 *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

E631 Terminology of Building Constructions

E997 Test Method for Evaluating Glass Breakage Probability Under the Influence of Uniform Static Loads by Proof Load Testing

E998 Test Method for Structural Performance of Architectural Glass Products Under the Influence of Uniform Static Loads

E1233/E1233M Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Cyclic Air Pressure Differential

E1300 Practice for Determining Load Resistance of Glass in Buildings

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

E1996 Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems

¹ This test method 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 Additional information on curtain wall assemblies can be obtained from the Fenestration & Glazing Industry Alliance (FGIA), 1900 E Golf Rd, Suite 1250 Schaumburg, IL 60173, <https://www.fgiaonline.org/>.

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.

Impacted by Windborne Debris in Hurricanes

2.2 *ASCE/SEI Standard*:⁴

ASCE/SEI 7 Minimum Design Loads for Buildings and Other Structures

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology **E631**, unless otherwise indicated.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *design wind load*—the uniform static air pressure differences, inward and outward, for which the specimen would be designed under service load conditions using conventional wind engineering specifications and concepts, expressed in pascals [or pounds-force per square foot]. This pressure is determined by either analytical or wind-tunnel procedures (such as are specified in ASCE/SEI 7).

3.2.2 *permanent deformation, n*—the displacement or change in dimension of the specimen after the applied load has been removed and the specimen has relaxed for the specified period of time.

3.2.3 *proof load*—a test load multiplied by a factor of safety.

3.2.4 *stick system, n*—a curtain wall assembly composed of individually framed continuous members, vertical mullions, and horizontal rails that are installed in a sequential, piece-by-piece process. The completed system is assembled entirely in the field.

3.2.5 *structural distress*—a change in condition of the specimen indicative of deterioration or incipient failure, such as cracking, local yielding, fastener loosening, or loss of adhesive bond.

3.2.6 *test load*—the specified difference in static air pressure (positive or negative) for which the specimen is to be tested, expressed in pascals [or pounds-force per square foot].

3.2.7 *test specimen, n*—the entire assembled unit submitted for test (as described in Section 8).

3.2.8 *unit/panel system, n*—a curtain wall assembly composed of pre-assembled groups of individual framing members. The completed system is designed to be modular, transportable, and installed as a finished assembly.

4. Summary of Test Method

4.1 This test method consists of sealing the test specimen into or against one face of a test chamber, supplying air to or exhausting air from the chamber according to a specific test loading program, at the rate required to maintain the test pressure difference across the specimen, and observing, measuring, and recording the deflection, deformations, and nature of any distress or failures of the specimen.

5. Significance and Use

5.1 This test method is a standard procedure for determining structural performance under uniform static air pressure difference. This typically is intended to represent the effects of a

wind load on exterior building surface elements. The actual loading on building surfaces is quite complex, varying with wind direction, time, height above ground, building shape, terrain, surrounding structures, and other factors. The resistance of many windows, curtain walls, and door assemblies to wind loading is also complex and depends on the complete history of load, magnitude, duration, and repetition. These factors are discussed in ASCE/SEI 7 and in the literature **(1-8)**.⁵

5.2 Design wind velocities are selected for particular geographic locations and probabilities of occurrence based on data from wind velocity maps such as are provided in ASCE/SEI 7. These wind velocities are translated into uniform static air pressure differences and durations acting inward and outward. Complexities of wind pressures, as related to building design, wind intensity versus duration, frequency of occurrence, and other factors must be considered. Superimposed on sustained winds are gusting winds which, for short periods of time from a fraction of a second to a few seconds, are capable of moving at considerably higher velocities than the sustained winds. The analytical procedures in ASCE/SEI 7, wind tunnel studies, computer simulations, and model analyses are helpful in determining the appropriate design wind loads on exterior surface elements of buildings. Generally, wind load durations obtained from ASCE/SEI 7 are 2 s to 10 s and are dependent upon the specific time reference employed in determining the pressure coefficients.

5.3 Some materials have strength or deflection characteristics that are time dependent. Therefore, the duration of the applied test load may have a significant impact on the performance of materials used in the test specimen. The most common examples of materials with time-dependent response characteristics that are used are glass, plastics, and composites that employ plastics. For this reason, the strength of an assembly is tested for the actual time duration to which it would be exposed to a sustained or a gust load, or both, as discussed above. Generally, U.S. practice for wind load testing has been to require a minimum test period of 10 s for test loads equal to the design wind load and proof loads equal to 1.5 times the design wind load. Thus a safety factor is incorporated in the testing. If the design wind load is determined through the analytical procedures of ASCE/SEI 7, the test load shall be based on the nominal loads derived from the load combinations used in allowable stress design. With test loads for wind higher than those determined by ASCE/SEI 7 or of longer time duration than 10 s, the designer must consider what safety factors are appropriate. For test loads that represent design loads other than wind, such as snow load, consideration shall be given to establish an appropriate test period for both design and proof load testing.

5.4 This standard is not intended to account for the effect of windborne debris or cyclic loads. Consideration of cyclic air pressure differentials is addressed in Test Method **E1233/E1233M**. Consideration of windborne debris in combination

⁴ Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, <http://www.asce.org>.

⁵ The boldface numbers in parentheses refer to a list of references at the end of this standard.