Designation: F 588 – 97

An American National Standard

Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact[1]

This standard is issued under the fixed designation F 588; 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 These test methods determine the ability of window assemblies of various types to restrain, delay, or frustrate forced entry.

1.2 For purposes of these test methods, window assemblies are classified as described in 1.2.1-1.2.4 and as shown in Fig. 1. Window assemblies with a combination of operable sash and fixed panes (lites) shall be classified and tested separately for each type.

1.2.1 *Type A*—A window assembly which incorporates one or more sash that open by sliding, either vertically or horizontally within the plane of the wall.

1.2.2 *Type B*—A window assembly which incorporates one or more sash that are hinged at or near two corners of the sash and that open toward the exterior (outswinging) or toward the interior (inswinging).

1.2.3 *Type C*—A window assembly which incorporates one or more sash that are pivoted so that part of the sash opens toward the interior and part of it opens toward the exterior.

1.2.4 *Type D*—A window assembly which incorporates one or more fixed panes (lites) or stationary sash that are designed not to open.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *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.* For a specific hazard statement, see Section 8.

2. Referenced Documents

2.1 *ASTM Standards:*

E 631 Terminology of Building Constructions[2]

3. Terminology

3.1 *Definitions:* Definitions for standard terminology can be found in Terminology E 631.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *locking device(s) (lock), n*—one or more components of a window assembly intended to resist the opening of movable sash from the exterior.

3.2.2 *sash operator, n*—a component of the window assembly that is used to move, pivot, or to adjust the position of a movable sash within the window frame. (The sash operator, in some window assemblies, is also a locking device.)

4. Summary of Test Method

4.1 The procedure consists of mounting a specimen into a test assembly fixture which in turn is mounted to a wall support fixture, and, after removing all exterior fasteners and loose component items, specified loads and forces are applied to the window test specimen in a prescribed sequence. Following removal of all loads, a determination is made as to whether or not entry can be gained through the window test specimen from the exterior.

5. Significance and Use

5.1 These test methods are intended to establish a measure of resistance for window assemblies subjected to attacks (other than impacting glazing materials) by unskilled or opportunistic burglars. Resistance to higher levels of force generated by skilled burglary attack requires methods, such as alarms, communication, or apprehension systems, or special security glazing materials more sophisticated than those evaluated by these test methods.

5.2 Acceptance criteria for performance levels are a matter for authorities having specific jurisdiction to establish. Suggested guidelines are found in the Annex.Annex A1

6. Test Criteria

6.1 *Window Test Specimen*—The same window assembly shall be used for all testing and shall contain sash having the greatest height and width for which approval is sought.

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[1] These test methods are under the jurisdiction of ASTM Committee E06 on Performance of Buildings and are 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.

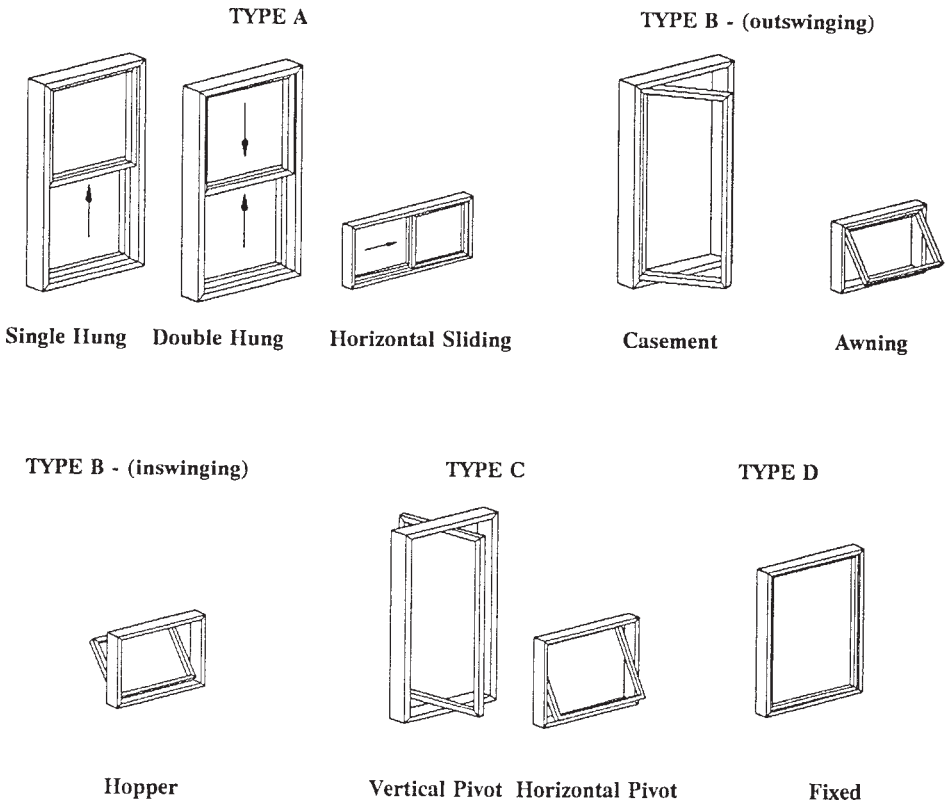

FIG. 1 Typical Window Types (viewed from the exterior)

6.1.1 The construction of the window test specimen, including all hardware, components, and arrangement of sash shall be representative of that for which acceptance is desired.

6.1.2 The window test specimen shall consist of the entire assembled unit, including frame, glazing, and anchorage as supplied by the manufacturer for installation in the building.

6.1.3 Unless otherwise specified, the window test specimen shall contain annealed glass for testing and shall be single glazed if designed for either single or double glazing, or double glazed if designed exclusively for multiple glazing. Products tested with glazing materials other than annealed glass shall qualify only the specific glazing material tested.

6.1.4 Windows tested with more than one locking device shall not qualify windows with fewer locking devices, regardless of size.

6.2 *Performance Criteria*—The performance level is attained if all locking devices remain engaged and entry cannot be gained during the test or upon removal of loads. If during testing, any component, including the glazing material, fails, allowing entry, this shall be considered a failure to attain the performance level. Glazing which breaks, but which does not allow entry, shall not be considered a failure to attain the performance level.

6.3 *Multiple Sash*—Window assemblies with a combination of operable sash and fixed panes (lites) shall be classified and tested separately for each type. If multiple sash within a window assembly are identical in construction and locking condition, only one sash need be tested.

6.4 *Test Sequence*—Perform the tests for each window test specimen in the sequence as outlined in Section 10. The sequence for testing multiple sash shall be at the discretion of the testing agency.

6.5 *Loading*—Apply test loads and forces at a rate not to exceed 4.5 kg/s (10 lb/s). Maintain performance level loads for a period of 60 ± 5 s.

6.6 *Load Removal*—At the conclusion of each test, remove all loads before starting the next test.

7. Apparatus

7.1 *Instrumentation*—Load and time-measuring devices with an accuracy of ± 2 % of the full scale shall be incorporated in the test setups. The scale ranges used shall assure that the performance levels are within an accuracy of ± 5 %.

7.2 *Load Attachments*—Brackets, fasteners, or other devices used in performing these tests shall be designed and attached so as to minimize their influence on the test results.

7.3 *Test Frame*—The test frame shall be designed and constructed to accept and rigidly secure the window specimen and to provide rigid points of anchor for all test loads described in Section 10. The load bearing members of the test frame shall be constructed to limit deflection of such members to a maximum of 3 mm (⅛ in.) under full prescribed load.

8. Hazards

8.1 Glass breakage may occur during the application of loads or forces required by these test methods. Take adequate precautions to protect personnel from broken glass.

8.2 Locking devices, glass, and other window test specimen components may suddenly fail when loads and forces are applied during these test methods, causing sash to open rapidly. Take adequate precautions to protect personnel from rapidly moving weights and window test specimen components.

9. Preparation

9.1 Mount the window test specimen into a nominal 2×4 or 2×6 lumber surround frame, in accordance with the manufacturer's written installation instructions.

9.2 Install the mounted window test specimen into the test frame, rigidly supporting the mounting frame to resist all loads stipulated for the type of specimen to be tested.

9.3 Close and lock the window test specimen.

9.4 Without in any other manner damaging the window test specimen, remove from the window test specimen all screws, glazing beads, and any other members or other mechanical fasteners that can be removed readily from the exterior within a time limit of 5 min using the following tools:

9.4.1 A spatula or other non-cutting tool with a thin blade, 0.75 to 0.85 mm (0.030 to 0.033 in.) thick, 19 to 25 mm (¾ to 1 in.) wide, and 125 to 150 mm (5 to 6 in.) long.

9.4.2 Any non-powered screwdriver appropriate to the mechanical fastener.

9.4.3 A standard slot-type pliers with a 150 to 175 mm (6 to 7 in.) overall length.

10. Procedure

10.1 *Lock Manipulation Test*:

10.1.1 Examine the window test specimen and determine a method of inserting the tools in 10.1.1.1 and 10.1.1.2 from the outside so as to contact the locking device. Without damaging the window test specimen and using one technician only, attempt to gain entry by attempting to open the sash by hand and manipulating the locking device with these tools, in any combination. Conduct this test continuously for a time limit of (T_1).

10.1.1.1 A spatula or other non-cutting tool with a thin blade, 0.75 to 0.85 mm (0.030 to 0.033 in.) thick, 19 to 25 mm (¾ to 1 in.) wide, and 125 to 150 mm (5 to 6 in.) long.

10.1.1.2 A piece of stiff steel wire (such as, a coat hanger) at least long enough to reach from the point of insertion to the locking device(s). The wire diameter shall be 1.3 to 1.8 mm (0.05 to 0.07 in.).

10.2 *Static Load on Sash and Locking Device Strength Resistance Tests*:

10.2.1 *Type A Window Assembly*:

10.2.1.1 *Test A1*——With the sliding sash in the test position, a concentrated load (L_1) shall be applied separately, from the exterior, to each member incorporating a locking device, at a point on the sash member within 75 mm (3 in.) of the locking device, in a direction parallel to the plane of the glass that would tend to open the window. For interior sliding sash where the locking device is mounted at the interlocking stile or rail, the load attachment point shall be at the center of the member directly opposite the member which contains the locking device. Where more than one primary lock is used, the load shall be equally divided among the locks and shall be applied simultaneously. (See Fig. 2.)

10.2.1.2 *Test A2*—Repeat Test A1 (see 10.2.1.1) while, simultaneously, an additional concentrated load (L_2) is applied to the center of the exposed interlocking stile or rail, in the direction perpendicular to the plane of the glazing material toward the interior side of the window. (See Fig. 2.)

10.2.1.3 *Test A3*—Repeat Test A1 (see 10.2.1.1) while, simultaneously, an additional concentrated load (L_2) is applied to the center of the exposed interlocking stile or rail, in the direction perpendicular to the plane of the glazing material toward the exterior side of the window. (See Fig. 2).

10.2.1.4 *Test A4*—Repeat Test A1 (see 10.2.1.1) while, simultaneously, an additional concentrated load (L_2) is applied to the center of the member opposite the interlocking stile or rail, in the direction perpendicular to the plane of the glazing material toward the interior side of the window. (See Fig. 3).

10.2.1.5 *Test A5*—Repeat Test A1 (see 10.2.1.1) while, simultaneously, an additional concentrated load (L_2) is applied to the center of the member opposite the interlocking stile or rail, in the direction perpendicular to the plane of the glazing material toward the exterior side of the window. (See Fig. 3.)

10.2.1.6 *Test A6, Outside Sliding Sash*—With the sliding sash lifted upward (for horizontal operating units) or shifted toward the frame jamb (for vertical operating units) to the full limit within the confines of the frame, repeat Test A3 (see 10.2.1.3) while simultaneously applying a concentrated load (L_3) outward within 75 mm (3 in.) of the corner of the operating sash on the interlocking stile or rail. (See Fig. 3.)

10.2.1.7 *Test A7, Inside Sliding Sash*—With the sliding sash lifted upward (for horizontal operating units) or shifted toward the frame jamb (for vertical operating units) to the full limit within the confines of the frame, repeat Test A2 (see 10.2.1.2) while simultaneously applying a concentrated load (L_3) inward within 75 mm (3 in.) of the corner of the operating sash on the interlocking stile or rail. (See Fig. 3.)

10.2.1.8 After completion of Tests A1 through A7 (see 10.2.1.1-10.2.1.7) and with all loads removed, perform the Lock Manipulation Test (see 10.1).

10.2.2 *Type B Window Assemblies*:

10.2.2.1 *Test B1*—With the swinging sash in the test position, simultaneously apply a concentrated load (L_2) within 75 mm (3 in.) from each end of the rail or stile which is opposite the hinged side, in the direction perpendicular to the plane of the glazing that would tend to open the window. (See Fig. 4.)

10.2.2.2 *Test B2*—Repeat Test B1 (see 10.2.2.1), while simultaneously applying a concentrated load (L_1) from the exterior side within 25 mm (1 in.) from the end of the stile or rail between the lock stile and frame or mullion, in a direction parallel to the short dimension of the window test specimen and parallel to the plane of the glazing material in a manner which would tend to disengage the lock. (See Fig. 4.)

10.2.2.3 *Test B3*—Repeat Test B1 (see 10.2.2.1), while simultaneously applying a concentrated load (L_1) from the exterior side within 25 mm (1 in.) from the end of the stile or rail between the lock stile and frame or mullion, in a direction parallel to the long dimension of the window test specimen and parallel to the plane of the glazing material in a manner which would tend to disengage the lock. (See Fig. 4.)

TYPE A WINDOW

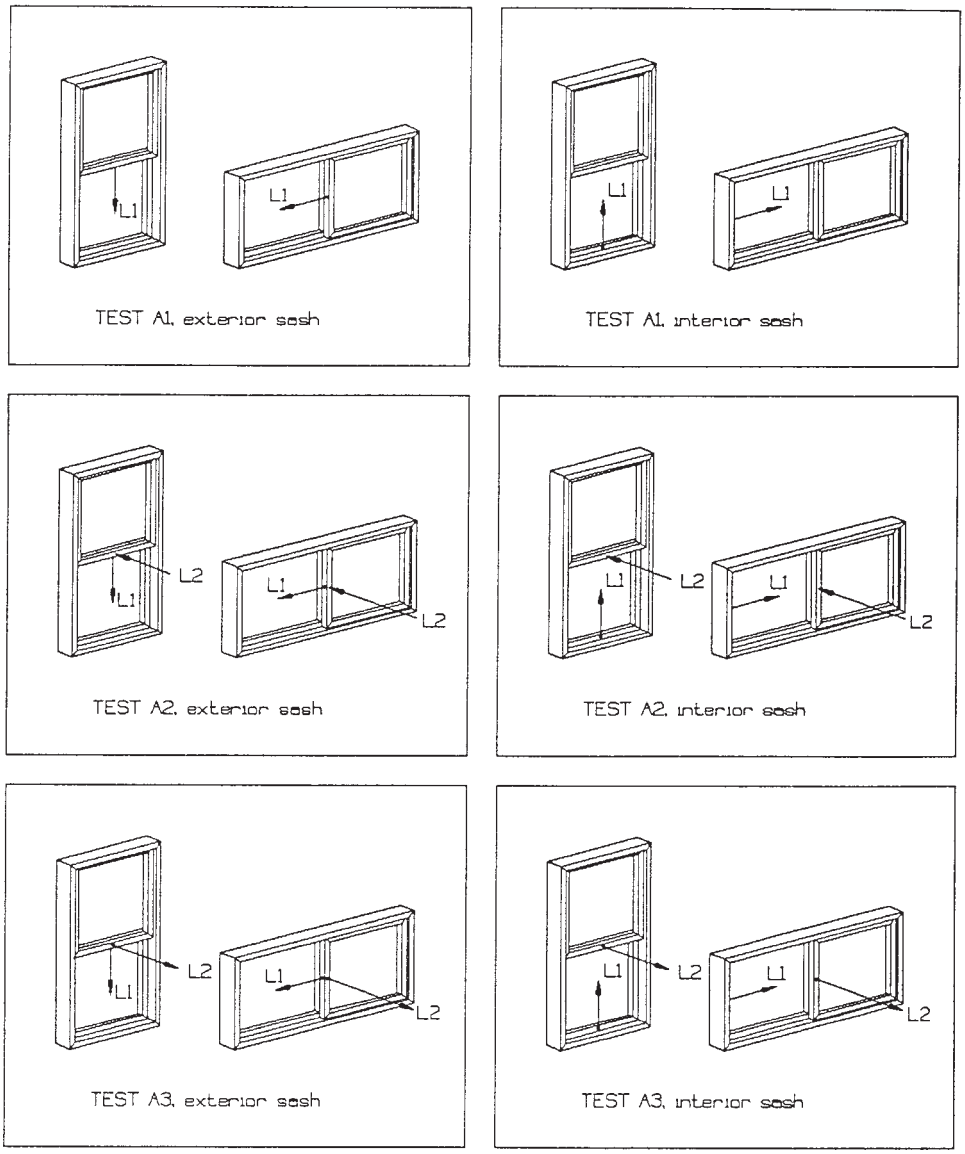

FIG. 2 Schematic of Test Load Applications (viewed from the exterior)

10.2.2.4 After completion of Tests B1 through B3 (see 10.2.2.1-10.2.2.3) and with all loads removed perform the Lock Manipulation Test (see 10.1).

10.2.3 *Type C Window Assembly*:

10.2.3.1 *Test C1*—With the sash in the test position, simultaneously apply a concentrated load (L_2) 75 mm (3 in.) from each end of each rail or stile which is perpendicular to the pivot sides in the outward direction that would tend to open the sash. (See Fig. 5.)

10.2.3.2 *Test C2*—With the sash in the test position, apply a concentrated load (L_1) on the rail or stile containing the pivot pins within 75 mm (3 in.) from the pivot in a direction parallel to the glazing which would tend to disengage the pivot. (See Fig. 5.)

10.2.3.3 *Test C3*—Repeat Test C2 (see 10.2.3.2), applying the load to the opposite rail or stile containing the pivot. (See Fig. 5.)

10.2.3.4 *Test C4*—Repeat Test C2 (see 10.2.3.2) while simultaneously applying a concentrated load (L_1) to the member containing the locking device within 75 mm (3 in.) of the lock in the direction that would tend to open the sash. If more than one primary lock is used, the load shall be equally divided among the locks and applied simultaneously. (See Fig. 5.)

10.2.3.5 *Test C5*—Repeat Test C3 (see 10.2.3.3) while simultaneously applying a concentrated load (L_1) to the member containing the locking device within 75 mm (3 in.) of the lock in the direction that would tend to open the sash. If more than one primary lock is used, the load shall be equally divided among the locks and applied simultaneously. (See Fig. 5.)

10.2.3.6 After completion of Tests C1 through C5 (see 10.2.3.1-10.2.3.5) and with all loads removed, perform the Lock Manipulation Test (see 10.1).

10.2.4 *Type D Window Assembly*:

TYPE A WINDOW (continued)

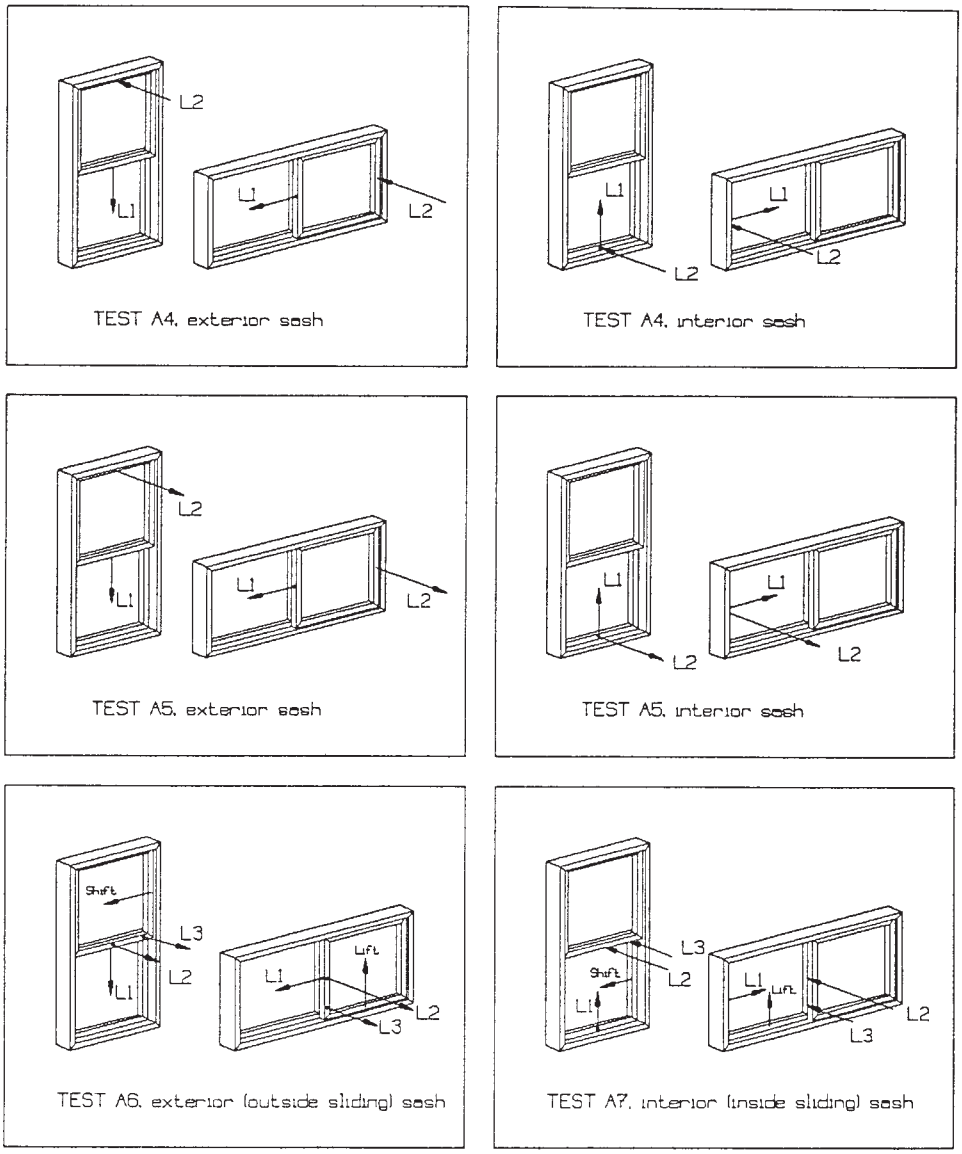

FIG. 3 Schematic of Test Load Applications (viewed from the exterior)

10.2.4.1 If a locking device is present anywhere on the window test specimen, apply the Lock Manipulation Test (see 10.1) and attempt to remove the glazed panel within a time limit of (T_1).

10.2.4.2 If a locking device is not present anywhere on the window test specimen, examine the window assembly and determine a method of inserting the tools in 10.1.1.1 and 10.1.1.2 from the outside between the glazed panel and the remainder of the window test specimen. Without damaging the window test specimen, attempt to gain entry by attempting to open the glazed panel by hand and manipulating it with these tools, in any combination. Conduct this test continuously for a time limit of (T_1).

11. Report

11.1 The report shall contain a description of the results of the test(s) performed in accordance with these test methods.

11.2 The report shall also include at least the following:

11.2.1 Identification of the window test specimen;

11.2.2 Type, size, location, and number of locking devices and other hardware;

11.2.3 Type, location, and number of installation fasteners;

11.2.4 Type and thickness of glazing material;

11.2.5 Bill of materials;

11.2.6 Assembly drawing;

11.2.7 Performance level, loads, and times (L_1, L_2, L_3, T_1) used;

11.2.8 A statement as to whether the window specimen complies or not and the grade at which it complies;

11.2.9 A description of the method of installation or installation fastening; and

11.2.10 A description of the test equipment used.

TYPE B WINDOW

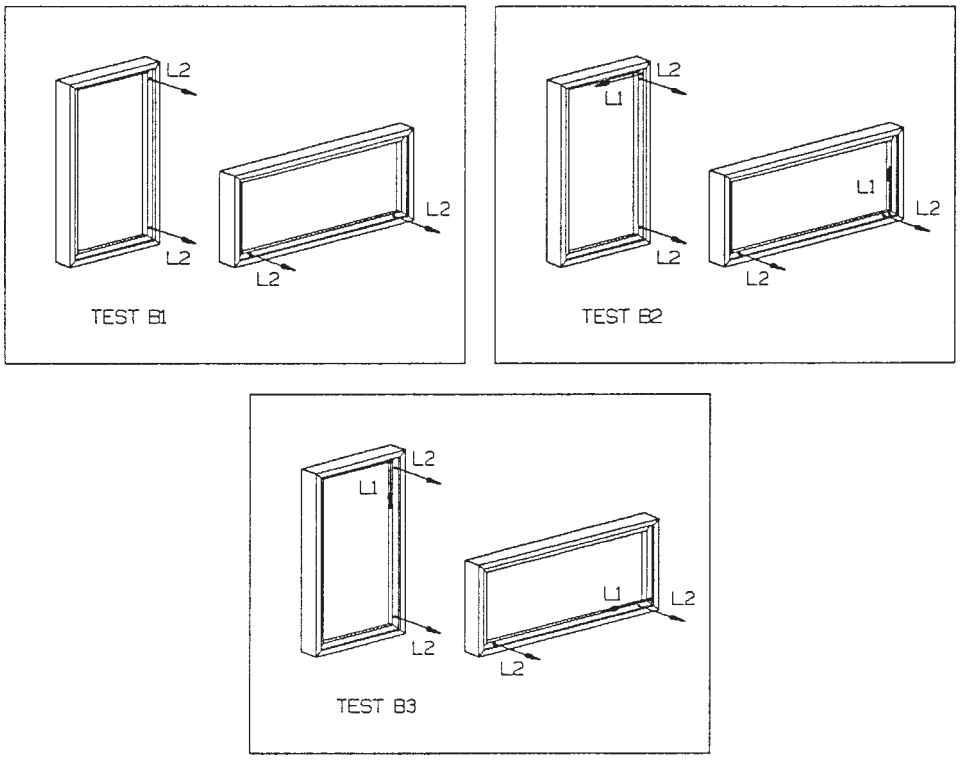

FIG. 4 Schematic of Test Load Applications (viewed from the exterior)

12. Precision and Bias

12.1 These test methods do not generate numerical values. They establish a pass/fail condition which cannot generate numerical values for precision and bias.

13. Keywords

13.1 fenestration; forced entry resistance; laboratory method; windows

TYPE C WINDOWS

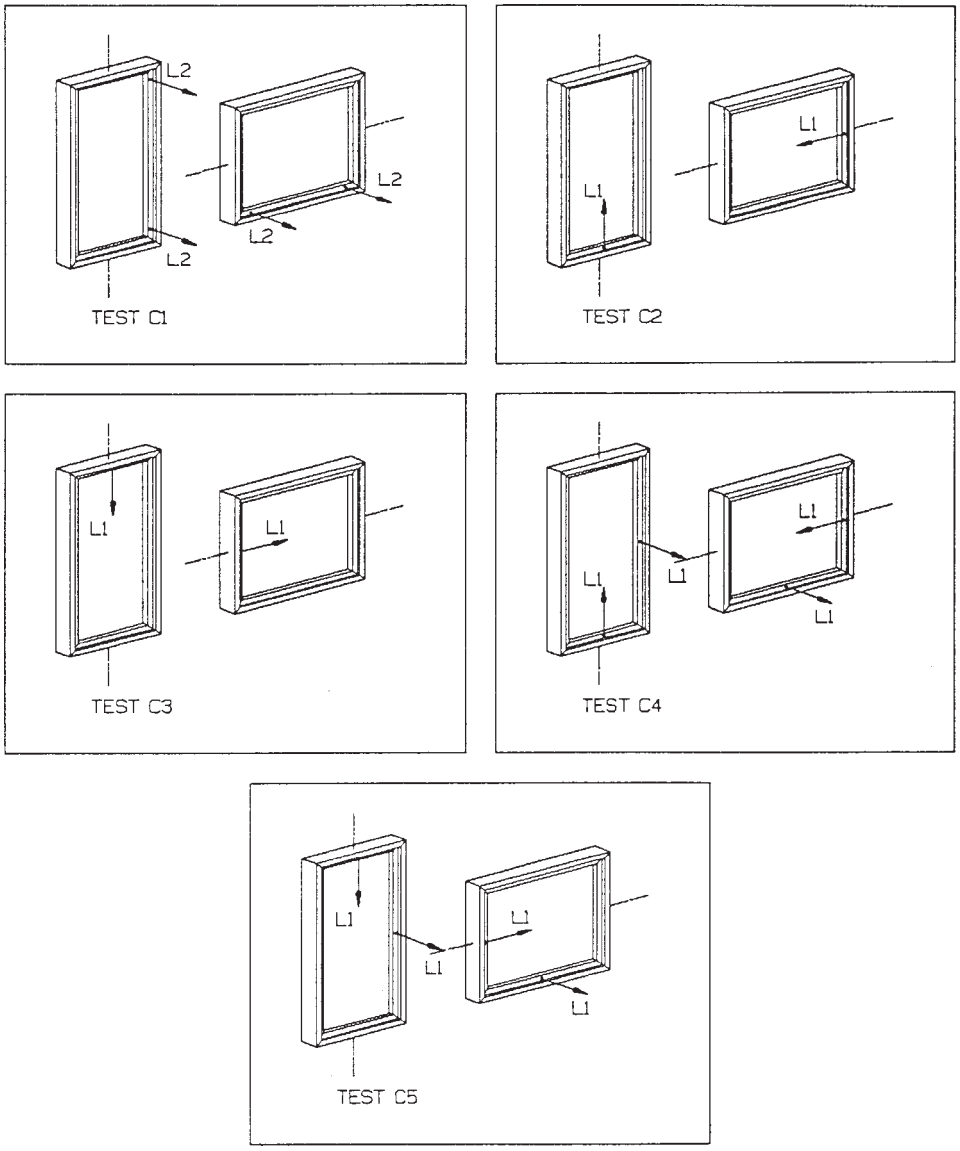

FIG. 5 Schematic of Test Load Applications (viewed from the exterior)

ANNEX

(Mandatory Information)

A1. SUGGESTED MEASURED PERFORMANCE

See Table A1.1

TABLE A1.1 Suggested Measured Performance[A]

Load Identification	Grade 10	Grade 20	Grade 30	Grade 40
T_1	5 min	5 min	10 min	10 min
L_1	667 N (150 lbf)	890 N (200 lbf)	1112 N (250 lbf)	1334 N (300 lbf)
L_2	333 N (75 lbf)	445 N (100 lbf)	556 N (125 lbf)	667 N (150 lbf)
L_3	111 N (25 lbf)	155 N (35 lbf)	222 N (50 lbf)	267 N (60 lbf)

[A] It is suggested that Table A1.1 be used with the understanding that four levels of load identification are established with load identification 40 being the highest and 10 being the lowest. Use of load identifications should be selected in accordance with security objectives desired.

APPENDIX

(Nonmandatory Information)

X1. BACKGROUND INFORMATION

X1.1 A number of documents relative to forced entry resistance testing and test standards were reviewed in the development of these test methods, including those published by the American Architectural Manufacturers Association, California Association of Window Manufacturers, National Wood Window and Door Association, International Conference of Building Officials, and National Institute of Law Enforcement and Criminal Justice. In addition, available crime incident and attack reports were reviewed, such as the California Crime Technological Research Foundation Report. Based on the above information and actual designing and testing by manufacturers associated with window assemblies, these ASTM Window Test Methods were written.

X1.2 These test methods are designed to measure forced-entry resistance of window assemblies. They are not addressed to situations involving high crime areas or areas attacked by professional, sophisticated criminals. To protect against this type of crime, a multiple approach must be taken. This will often include alarm and other surveillance systems and specially designed windows, hardware, and burglary-resistance glazing materials, and, perhaps different test methods. Basically, this type of approach must be custom designed to meet the demands of the specific area or problem and is considered costly beyond the needs of the resident of a low-crime area.