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

This standard is issued under the fixed designation E 330; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

This Standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

1. Scope

1.1 This test method describes the determination of the structural performance of exterior windows, curtain walls, and doors under uniform static air pressure differences, using a test chamber.

1.2 This test method is applicable to areas of curtain walls or to windows and doors alone.

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 10.2) shall be used when a load-deflection curve is not required.

1.4.2 Procedure B (see 10.3) shall be used when a load-deflection curve is required.

1.5 The values stated in SI units are to be regarded as the standard.

1.6 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. For specific hazard statements, see Section 7.*

2. Referenced Documents

2.1 ASTM Standards:

E 631 Terminology of Building Construction²

E 997 Test Method for Structural Performance of Glass in Exterior Windows, Curtain Walls, and Doors Under the Influence of Uniform Static Loads by Destructive Methods²

E 998 Test Method for Structural Performance of Glass in Windows, Curtain Walls, and Doors Under the Influence of Uniform Static Loads by Nondestructive Method²

¹ This test method is under the jurisdiction of ASTM Committee E-6 on Performance of Building Construction and is the direct responsibility of Subcommittee E06.51 on Component Performance of Windows, Curtain Walls, and Doors.

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² Annual Book of ASTM Standards, Vol 04.07.

2.2 ANSI Standard:³

A58.1–1982 Building Codes Requirements for Minimum Design Loads in Buildings and Other Structures

3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminology E 631, unless otherwise indicated.

3.2 Descriptions of Terms Specific to This Standard:

3.2.1 *permanent deformation*—the displacement or change in dimension after the applied load has been removed and the specimen has relaxed.

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

3.2.3 *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.

3.2.4 *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).

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 wind loads 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

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repetition. These factors are discussed in ANSI A58.1 and in the literature (1, 2, 3).⁴

5.2 Design wind velocities may be selected for particular geographic locations and probabilities of occurrence from wind velocity maps such as are prepared by the National Weather Service. The approach in collecting data for these maps is to measure the fastest average wind during finite time periods within each hour. The finite time duration used is given by the equation $t = 5800/V$ (3600/ V), where t is the time span in seconds and V is the wind velocity in kilometres (miles) per hours. Wind velocity maps therefore show isotachs of the fastest average wind velocities during time spans which become shorter as the wind velocity increases. For example, a 145-km/h (90-mph) wind is actually the highest sustained average wind for a 40-s time span and a 290-km/h (180-mph) wind is actually the highest sustained average wind for a 20-s time span. Measurements obtained in this way are known as the fastest 1610-m (1 mile) of wind because the procedure is actually to measure the time required for a 1610-m (1 mile-) long sample of air to pass a fixed point. ANSI A58.1 provides additional information on this subject.

5.3 The person specifying the test must translate anticipated wind velocities and durations into uniform static air pressure differences and durations. 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, may move at considerably higher velocities than the sustained winds.

5.3.1 If a 40-m/s (90-mph) wind storm is considered, the average velocity during at least one 40-s time period is 40 m/s (90 mph). Studies reveal that there are also 2-s average velocities of 54 m/s (120 mph), 10-s average velocities of 47 m/s (106 mph), and 1-h average velocities of 24 m/s (54 mph) in the same storm. Reference (4) gives information on these studies. For a 40-m/s (90-mph) fastest 1610-m (1-mile) wind, it is apparent that there are other velocities that may be considered for the purpose of testing exterior window, wall, and door products. If the 40-m/s (90-mph) fastest 1610-m (1-mile) wind has been selected as appropriate for a particular location, the time duration at 40 m/s (90 mph) would be 40 s. This period of time may be considered as the time duration for a test at a load equivalent to the design pressure for the 40-m/s (90-mph) wind. Following the line of reasoning in the example above that the test load and time duration of tests should be related, if a 10-s time duration is used, the test should be conducted at a load equivalent to the design pressure for a 47-m/s (106-mph) wind which is 39 % greater than for a 40-m/s (90-mph) wind. If structural performance under both sustained and gust loads is to be checked, testing should be conducted at both the sustained and gust load static pressure differences and for the time duration appropriate to each.

5.4 The duration of the applied test load may have serious effects on materials used in the test specimen. Most materials

have strength or deflection characteristics that are time dependent. For this reason it is appropriate to test for the time duration to which an assembly may be exposed to a sustained or gust load, or both, as discussed in 5.3. Generally, U.S. practice in the past has been to require a minimum test period of 10 s for specific loads equal to 1.5 times the design pressure, unless requirements have been otherwise specified. Thus a safety factor was incorporated in the testing. With higher test loads and longer time durations, the designer must also consider what safety factors are essential, particularly with regard to gust wind loads. As previously pointed out, gust wind loads are of relatively short duration, so that care should be exercised not to specify unnecessarily long duration loads for purposes of testing the adequacy of the structure to withstand wind gusts.

5.5 This test method is not intended for use in evaluating the structural adequacy of the glass for a particular application. When the structural performance of glass is to be evaluated, the procedure described in Test Method E 997 or E 998 is to be used.

5.6 Further information on the subjects covered above is available in the literature (5, 6, 7).

NOTE 1—In applying the results of tests by this test method, it should be borne in mind that the performance of a wall or its components, or both, may be a function of fabrication, installation, and adjustment, and that the specimen may or may not truly represent the actual structure. In service, the performance will also depend on the rigidity of supporting construction, temperature, and on the resistance of components to deterioration by various other causes, including vibration, thermal expansion and contraction, etc.

6. Apparatus

6.1 The description of apparatus is general in nature; any equipment capable of performing the test procedure within the allowable tolerances is permitted.

6.2 Major Components (see Fig. 1):

6.2.1 *Test Chamber*, or a box with an opening, a removable mounting panel, or one open side in which or against which the specimen is installed. Provide a static pressure tap to measure the pressure difference across the test specimen. Locate the tap so that the reading is unaffected by the velocity of air supplied to or from the chamber or by any other air movements. The air supply opening into the chamber shall be arranged so that the air does not impinge

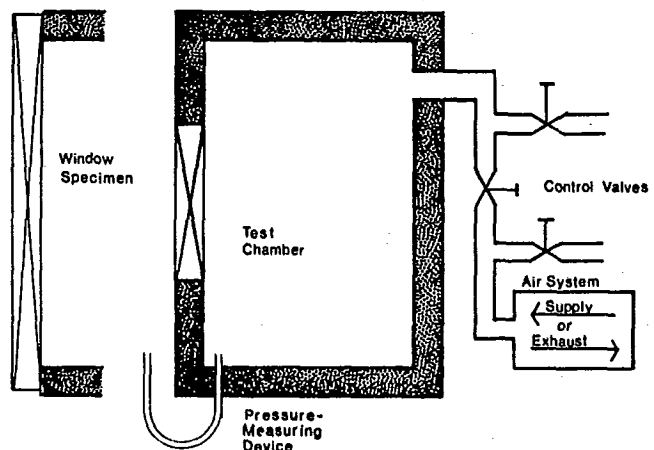


FIG. 1 General Arrangement of Testing Apparatus

⁴ The boldface numbers in parentheses refer to the list of references appended to this test method.