



Standard Specification for Generic Performance Requirements for Exterior Residential Window Assemblies¹

This standard is issued under the fixed designation E 1017; 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 establishes the performance requirements for exterior prime and replacement residential window assemblies, regardless of their method or materials of manufacture. These requirements are limited only to exterior prime window assemblies and does not include requirements for secondary windows or storm windows.

1.2 Although this specification establishes various levels of acceptance criteria for window assemblies, there is no intent to infer that a given window assembly or design meeting any of these levels is acceptable for use in a particular building. The loads and levels of performance to which the test specimen is subjected within this specification are physical quantities to be applied or measured during testing and do not include consideration of safety factors.

1.3 This is a developmental specification representing those parameters that are customarily used to measure the generic performance of windows. The requirements prescribed in this specification shall be supplemented by the writers of individual window specifications to take into account particular material of construction. It is the intent of Subcommittee E06.51 to expand these requirements in future revisions to cover additional parameters as applicable.

1.4 The values stated in inch-pound units are to be regarded as the standard. SI equivalents of inch-pound units may be approximate.

1.5 The following hazards caveat pertains only to the test method portion, Section 8, 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

E 283 Test Method for Determining the Rate of Air Leakage

Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Across the Specimen²

E 330 Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference²

E 547 Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential²

E 631 Terminology of Building Constructions²

F 588 Test Methods for Resistance of Window Assemblies to Forced Entry, Excluding Glazing²

2.2 ANSI Standard:

A58.1 Building Code Requirements for Minimum Design Loads in Buildings and Other Structures³

3. Terminology

3.1 *Definitions:* For definitions of terms used in this specification, see Terminology E 631 or the appropriate test method.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *exterior window*—the construction intended to be installed in the exterior of the building envelope; does not refer to the position of this construction relative to a storm or secondary window.

3.2.2 *prime window*—the vision area of new building construction that protects the building interior from climatic elements as opposed to a storm or secondary product used mainly for energy conservation.

3.2.3 *replacement window*—the vision area that takes the place of an existing window.

4. Classification

4.1 Window assemblies are generally divided into types based upon their intended application (for example, residential, commercial, industrial, etc.). For the purposes of this specification, which deals only with residential-type window assemblies, windows are subdivided into the following grades based on their performance capabilities with the grade numbers indicating the design pressure in pounds per square foot.

4.1.1 Grade 15,

¹ This specification is under the jurisdiction of ASTM Committee E-6 on Performance of Buildings 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 04.11.

³ Available from American National Standards Institute, 11 West 42nd Street, New York, NY 10036.

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TABLE 1 Performance Test Requirements (Inch-Pound Units)

	Grade Level									
	15	20	25	30	35	40	45	50	55	60
Preliminary load (minimum test pressure sustained without damage), lbf/ft ²	15	20	25	30	35	40	45	50	55	60
Air infiltration for operable windows (maximum infiltration at each test pressure, ft ³ /min-ft of operating crack length):										
0.57 lbf/ft ²	0.25	0.25	0.25	0.20	0.20	0.20	0.20	0.10	0.10	0.10
1.57 lbf/ft ²	0.37	0.37	0.37	0.30	0.30	0.30	0.30	0.15	0.15	0.15
6.24 lbf/ft ²	0.75	0.75	0.75	0.60	0.60	0.60	0.60	0.30	0.30	0.30
Air infiltration for nonoperable windows ^A (maximum infiltration at each test pressure, ft ³ /min-ft ² of overall window area):										
0.57 lbf/ft ²	0.25	0.25	0.25	0.20	0.20	0.20	0.20	0.10	0.10	0.10
1.57 lbf/ft ²	0.37	0.37	0.37	0.30	0.30	0.30	0.30	0.15	0.15	0.15
6.24 lbf/ft ²	0.75	0.75	0.75	0.60	0.60	0.60	0.60	0.30	0.30	0.30
Water penetration (minimum test pressure sustained without leakage, lbf/ft ²)	2.86	2.86	2.86	3.00	3.50	4.00	4.50	5.00	5.50	6.00
Structural performance (minimum test pressure sustained without damage, lbf/ft ²)	22.5	30	37.5	45	52.5	60	67.5	75	82.5	90
Forced entry resistance ^B	...	...	...	...	...	...	...	...	...	...

^A Nonoperable windows refer to a complete window assembly and do not include any operable portions. To calculate air leakage when windows contain both operable and nonoperable portions, no consideration shall be made for the nonoperable portion of the window unit.

^B To be determined by the specifying authority.

- 4.1.2 Grade 20,
- 4.1.3 Grade 30,
- 4.1.4 Grade 40,
- 4.1.5 Grade 50, and
- 4.1.6 Grade 60.

5. Performance Requirements

5.1 *Preliminary Loading Requirements*—When tested in accordance with 8.1, under the uniform static air pressure differential prescribed in Table 1 and Table 2 for the grade of performance desired, there shall be no glazing material breakage, permanent damage to fasteners, hardware parts, or any other components that would cause the unit to be inoperable.

5.2 *Operating Force Requirements*—When tested in accordance with 8.2, the operating force shall never exceed 25 lbf (111 N).⁴

5.3 *Air Infiltration Requirements*—When tested in accordance with 8.3, the rate of air infiltration measured at each of the three uniform static air pressure differentials shall not exceed the limits established in Table 1 and Table 2 for the grade of performance desired.

5.4 *Water Penetration Resistance Requirements*—When tested in accordance with 8.4, under the uniform static air pressure differential prescribed in Table 1 and Table 2 for the grade of performance desired, no water shall pass beyond the interior face of the test specimen and overflow into the room or penetrate into the wall cavity area.

5.5 *Structural Performance Requirements*—When tested in accordance with 8.5, under the uniform static air pressure

differential prescribed in Table 1 and Table 2 for the grade of performance desired, there shall be no glazing material breakage, permanent damage to fasteners, hardware parts, or any other components that would cause the unit to be inoperable, and there shall be no permanent deformation of any main frame, sash, or ventilator member in excess of 0.4 % of its span.

5.6 *Forced Entry Resistance Requirements*—When tested in accordance with 8.6, the forced entry resistance shall meet or exceed Test Methods F 588 requirements set forth by the specifying authority.

6. Test Specimen

6.1 Window assemblies tested for conformance to this specification shall be specimens representative of those produced by the manufacturer or fabricator. Test specimens shall be caulked, sealed, painted, or otherwise finished and prepared only as they would normally be prepared for actual installation and use. Test specimens shall be mounted for testing as required by the appropriate test method, in a manner simulating the intended field installation of the unit in accordance with the manufacturer’s written installation instructions.

6.2 Test specimens submitted for testing for conformance to this specification shall be of the largest frame and sash or ventilator size for which conformance is desired.

6.2.1 Casement, awning, projected, nonoperative, and similar designs submitted for testing shall be of the largest unit frame and sash or ventilator area for which conformance is desired.

6.2.2 Double-hung, single-hung, and similar designs submitted for testing shall be of the greatest width and of the largest unit frame and sash or ventilator area in that width for which conformance is desired.

⁴ Supporting data are available from ASTM Headquarters. Request RR: E06-1001.


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TABLE 2 Performance Test Requirements (SI Units)

	Grade Level									
	15	20	25	30	35	40	45	50	55	60
Preliminary load (minimum test pressure sustained without damage), Pa	718	958	1197	1436	1676	1915	2155	2394	2633	2873
Air infiltration for operable windows (maximum infiltration at each test pressure, m ³ /s-m of operating crack length):										
27 Pa	3.87 × 10 ⁻⁴	3.87 × 10 ⁻⁴	3.87 × 10 ⁻⁴	3.10 × 10 ⁻⁴	3.10 × 10 ⁻⁴	3.10 × 10 ⁻⁴	3.10 × 10 ⁻⁴	1.55 × 10 ⁻⁴	1.55 × 10 ⁻⁴	1.55 × 10 ⁻⁴
75 Pa	5.73 × 10 ⁻⁴	5.73 × 10 ⁻⁴	5.73 × 10 ⁻⁴	4.64 × 10 ⁻⁴	4.64 × 10 ⁻⁴	4.64 × 10 ⁻⁴	4.64 × 10 ⁻⁴	2.32 × 10 ⁻⁴	2.32 × 10 ⁻⁴	2.32 × 10 ⁻⁴
300 Pa	1.16 × 10 ⁻³	1.16 × 10 ⁻³	1.16 × 10 ⁻³	9.29 × 10 ⁻⁴	9.29 × 10 ⁻⁴	9.29 × 10 ⁻⁴	9.29 × 10 ⁻⁴	4.64 × 10 ⁻⁴	4.64 × 10 ⁻⁴	4.64 × 10 ⁻⁴
Air infiltration for nonoperable windows ^A (maximum infiltration at each test pressure, m ³ /s-m ² of overall window area):										
27 Pa	1.27 × 10 ⁻³	1.27 × 10 ⁻³	1.27 × 10 ⁻³	1.02 × 10 ⁻³	1.02 × 10 ⁻³	1.02 × 10 ⁻³	1.02 × 10 ⁻³	5.08 × 10 ⁻⁴	5.08 × 10 ⁻⁴	5.08 × 10 ⁻⁴
75 Pa	1.88 × 10 ⁻³	1.88 × 10 ⁻³	1.88 × 10 ⁻³	1.52 × 10 ⁻³	1.52 × 10 ⁻³	1.52 × 10 ⁻³	1.52 × 10 ⁻³	7.62 × 10 ⁻⁴	7.62 × 10 ⁻⁴	7.62 × 10 ⁻⁴
300 Pa	3.81 × 10 ⁻³	3.81 × 10 ⁻³	3.81 × 10 ⁻³	3.05 × 10 ⁻³	3.05 × 10 ⁻³	3.05 × 10 ⁻³	3.05 × 10 ⁻³	1.52 × 10 ⁻³	1.52 × 10 ⁻³	1.52 × 10 ⁻³
Water penetration (minimum test pressure sustained without leakage), Pa	137	137	137	144	167	192	215	239	263	287
Structural performance (minimum test pressure sustained without damage), Pa	1077	1436	1795	2155	2513	2873	3231	3591	3949	4309
Forced entry resistance ^B	...	...	...	...	...	...	...	...	...	...

^A Nonoperable windows refer to a complete window assembly and do not include any operable portions. To calculate air leakage when windows contain both operable and nonoperable portions, no consideration shall be made for the nonoperable portion of the window unit.

^B To be determined by the specifying authority.

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6.2.3 Horizontal-sliding and similar designs submitted for testing shall be of the greatest height and of the largest unit frame and sash or ventilator area in that height for which conformance is desired.

6.2.4 For designs not specifically addressed in 6.2.1-6.2.3, the window manufacturer, testing agency, and specifier shall mutually agree upon the size and configuration of the specimen to be submitted for testing.

NOTE 1—It should be recognized that performance is likely to be a function of size and geometry. Therefore, one should select specimens covering the range of sizes for which conformance to this specification is desired. In general, the largest size and most heavily loaded of a particular design, type, construction, or configuration should be tested.

6.3 For those designs where more than one configuration or arrangement of sash or ventilators is possible, (for example, OX versus OXO horizontal-sliding window designs), all configurations of the unit design shall be tested unless otherwise stipulated by the testing agency or specifier. (See Table X1.1 for configurations and window designs.)

6.3.1 Simple reversal of arrangement of sash or ventilators (for example, OX versus XO horizontal-sliding window designs) is not considered a variation in design and does not require separate testing of each arrangement. (See Table X1.1 for configurations and window designs.)

6.3.2 Simple repetitive stacking or mulling of identical unit designs is not considered a variation in design and does not require separate testing of each possible configuration. One test specimen consisting of not less than three typical units wide or high, or both, shall constitute the configuration covering all other configurations.

7. Test Sequence

7.1 The tests required by this specification shall be performed in the sequence outlined in 7.1.1-7.1.6. If changes or adjustments are made to the test specimen during the conduct of this sequence of tests, necessitating retesting, the test specimen must be thoroughly dried before the conduct of the retest.

- 7.1.1 Preliminary loading,
- 7.1.2 Operating force test,
- 7.1.3 Air infiltration test,
- 7.1.4 Water penetration resistance test,
- 7.1.5 Structural performance test, and
- 7.1.6 Forced entry resistance test (test can be performed on a separate specimen).

8. Test Methods

8.1 *Preliminary Loading*—The equipment used to conduct this test is identical to the equipment used to conduct the