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Standard Test Method for Evaluating Fenestration Components and Assemblies for Resistance to Impact Energies[1]

This standard is issued under the fixed designation E2025; 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 test method covers the evaluation of the resistance of fenestration components, fenestration assemblies, and impact protection systems to specified impact energies.

1.2 Window, glazed door, and skylight assemblies covered by this test method also include individual components, such as the glazing in-fill.

1.3 *This standard does no 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

F476 Test Methods for Security of Swinging Door Assemblies (Withdrawn 2011)[3]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *assembly support fixture, n*—the assembly or structure that supports the test specimen.

3.1.2 *component (fenestration), n*—an individual product that combines with other components to make up a complete fenestration assembly.

3.1.3 *fenestration assembly, n*—a glazed aperture in a building composed of a group of parts or components that may include glass or plastic panels or lites, opaque panels, framing, mullions, muntins and dividers, screens and shading devices, for example, windows or glazed doors, or both.

3.1.4 *glazed panel, n*—glazing installed in a framing system.

3.1.5 *impact energy, n*—impact energy is expressed as vertical drop height of the pendulum, times its weight, for a particular impact event.

3.1.6 *impact energy (cumulative), n*—the sum of impact energies from each of the respective impact events for the entire applied impact sequence, derived from intentionally impacting the test specimen more than once; the total impact energy either applied to meet a test protocol or observed during an impact sequence and associated with a particular level of damage.

3.1.7 *impact protection system, n*—moveable (or permanent) construction that may be applied, attached or locked over a fenestration assembly to protect the assembly from impact, for example, shutters.

3.1.8 *impact ram, n*—the device that (when released) delivers the impact energy to the test specimen. The impact ram includes the impact nose.

3.1.9 *instrumented impact testing, n*—additional apparatus attached to the impact ram to provide for the load versus deformation responses of fenestration components and assemblies under various impact conditions.

3.1.10 *plastic glazing sheet material, n*—an organic plastic sheet specifically developed for glazing.

3.1.11 *required impact energy, n*—the potential energy level specified for a single impact event to be applied in the test as required by the specifying authority.

3.1.12 *required impact sequence, n*—the number of impact events and the required impact energy for each event to be applied to a specimen in the test and the order in which the events are to be applied as required by the specifying authority.

3.1.13 *required cumulative energy, n*—the sum of the impact energy times the number of each such impact events for the

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[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] 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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

entire required impact sequence to be applied to a specimen in the test as required by the specifying authority.

3.1.14 *test specimen, n*—the fenestration assembly, impact protection system or glazing in-fill, which is subject to the impact energies delivered by the impact ram.

4. Summary of Test Method

4.1 This test method consists of installing a fenestration component, fenestration assembly, or impact protection system in a wall assembly and impacting the test specimen.

4.2 The impact is applied by an impact ram supported by a pendulum system and released from a specified height.

5. Significance and Use

5.1 This test method is intended for determining the ability of a fenestration component, fenestration assembly, or impact protection system to resist specified impact energies.

5.2 The test apparatus, referenced herein, is capable of applying a variety of impacts to a specimen as the impactor head may be fabricated into a variety of shapes and from materials having different degrees of hardness. The user is able to simulate a specific type of impact and the impact energy with this apparatus.

5.3 There is a need to correlate the damage to fenestration assemblies from the impacts in question with the impacts delivered by the test apparatus in order for the test results to be properly interpreted. Due to the nature of the test apparatus, care must be taken when interpreting the results of a specific test to actual performance in the field. The impact energies involved in a pendulum impact cannot be directly transferred to impact energies applied by other devices, for example, projectiles; therefore, the performance of a specimen to the impacts applied by this test method are not directly transferable to performance in actual use. The application of impact energies to a specimen, as applied in this test method, however, does provide valuable information regarding the ability of the specimen to resist damage when impacted.

NOTE 1—Use Test Method E1886 for determining the performance of fenestration components subjected to impacts from windborne debris in a windstorm environment.

5.4 When using this test method to compare the performance of products the same impact nose, impact device mass and impact speed must be applied to each product tested.

6. Apparatus

6.1 *Impact Device*—A variable mass moving carriage (impact ram), supported by a suspension system of four cables, shall be used to supply the specified level of impact energy.

6.1.1 The impact device shall be a pendulum system with an impact ram capable of delivering the specified horizontal impact energy.

6.1.2 The mass of the (movable) suspension system shall not exceed 5 % of the mass of the impact ram, including impact ram nose, and shall not be included as part of the specified impact mass.

6.1.3 Care shall be taken to prevent impact ram wobble and to assure that the impact ram is level and perpendicular to the specimen at impact. No slack in the supporting cables is allowed when retracting the impact ram to the specified drop height. The length of the cables in the suspension system defines the allowable drop height for that system. To prevent impact ram wobble, it is necessary to use two pairs of cables of sufficient separation that, hanging unrestrained, are parallel to each other when viewed perpendicular to the long axis of the impact ram.

6.1.4 Use a quick release mechanism that is capable of holding the impact ram and releasing it in uniform manner without imparting any forward motion or acceleration. Provide a means to assure that the impact ram does not unintentionally strike the specimen after the initial impact, that is, rebound and strike the specimen again.

6.1.5 The nose of the impact ram shall be of any material, shape, size, or surface as specified and within the weight limits for the impact device. Standardize the impact nose specified and referenced for particular tests. Impact nose substitutions shall meet the criteria of hardness, shape, and composition specified for the impact nose by the test protocol. Adjust the impact ram length for the specified impact nose to comply with impact device system weight limits.

NOTE 2—Variations in impact nose specifications or composition may affect test results.

6.1.5.1 Unless otherwise specified, the impact nose shall be 2.5 ± 0.2 in. (63 mm ± 5 mm) in diameter and the radial tolerance shall be within 0.125 in. (3.2 mm). The nose shall be made from cast epoxy-polyamide resin with a measured Shore A durometer hardness of 80 (± 5). No chips or surface blemishes shall be present on the impact nose.

6.2 An assembly support fixture shall supply the rigidity normally provided to an assembly in a building by the ceiling, floor, and walls. The support fixture for the specimen shall consist of a vertical wall section constructed from nominal steel or 2 × 4-in. wood studs, 16 in. (406 mm) on center, with a rough opening of sufficient size to support the test specimen. Install the specimen into the rough opening in accordance with the manufacturer specifications with clearances between the specimen and rough opening no greater than 0.75 in. (18 mm) on all sides of the specimen. Cover both sides of the vertical wall section with ½ in. (12.7 mm) exterior grade plywood. The assembly shall conform to the wall assembly described in Test Methods F476. The limiting deflection of the wall shall be L/175 (based on the anticipated loads).

6.3 *Standard Test Frame*—To test glazed panels, design the standard test frame to support a rectangular specimen in a vertical plane and expose it to impact energies. Construct the frame of 2-in. (50-mm) steel angles, at least ¼-in. (6.4-mm) thick, welded at all four corners to form a rigid assembly. Support the assembly is with a support fixture similar to that described in 6.2. Line that part of the test frame that comes in contact with the glazed panel with hardwood stripping. The wood stripping in turn is to be covered with ⅜ × ¾ in. (9.5 × 19 mm) neoprene stripping, which shall have a Shore A durometer hardness of 30 to 50 and a compressive strength of 4–10 lb/lineal in. (0.7–1.7 kN/m). The neoprene stripping shall be in full contact with all four edges of the specimen.