

American National Standard

*Testing and Rating of
Severe Windstorm Resistant Components
for Swinging Door Assemblies*



SPONSORS

**Steel Door Institute and
Builders Hardware Manufacturers' Association**

Approved September 10, 2003



American National Standard

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Severe Windstorm Resistant Components
for Swinging Door Assemblies

Secretariat

Steel Door Institute

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American National Standards Institute, Inc.

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Published by

Steel Door Institute
30200 Detroit Road, Cleveland, Ohio 44145-1967

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Printed in the United States of America

ANSI A250.13-2003

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Foreword (This Foreword is not part of American National Standard A250.13-2003)

In the aftermath of hurricane Andrew in 1993 and other major windstorms, building codes and standards were developed with the goal of improving structures so that they would better resist damage associated with high wind speeds. A primary focus was to include requirements for protective opening systems that would decrease the potential for the building envelope to be breached due to impact from wind-borne debris and high fluctuating wind pressures. As a result, the new building codes included specific test requirements for windows and doors in hurricane-prone areas. These tests were designed to evaluate a complete assembly (door, mounting and latching hardware, door frame and the attachment of the assembly to the surrounding wall) however, few entry door systems, particularly commercial, are marketed as complete assemblies. Thus, there was a problem in defining and providing test results that applied to assemblies when the components to be installed came from multiple sources and included a substantial number of interchangeable elements.

In the fall of 1998 members of the Steel Door Institute (SDI) and members of the Builders Hardware Manufacturers' Association (BHMA) agreed to develop a national standard for a component-based approach to testing and certification for windstorm resistance of swinging door assemblies. The test procedures used in this standard represented the most severe requirements found in all the windstorm resistance standards currently in use in US building codes. However, the procedures are designed to isolate, as much as possible, the loads and conditions that a particular component is subjected to in the full assembly test and duplicate these specific conditions. Using a combination of worst-case assembly design and safety factors, this process was designed to provide a component rating that related directly to the component's ability to withstand the conditions that occur in a full assembly test.

Prior to releasing the proposed standard for consideration, the BHMA/SDI task group conducted validation testing where components were expected to be rated at three design-load target values. Those components were tested to establish their ratings by the proposed procedure. Following this process, complete assemblies were tested in accordance with the ASTM E1886 test method. The results of this process confirmed that assemblies made up of rated components would perform as expected. In addition, the validation test showed that where a component was identified as the weakest element of an assembly, based the component tests, the same component would fail in a similar manner when tested as part of an assembly to levels exceeding the component's rated capacity.

It is the intent of the BHMA/SDI task group to propose A250.13 *Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies* for formal recognition by the Florida Building Code, International Building Code and International Residential Code. Products that have been evaluated and rated under this procedure will be listed and labeled by nationally recognized certification bodies, and will carry identifying certification marks, as well as labels that provide basic rating information. Where applicable, component manufacturers will provide installation instructions and rating data information needed to verify code compliance. Building designers will generally use the data supplied to conduct an opening-by-opening design analysis, verify code compliance, and submit

the results through the normal plan review process. Code Authorities will thus need only to verify that the design load and compliance analysis has been correctly carried out and that the specified components are actually installed during construction in accordance with the manufacturer's instructions and project specifications.

There are three appendices in this standard. Appendices A and C are informative and are not considered part of this standard. Appendix B is normative and is considered part of this standard.

Suggestions for improvement of this standard will be welcome, and should be sent to the Steel Door Institute, 30200 Detroit Road, Cleveland, Ohio 44145-1967.

The organizations that have approved this standard are as follows:

American Institute of Architects
American Iron and Steel Institute
Builders Hardware Manufacturers' Association
Canadian Steel Door Manufacturers' Association
Door and Hardware Institute
Factory Mutual Research Corporation
General Services Administration
Hollow Metal Manufacturers' Association / Division of National Association of Architectural Metal Manufacturers' Association
Insulated Steel Door Institute
International Conference of Building Officials
Intertek Testing Services
Manufactured Housing Institute
National Association of Home Builders
Steel Door Institute
Underwriters Laboratories Inc.
Window and Door Manufacturers' Association

The Accredited Standards Committee A250 TC-1 developed this standard and had the following personnel at the time of approval:

Robert M. Berhinig, Chairman
 J. Jeffery Wherry, Managing Director

<i>Organization Represented</i>	<i>Name of Representative</i>
American Institute of Architects	Christopher Bushnell
American Iron & Steel Institute	Robert Wills
Amweld Building Products LLC	Allan Ashachik
Benchmark Commercial Doors	Randall Barber
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Steel Door Institute.....	J. Jeffery Wherry
Underwriters Laboratories Inc.	Daniel Kaiser
Window & Door Manufacturers' Association	Rick Perry

American National Standard

Testing and Rating of Severe Windstorm Resistant Components for Swinging Door Assemblies

1 Scope

1.1 This standard provides procedures for testing and establishing load ratings (design load in pounds per square foot or pounds force) for components of exterior swinging door assemblies for purposes of protection of openings during severe windstorm conditions, such as a hurricane, that produces sustained wind speeds or gusts in a range of 110 to 150 miles per hour as defined by ASCE 7-02. It is not intended to simulate wind forces generated by tornadoes.

1.2 The procedures cover all components normally assembled to form an exterior swinging door system. This includes door frames, hardware mullions, thresholds, frame anchorage, hinges, locksets, latches and bolts, doors, sidelights and transoms and glazing systems. This procedure applies to both single swing and pair assemblies and also includes procedures for testing and rating components for both in-swing and out-swing installations.

1.3 The evaluations required by this standard are based on the structural performance tests specified in ASTM E1886, ASTM E1996 and ASTM E330.

1.4 Evaluations under this procedure are designed to determine the ability of exterior doors to remain closed under conditions present in severe windstorms, including high, fluctuating wind speeds and the presence of wind-born debris. Assemblies meeting these requirements are less likely to open during a storm, preventing potentially large pressure differentials which may cause or contribute to major structural damage. This procedure does not consider it necessary for the door assembly to be capable of preventing water intrusion as a result of severe windstorm exposure conditions.

It is recognized that products and assemblies meeting these requirements will not necessarily prevent all forms of damage associated with hurricanes and other severe windstorms. It is also assumed that these assemblies themselves might be damaged in a severe windstorm to an extent that would require repair or replacement after such an event.

2 Definitions

Severe Windstorm: A weather event such as a hurricane that produces sustained wind speeds or gusts in a range of 110 to 150 miles per hour.

Labeled: Identified by the application of a label bearing the certification mark of a recognized certification agency, the manufacturer's name or identifying symbol and any applicable rating(s).

Label: An identification applied on a product by the manufacturer that contains the name of the manufacturer and the function and performance characteristics of the product or material.

Operable: Capable of being opened by the application of ordinary levels of hand applied force to the latch operator and door assembly.

Note: Door assemblies that have been subjected to the severe conditions of the tests involved in this method are not expected to be undamaged and thus will normally not operate with the low force levels generally required for undamaged assemblies. The goal is to provide an assembly that will remain closed during the windstorm, but not be damaged to the extent that it requires the use of tools to be opened after the event.

Stiffness Classification: A measure of a door's overall resistance to bending as determined by a twist test under a prescribed

loading condition. Stiffness classifications allow for the evaluation of hardware/door interactions where either the bending of the door may tend to cause disengagement of the latch, or where applied hardware may be capable of reinforcing the door to reduce bending under load.

Component: Any of several manufactured items used in the construction and installation of a swinging door assembly. Components include door frames, doors and parts such as thresholds and mullions, locksets and hardware (such as hinges, bolts, and closers), glazing systems and similar products. Components are normally supplied separately to a job-site where they are installed to form a complete assembly.

3 General

3.1 Units of Measurement

3.1.1 When a value for measurement is followed by a value in other units in parentheses, the second value is only approximate. The first stated value is the requirement. The primary units are Inch-Pound. Appendix B contains a table of conversion factors for the units used in this standard.

3.1.2 Where load ratings are to be applied in units of pounds per square foot (PSF), these values shall be expressed in 5-pound-per-square-foot increments. For components that are rated in terms of pounds force, values shall be expressed in 10-pound increments. All rated values shall be determined by rounding down from values derived from tests.

3.2 Referenced Standards

3.2.1 ANSI/ASCE 7-02, Minimum Design Loads for Buildings and Other Structures

3.2.2 ANSI/SDI A250.4-2001, Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings

3.2.3 ASTM E330-2002, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference

3.2.4 ASTM E1886-2002, Standard Test Method for Performance of Exterior Windows,

Curtain Walls, Doors, and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials

3.2.5 ASTM E1996-2003, Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes

3.2.6 ASTM F476-84(2002) Standard Test Methods for Security of Swinging Door Assemblies

3.2.7 ANSI/BHMA A156.1-2000, Butts and Hinges

3.2.8 ANSI/BHMA A156.16-2002, Auxiliary Hardware

3.3 Undated References

3.3.1 References to standards listed above shall be to the edition indicated.

4 Overview

4.1 The procedures in this document are designed to evaluate each critical component used in a swinging door assembly for the component's ability to perform its intended function. The evaluation is conducted under the conditions of stress and loading the component would be subjected to in the testing of a complete assembly under the assembly test methods commonly specified for severe windstorm resistance.

4.2 The tests and evaluations required by this procedure include both the application of engineering safety factors and worst-case analysis to ensure that component substitutions in field assemblies will perform to the minimum levels expected.

4.3 Components evaluated by this method are classified into various strength categories that can be used to determine assembly ratings. A single component may have multiple ratings depending on various parameters such as size, number and location of anchors or fasteners, type of surrounding construction and other factors. Proper application of these ratings allows for the determination of an assembly's design load rating in pounds per square foot and minimum impact resistance in terms of energy in foot-pounds. These ratings are intended to be used to determine compliance

with code requirements developed for complete assemblies.

4.3.1 Doors are rated for design load in pounds per square foot (PSF), impact energy in foot-pounds (ft-lbf) and stiffness classification. Stiffness is required in determining the interaction between the door bending under load, transmission of impact energy to latching hardware and frames, and latching engagement.

4.4 Proper application of this standard requires a basic level of understanding of physics, mechanics and materials science.

4.5 This procedure provides specific tests and rating methods for the following components.

4.5.1 Door Frames – Section 5.

4.5.2 Hinges – Section 6.

4.5.3 Locksets (Latches) – Section 7.

4.5.3.1 Bored, Mortise, Deadbolts – Section 7.1

4.5.3.2 Rim or Mortise Exit – Section 7.2

4.5.3.3 Multi-point (including flush and surface bolts) – Section 7.3

4.5.4 Doors – Section 8.

4.5.5 Glazing Systems – Section 9.

4.5.6 Sidelight and transom assemblies – Section 10.

4.5.7 Miscellaneous – Section 11.

4.5.7.1 Hardware Mullions – Section 11.1

4.5.7.2 Thresholds – Section 11.2

5 Frames

5.1 Frames are to be evaluated in the largest sizes and minimum frame material thickness for which a design rating is to be determined. Frames intended for use in both single swing and pair assemblies shall be tested in both configurations. Frames are to be installed following the manufacturer's written instructions which are to include:

- a) Wall substrate – wood/steel stud, concrete/masonry, structural steel.

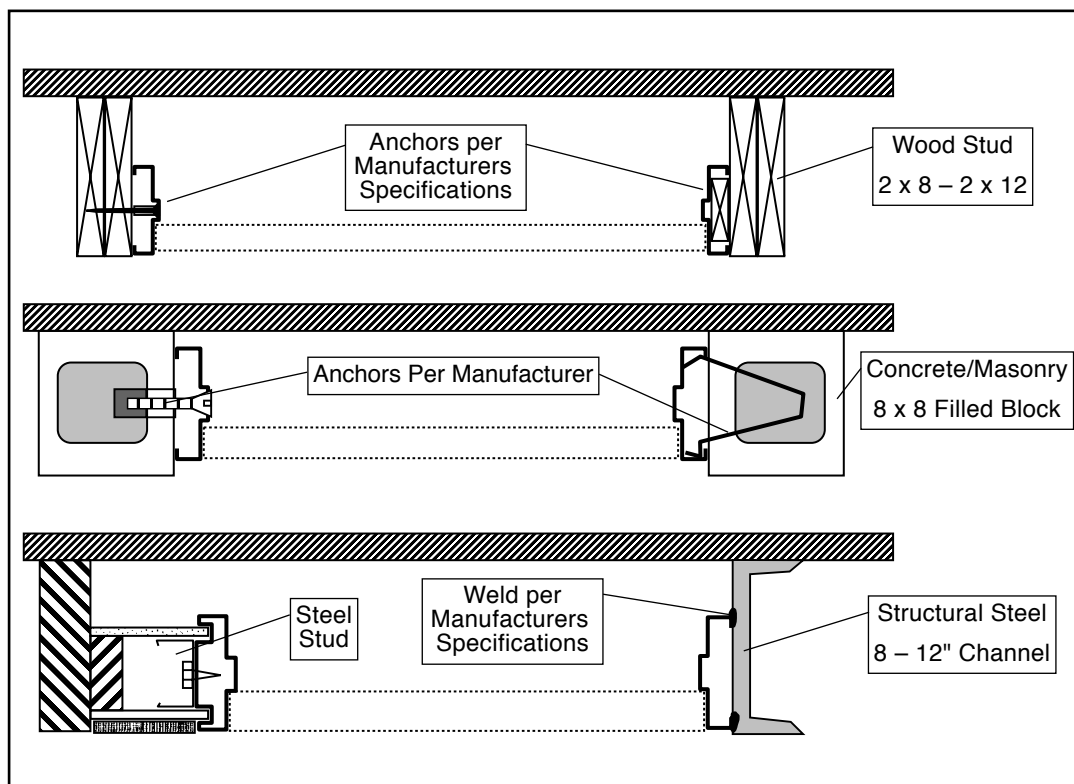


Figure 1 – Wall Substrates for Frame Tests

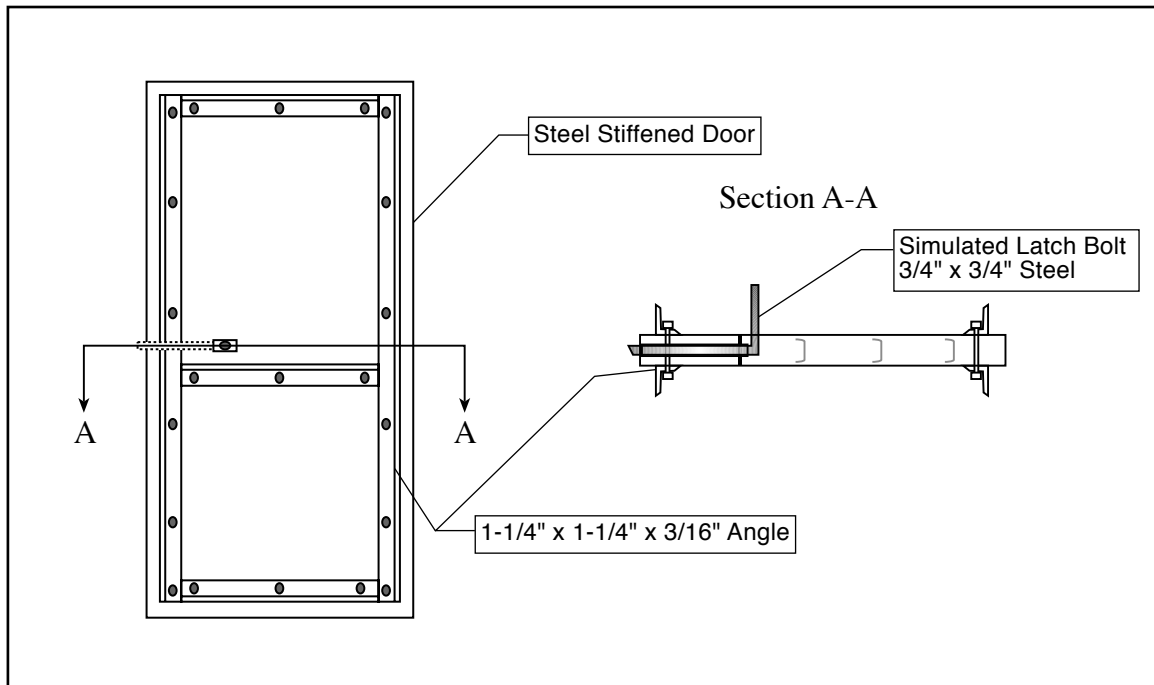


Figure 2 – Door Reinforcement for Frame Tests

- b) Number, size, type and spacing of anchors.
- c) Location and attachment of any reinforcements, if applicable.
- d) Location and attachment of gasketing.
- e) Number, type, size and locations of hinges.
- f) Location of latching/locking hardware.

5.2 Test Procedure

5.2.1 Structural Load Test

5.2.1.1 The frame shall be installed into a test unit with wall constructed to simulate the wall design specified by the frame manufacturer. The installation shall be in accordance with the manufacturer's written instructions (refer to figure 1 for buck details). For wall designs that differ significantly from those shown, the test installation shall simulate actual intended wall design and anchorage.

A Class I stiffness door slab shall be mounted with two hinges for doors 60 inches or less high, and one additional hinge for each ad-

ditional 30 inches of door height or fraction thereof. For single-swing frames, a single point simulated latch and a stainless steel strike shall be installed (see figure 2). The door and latching hardware shall be of sufficient strength so that they do not fail at the required test load.

If the manufacturer specifies multiple latch/lock locations, tests shall be conducted under specified conditions and the resulting rating shall specify the latching requirements. When multi-point latching is specified, additional simulated latches similar to that shown in figure 2 shall be provided at the appropriate locations.

5.2.1.2 For pair frames, two Class I stiffness doors shall be installed with a simulated latching arrangement with a top and bottom bolt on the inactive door and a single point latch on the active door latching into the inactive. The doors used are to be reinforced as described in 5.2.1.2.1 and latched as shown in figure 2.

If the manufacturer specifies other latch/lock locations, tests shall be conducted under specified conditions and the resulting rating shall specify the latching requirements.

5.2.1.2.1 The door used is to be reinforced along the latch or meeting edge by bolting a 1-1/4 inch by 1-1/4 inch by 3/16 inch structural steel angle to both faces of the door with 1/4-20 bolts at 16 ± 1 inches on center and within 6 ± 1 inches of the corners. The angle shall be placed such that the free leg of the angle is oriented toward the edge of the door and is located at 3 inches from the door latch edge (see figure 2).

5.2.1.3 The frame and door assembly shall be installed in a load test chamber per the requirements of ASTM E330.

5.2.1.4 The assembly shall be subjected to a static load equal to 1.5 times the design load rating specified by the frame manufacturer under both positive and negative pressure. Each load shall be applied for a minimum of 30 seconds, then released. Positive loading means that the force is applied to the outdoor, exterior, or pull side of the assembly. Negative loading means that the force is applied to the indoor, interior, or push side of the assembly.

5.2.1.5 At the conclusion of this test, the frame shall not prevent the door from operating after the simulated latch bolt(s) has been retracted and a 15 pound force is applied to the lock

edge of the door at the vertical centerline 1 inch from the frame stop. The frame shall remain in the opening.

5.2.2 Impact Test

5.2.2.1 Upon completion of the structural load test an identical assembly shall be subjected to impacts of 350 foot-pounds, delivered by a 100-pound mass pendulum impactor fitted with a number 2 or better, 12-inch-long Douglas Fir or Southern Yellow Pine, nominal 2 by 4 striking face. The pendulum is to be suspended in a manner that assures a direct normal impact to the door assembly. Refer to ASTM F476 for details of a comparable pendulum impact device (see figure 3).

Note: The 350 foot-pound impact specified in section 5.2 is equivalent in energy to a 9 pound 2 x 4 missile impacting end-on at a velocity of 50 feet per second.

5.2.2.2 Impacts are to be delivered to the pull side of the door per ASTM E1886 (see figure 4).

5.2.2.2.1 Single Frames

- a) One impact at each of the four corners of the assembly at 6 inches from each edge.

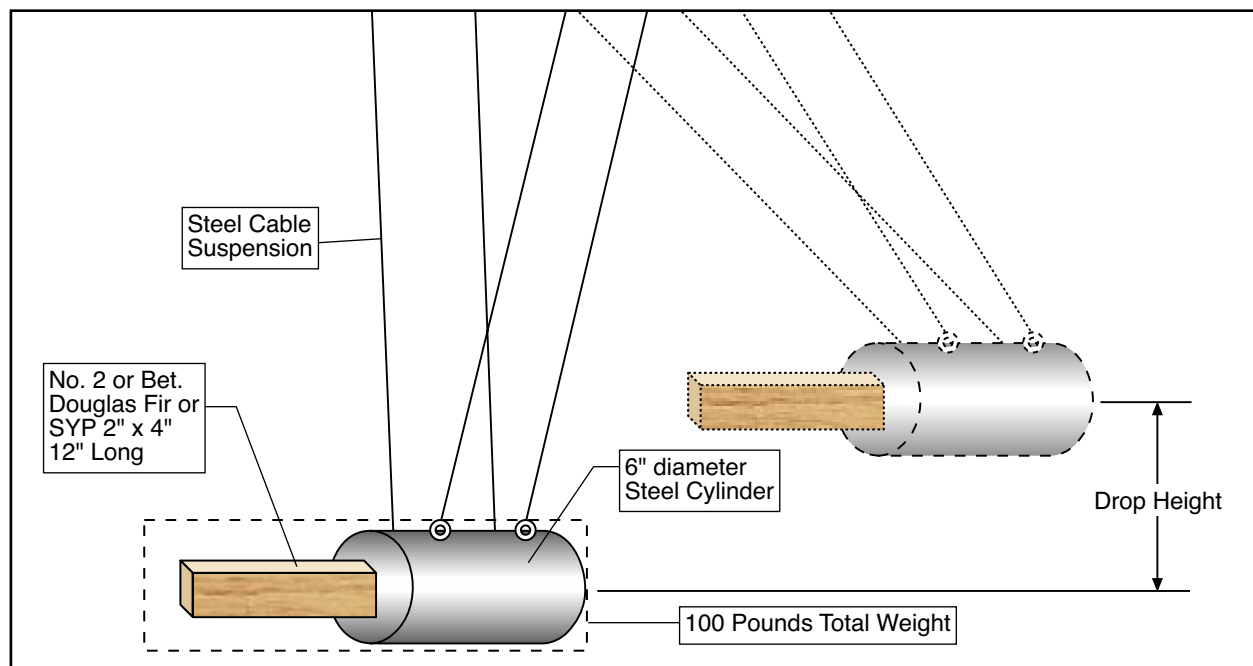


Figure 3 – Pendulum Impactor

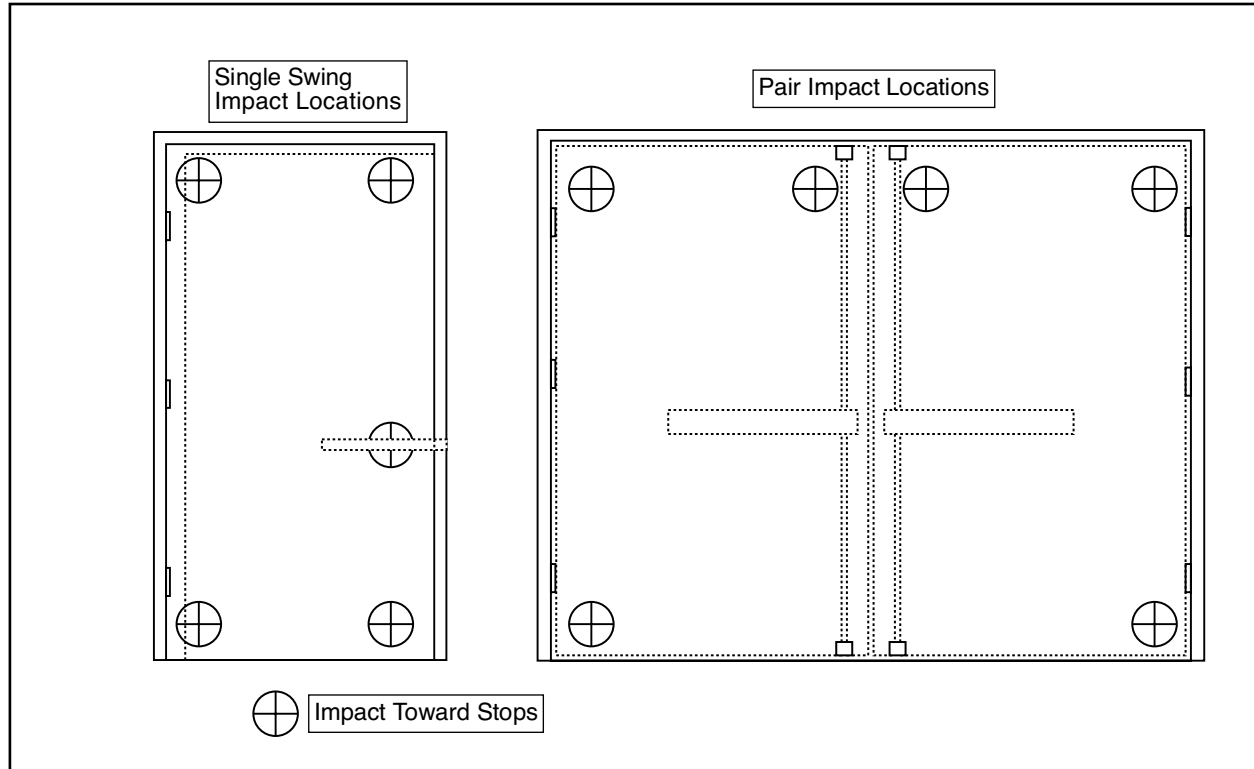


Figure 4 – Impact Locations for Frame Tests

- b) One impact at the vertical center of the latch and 6 inches horizontally from the latch.

5.2.2.2.2 Pair Frames

- a) One impact at the four corners of the assembly adjacent to the frame at 6 inches from each edge.
- b) One impact at the meeting edge of each of the doors 6 inches from the top edge and 6 inches from the meeting edge.

5.2.3 At the conclusion of this test, the frame shall not prevent the door from operating after the simulated latch bolt(s) has been retracted and a 15-pound force is applied to the lock edge of the door at the vertical centerline 1 inch from the frame stop. The frame shall remain in the opening.

5.3 Cycle Test

5.3.1 Upon completion of the impact tests specified in 5.2, the same assembly shall be

subjected to the pressure cycling test specified in ASTM E1886.

5.3.2 At the conclusion of this test, the frame shall not prevent the door from operating after the simulated latch bolt(s) has been retracted and a 15-pound force is applied to the lock edge of the door at the vertical centerline 1 inch from the frame stop. The frame shall remain in the opening.

5.4 Frame Ratings

5.4.1 Frames that meet the criteria specified in this section shall be rated for the design load used in the evaluation in pounds per square foot and for impact resistance in foot-pounds. Ratings shall be specific to positive and negative loading with respect to swing direction when applicable. Ratings will be given for both positive and negative pressures and shall apply to all overall frame sizes (not to exceed either height or width of frame tested) equal to or smaller than the frame tested.

6 Hinges

6.1 Leaf Hinges

Three representative specimens shall be tested. Ratings shall be based on the lowest load successfully sustained by all three specimens.

6.1.1 Impact Test

6.1.1.1 Hinges shall be mounted for testing in the test fixture shown in figure 5. Hinges are to be mounted to the simulated frame and door sections using screws provided by the hinge manufacturer.

6.1.1.2 A 350 foot-pound impact shall be delivered to the simulated door section at a point 6 inches from the hinge centerline by means of pendulum impactor specified in 5.2.2.1. The impact shall be applied to the push side of the simulated door section.

6.1.1.2.1 Exception

Hinges intended only for use in out-swing door assemblies do not require an impact test.

6.1.2 Structural Load Test

6.1.2.1 Upon completion of the impact test specified in 6.1.1, the same test assembly shall be mounted in a testing machine and loaded at a rate of 0.05 inches per minute until it is evident that no additional load increase is possible (i.e. failure). The load shall be applied through a 3/4-inch diameter roller and 1/4-inch thick by 3-inch wide steel plate in a manner that places the attachments in shear on the push side of the simulated door section. The load at failure shall be recorded.

6.1.3 Rating

6.1.3.1 Hinges that show no failure under the impact test shall be rated for a shear load of the ultimate load determined in 6.1.2.1 for the lowest of the three specimens divided by a safety factor of 2.0. Hinges rated for use on out-swing doors only do not require an impact load rating and are rated for shear load only.

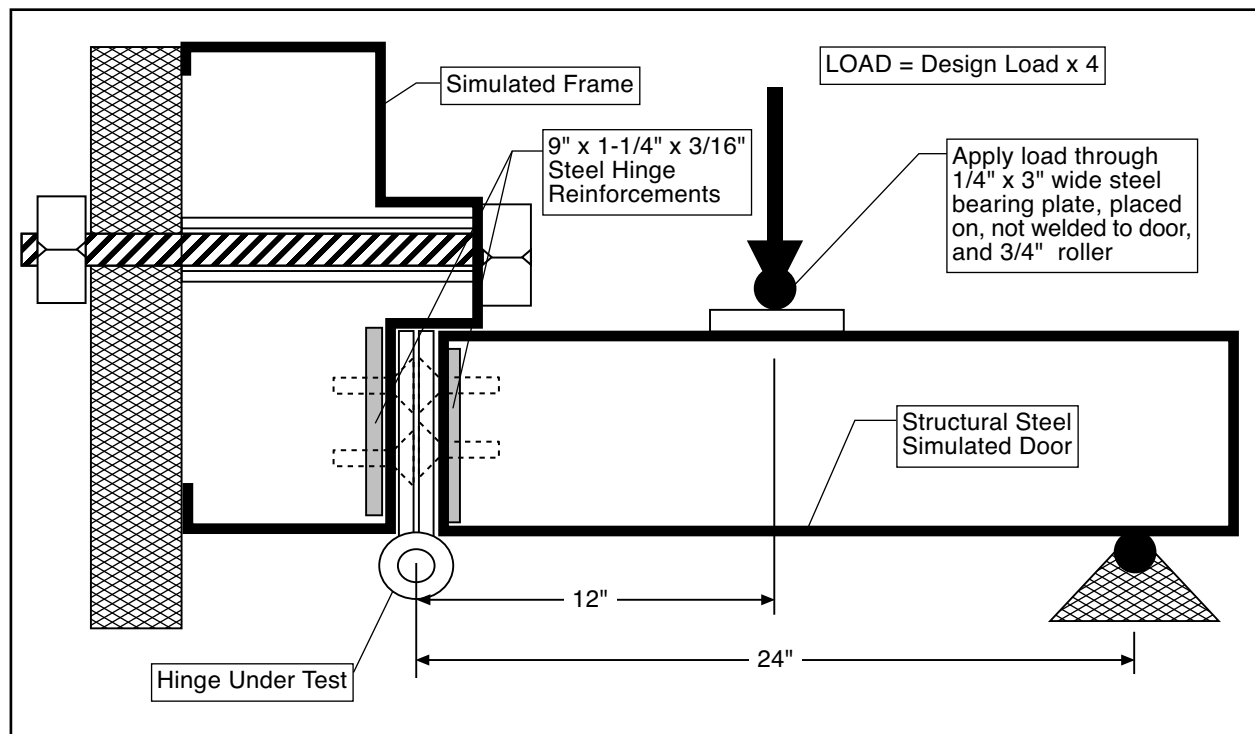


Figure 5 – Hinge Structural Load Test Fixture

6.2 Continuous Hinges and Pivots

6.2.1 Continuous hinges and/or pivots shall be tested in the maximum length with the minimum number of fasteners supplied by the manufacturer. Continuous hinges and/or pivots are to be tested applied to a simulated door as described in section 5.2.1.1 and a frame assembly designed to withstand the loads required to evaluate the hinge and/or pivots to the level required. A simulated frame constructed from 4-inch to 6-inch wide structural steel channel and with a solid steel stop 1-inch wide by 5/8-inch high is suitable for this purpose. Pivots and continuous hinges shall be tested using the maximum size of door for which a rating is desired.

6.2.2 Structural Load Test

6.2.2.1 Apply a load equal to 1.5 times the hinge manufacturer's specified design load per ASTM E330 in both positive and negative directions. Hold each load for a minimum of 30 seconds, then release.

6.2.3 Impact Test

6.2.3.1 Using either the same assembly used for the structural load test or an identical assembly, at the hinge manufacturer's option, conduct three impact tests using the pendulum impactor described in 5.2.2.1 at the following locations against the push side of the door.

6.2.3.1.1 Impact 6 inches down from the top and 6 inches horizontally from the hinge edge of the door.

6.2.3.1.2 Impact the mid-height of the door 6 inches from the hinge edge.

6.2.3.1.3 Impact 6 inches up from the door bottom and 6 inches from the hinge edge.

6.2.4 Cycle Test

6.2.4.1 Upon completion of the impact tests, the same assembly shall be cycled per ASTM E1886.

6.2.5 Throughout the tests described in section 6.2 the door shall remain secured in the frame and shall be operable at the conclusion of the tests.

6.2.6 Rating

6.2.6.1 Continuous hinges and pivots shall be rated for the impact resistance in foot-pounds and design load in pounds per square foot and maximum size, based on the tested assembly size for which they successfully complete the required testing.

7 Locksets and Bolts

7.1 Locksets

7.1.1 Impact Test

7.1.1.1 Locksets shall be mounted in the test fixture described in figure 6. Mounting shall be in accordance with the lock manufacturer's instructions. Locksets are to be in the locked mode for all tests.

7.1.1.2 Strikes shall be mounted to the simulated frame section using the screws provided by the lock manufacturer.

7.1.1.3 One impact of 350 foot-pounds shall be delivered to the test fixture (push side) at a point 6 inches from the simulated door edge using the pendulum impactor specified in 5.2.2.1. If the lockset handle or other parts are in the indicated impact area, the impact location shall be moved upward sufficiently to avoid hitting the parts.

7.1.1.3.1 Exception

Locksets or latches that are intended for use only on single swing out-swing door assemblies are not required to be subjected to the impact test.

7.1.2 Structural Load Test

7.1.2.1 Upon completion of the impact tests specified in section 7.1.1, the test fixture and the same specimen (figure 6) shall be mounted in a testing machine. A load shall then be applied equal to 1.5 times the manufacturers' designated design load. The load shall be applied through a 3/4-inch roller and 1/4-inch by 3-inch steel loading plate of sufficient width to span the simulated door portion of the test fixture. This load shall be held for 30 seconds and then released.

7.1.2.2 Upon completion of the structural test the lockset shall be operable.

7.1.3 Lockset Rating

7.1.3.1 The lockset rating shall be the design load specified by the manufacturer and verified by acceptable results in the impact and structural load test described in this section.

7.2 Single Point Rim and Mortise Exit Devices

7.2.1 Single point rim and mortise exit devices shall be mounted on a door of the stiffness classification and maximum size for which a rating is to be determined. Mounting shall be in accordance with the device manufacturer's instructions.

7.2.2 Impact Test

7.2.2.1 One 350 foot-pound impact shall be delivered to the pull side of the door using the impactor specified in section 5.2.2.1 at the centerline of the latch and 6 inches horizontally from the latch edge of the door.

7.2.2.2 Upon completion of the impact tests the door shall remain latched and the single

point rim or mortise exit device shall be operable.

7.2.3 Structural Load Test

7.2.3.1 Upon completion of the impact tests specified in 7.2.2.1, the same assembly shall be mounted in a structural load test chamber and tested per ASTM E330.

7.2.3.1.1 Apply 1.5 times the manufacturer's specified design load to the push side of the door. Hold for a minimum of 30 seconds and release.

7.2.3.1.2 Upon completion of the test the single point rim or mortise exit device shall be operable.

7.2.4 Rating of Single Point Rim and Mortise Exit Devices

7.2.4.1 Single point rim or mortise exit devices shall be rated for the design load, impact resistance and door stiffness Class specified by the device manufacturer and verified by acceptable results in the impact and structural load test described in this section.

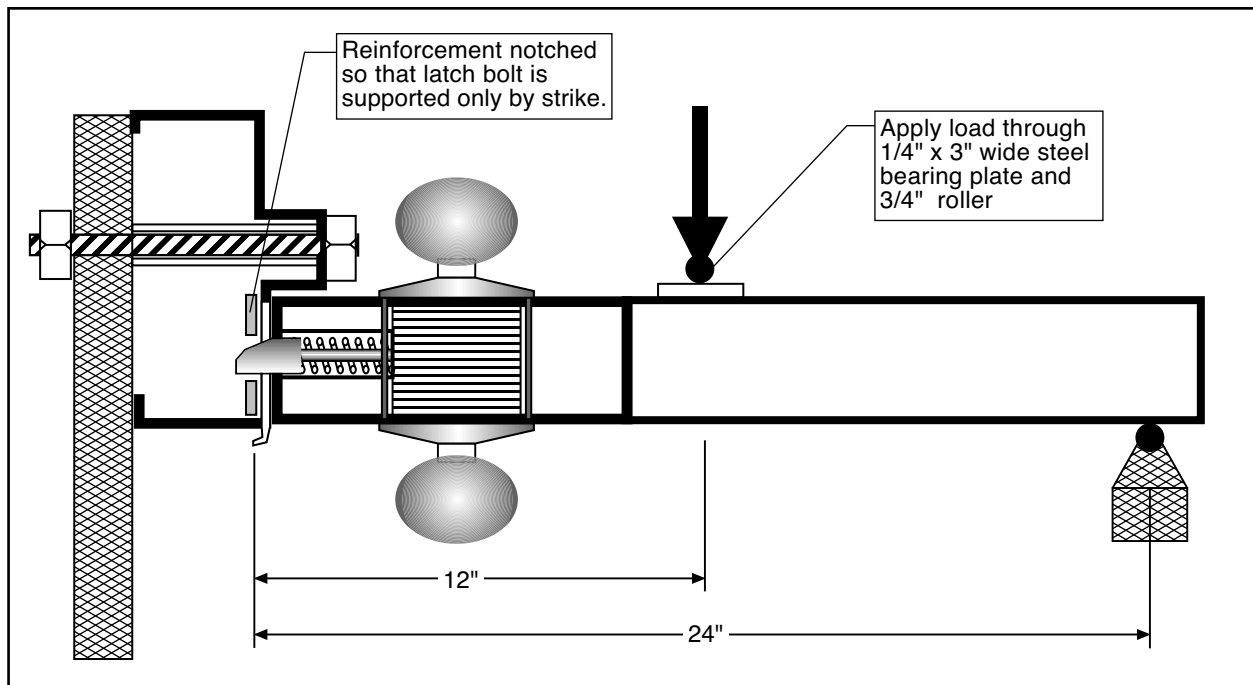


Figure 6 – Lockset Test Fixture

7.3 Multi-Point Latches

7.3.1 Multi-point latches shall be mounted on the maximum size pair of the minimum stiffness class doors specified by the manufacturer for testing. Multi-point latches tested on an active leaf of a rated pair can be used on a single door opening, but multi-point latches tested on a single swing door cannot be used on a pair of doors. Ratings will apply to a single door or a pair of doors equal to or smaller than the size(s) tested.

7.3.1.1 Multi-point latches are divided into three categories that consist of:

7.3.1.2 Exit Devices: Surface Vertical Rod (SVR x SVR), Concealed Vertical Rod (CVR x CVR), Mortise x SVR (inactive leaf), Mortise x CVR (inactive leaf), Mortise and CVR or SVR (3-point) x CVR or SVR (inactive leaf), etc.;

7.3.1.3 Mortise or Bored Lockset or Mortise Exit Device (active leaf) x Surface and/or Flush Bolts (inactive leaf) on a pair of doors; and

7.3.1.4 A combination of Mortise and Bored Locksets, Mortise or Rim Exit Devices and Surface Bolts (active leaf) x SVR, CVR Exits or Surface or Flush Bolts (inactive leaf).

Note: Since many exterior doors are used as a required "means of egress", building codes do not generally allow the use of additional manual bolts and locks on these doors. That is, it must be possible, under emergency conditions, for these doors to be opened with a single manual operation. The use of auxiliary latching devices as a means of increasing the windstorm resistance rating of an assembly should be verified for acceptability under prevailing building code requirements.

7.3.2 Impact Test

7.3.2.1 The door containing the device under test (active leaf) shall be subjected to three 350 foot-pound impacts delivered by the pendulum impactor specified in 5.2.2.1 to the pull side of the door. One impact is to be made at the upper meeting edge of the door 6 inches below the top edge of the door and 6 inches from the meeting edge. The second impact is to be made at the lower meeting edge of the door 6 inches above the bottom and 6 inches from the meeting door edge. The third impact is to be made at the center of the door opposite and 5 inches below the push bar. If hardware location interferes with the specified locations for impacts the impact shall be

located as close to the specified location as possible in a manner that avoids impact on the hardware.

7.3.2.2 When other hardware is being evaluated simultaneously with bolts (surface or flush type) to increase the overall rating, then a fourth impact is to be made at the centerline of the other hardware and 6 inches from the meeting door edge.

7.3.2.3 Upon completion of the impact tests the multi-point latch shall be operable.

7.3.3 Structural Load Test

7.3.3.1 Upon completion of the impact test, the same assembly shall be tested on the impact assembly or mounted in a test chamber and tested per ASTM E330 under uniform static loading.

7.3.3.2 Starting at the design load specified by the manufacturer, apply the load in 5 PSF increments in both positive and negative directions until failure occurs. Each load shall be held for a minimum of 10 seconds in each direction.

7.3.3.3 After each load increment, remove the load and check the hardware for operability. One load increment consists of both a positive and negative load.

7.3.3.4 Record mode of failure and load increment at failure.

7.3.4 Multi-Point Latch Rating

7.3.4.1 Multi-point latches shall be rated for design load in PSF as follows:

7.3.4.1.1 For pairs of doors with four or more points of latching, the design load is the maximum test load increment that did not result in failure as determined by 7.3.3.3 divided by a safety factor of 1.5.

7.3.4.1.2 For pairs of doors with single point latching on the active leaf and multi-point latching on the inactive leaf as described in 7.3.2.1, the design load is the maximum test load increment that did not result in failure as determined by 7.3.3.3 divided by a safety factor of 1.5.

7.3.4.1.3 For pairs of doors with single point latching on the active leaf and multi-point latching on the inactive leaf as described in 7.3.2.2 or 7.3.2.3 with surface or flush bolts

per ANSI/BHMA A156.16 (Auxiliary Hardware) mounted on the inactive leaf, the design load is the maximum load increment that did not result in failure as determined by 7.3.5.4 divided by a safety factor of 3.0.

8 Doors

8.1 Doors shall be tested in the largest size (overall area, greatest width, greatest height) for which a design load rating is to be applied. All doors of the same design with smaller dimensions shall be given the same rating as the test door(s).

8.2 Stiffness Classification

8.2.1 Doors shall be classified for stiffness by performing the following twist test on a 3'0" by 7'0" sample of the full flush panel (no hardware preparations) door construction under investigation.

8.2.1.1 Mount the door panel in a rigid test frame and clamp the bottom two corners and one top corner securely to the frame.

8.2.1.2 Apply a load of 300 lbf through a 2.5 inch diameter by 1/4-inch thick steel pad to a point centered 3 inches down and 3 inches horizontally from the free corner of the door per ANSI A250.4.

8.2.1.3 Measure the door deflection at the free corner, as described in ANSI A250.4, to the nearest 0.01 inch.

8.2.2 Classifications

8.2.2.1 Doors shall be classified for stiffness as follows in Table 1 based on the results of the twist test.

Table 1 – Stiffness Classification

Corner Deflection	Stiffness Class
≥ 0.5 inch	I
> 0.5 inch and ≤ 1.0 inch	II
> 1.0 inch and ≤ 2.0 inches	III
> 2.0 inches and ≤ 3.0 inches	IV
> 3.0 inches	V

8.3 Assembly Tests

8.3.1 Doors shall be installed in each assembly configuration for which a rating is to be determined. The following list shall be used to select the test configurations.

8.3.1.1 Single-swing with cylindrical single-point latch.

8.3.1.2 Single-swing with mortise single-point latch.

8.3.1.3 Single-swing with rim or mortise exit device.

8.3.1.4 Standard pair with 4-point latching – surface rods.

8.3.1.5 Standard pair with 4-point latching – concealed rods.

8.3.1.6 Standard pair with 3-point latching – surface rods by cylindrical latch.

8.3.1.7 Standard pair with 3-point latching – flush bolts or CVR by mortise latch.

8.3.2 A minimum of 3 assemblies shall be tested for single-swing configurations and a minimum of three assemblies shall be tested for pair configurations. Latching hardware configurations can be varied between the individual assemblies to provide coverage per 8.3.1. This includes combining surface and concealed-rod type hardware in one pair assembly to cover configurations 4 and 5 in the above list. The resulting ratings will be determined separately for pair and single-swing configurations. When the three assemblies of one swing type vary, the rating for the door is to be based on the highest design load test passed by all three assemblies.

8.3.3 Doors are to be tested installed in frames using latching hardware and hinges with a design load rating greater than or equal to the specified design-load rating of the door.

8.3.4 Assemblies which incorporate manual surface bolts or other latching hardware intended only for use in severe storm conditions (hurricanes) shall be evaluated for design load strength per ASTM E330 with and without the additional hardware engaged. The ratings for such assemblies shall indicate design loads for the assembly both with and without the additional hardware.

Table 2 – Example Door Rating Data

Door Model: 1234		Stiffness Class II			
Configuration	Maximum Size	Latch Throw Min. (in)	Latch Strength Min. (lbf)	Impact (ft-lbs)	Design Load (PSF)
Single Out-swing	4-0 x 8-0	1/2	1600	350	100
Single In-swing	4-0 x 8-0	1/2	1600	350	100
Single Out-swing Rim	3-0 x 8-0	5/8	1920	350	80
Pair w/ 4-Point	8-0 x 8-0	3/4	1280	350	80
Pair w/ 3-Point	8-0 x 8-0	VR 3/4, SB 3/4	VR 1280, SP 1280	350	80
Pair w/ 4-Point	6-0 x 7-0	3/4	2940	350	140

8.4 Test Procedure

8.4.1 Each assembly shall be tested based on the design load specified by the door manufacturer per ASTM E1886. Impact and cyclic load tests shall be conducted as specified in ASTM E1886. For doors designated by the manufacturer as either in-swing only or out-swing only, the impact test shall be conducted only from the outdoor side of the assembly. For doors designated as either in-swing or out-swing, the impact tests shall be conducted from the outside (push side) of in-swinging assemblies on two samples and from the outside (pull side) of an out-swinging assembly on the third sample.

8.4.2 Assemblies shall remain closed and latched during the tests specified and the active leaf shall be operable at the conclusion of the tests.

8.5 Ratings of Doors

8.5.1 Ratings of doors shall include the following information (see Table 2):

1. Maximum Size;
2. Stiffness Classification;
3. Design Load Rating for each configuration type;
4. Impact Resistance Classification;
5. Minimum Latch Throw for each configuration;

6. Minimum Latch-Strength Rating for each configuration.

9 Glazing Systems

9.1 Glazing systems shall be evaluated as complete units designed for installation into specific door types. Glazing systems shall include all parts necessary to install the glazing in a swing door. This will normally include at least a glazing panel, frame, sealant or glazing compound and fasteners.

9.2 Glazing systems shall be evaluated in the stiffest door type for which a rating is to be established.

9.3 Glazing systems shall be tested in the largest size (maximum area, height, width of exposed light) to be rated in the smallest standard door size (minimum 3'0" x 7'0") that can accommodate the glazing system.

9.4 Test Procedure

9.4.1 Install the glazing system into the type and size of door specified by the glazing system manufacturer. Three identical assemblies are required. The doors shall be mounted in frames and bucks as required for the standard door test procedure.

9.4.2 Test the assembly per ASTM E1886 with the impacts required applied to the center and one corner of the glazing panel in each as-

sembly. Cycle test each assembly per ASTM E1886.

9.4.3 Upon completion of the impact and cycle tests there shall be no failure of the glazing system as defined in the referenced standard ASTM E1996.

9.5 Glazing System Ratings

9.5.1 Glazing systems shall be rated at the design load used in the evaluation and shall include maximum door stiffness, minimum door size and maximum glazing dimensions (maximum area, maximum height and maximum width).

10 Sidelights and Transoms

10.1 Sidelight and/or transoms shall be tested with doors, to the largest total size (maximum area, height and width) to be rated. Testing shall be performed per ASTM E1886 with the impacts applied only to the glazed portion of the assembly. Doors used in the evaluation assembly shall be rated per this method for at least the design load specified for the sidelight/transom assembly.

10.2 Installation of sidelight and/or transom assemblies shall be per manufacturer's instructions. Frames for these assemblies shall be evaluated for installation in each wall type for which the product is intended. Installation instructions shall include: glazing material, sealants or glazing compounds, installation procedures, and details of frame anchoring methods.

10.3 Ratings for Sidelight / Transom Assemblies

10.3.1 Sidelight and/or transom assemblies shall be rated for design load based on successful tests in accordance with ASTM E1886.

11 Miscellaneous

11.1 Center Mullions Prepared for Hardware

11.1.1 Center mullions prepared for hardware shall be tested at the maximum height specified by the manufacturer. Install the mullion in a frame of the maximum width for which a

rating is desired following the manufacturer's instructions. Doors used for this test shall be stiffened as described in section 5.2.1.2.1, except that reinforcements are to be removed in areas required for mounting the latching device. Doors are to be equipped with rim exit devices or other hardware as specified by the manufacturer.

11.1.2 Structural Load Test

11.1.2.1 Load the assembly to 1.5 times design load in both positive and negative directions. Hold the load applied for a minimum of 30 seconds, then release.

11.1.3 Impact Test

11.1.3.1 On the same assembly used in the structural test or an identical assembly, at the manufacturer's option, apply four impacts of 350 ft-lbs using the pendulum impactor specified in section 5.2.2.1. One impact is to be applied at the meeting edge of the doors 6 inches down from the head jamb. The second impact is to be applied at the meeting edge of the doors 6 inches up from the sill and the third impact applied at the centerline of the latch and 6 inches horizontally from the latch edge of the door. Apply a fourth impact at the center of the other door 5 inches below the latch. Upon completion of the impact tests, conduct cycle testing as specified in ASTM E1886. At the completion of these tests the hardware mullion shall remain in place and the door assembly shall be operable.

11.1.4 Hardware mullions shall be rated for the impact load successfully passed and for the latching load established in the structural load and cycle tests. Latching load (lbf) shall be calculated as design load (PSF) times the area (square feet) of one door (the equivalent of half the load from each door).

11.2 Thresholds

11.2.1 Thresholds are only evaluated for their ability to retain latch bolts and strikes and remain secured to underlying construction when subjected to anticipated structural and impact loads.

11.2.2 Thresholds are to be tested in conjunction with hardware mullions as described in section 11.1 when applicable. Thresholds that are designed for direct attachment of latching devices shall be tested as follows.

11.2.3 Thresholds shall be tested at the maximum door opening width to which the resulting rating is to be applied. Thresholds shall be installed in a test assembly using a frame and stiffened doors (per 5.2.1.2.1) known to be capable of sustaining the required test loads. Thresholds shall be attached to a simulated floor using the number, size and locations of fasteners specified by the manufacturer. The set-up shall be for a single-point latching on the active leaf and two-point latching on the inactive leaf with the bolt and strike specified by the manufacturer.

11.2.4 Structural Load Test

11.2.4.1 The test assembly shall be loaded per ASTM E330 to 1.5 times the design load specified by the manufacturer in both positive and negative directions. Each load shall be maintained for a minimum of 30 seconds, then released.

11.2.5 Impact Test

11.2.5.1 The same assembly or an identical assembly which has not been subjected to the 1.5 times design load test shall be used for this test at the manufacturer's option.

Impact loads shall be applied using the pendulum impactor specified in 5.2.2.1 to a location on the centerline of any latching device that engages into the sill at a point 6 inches up from the sill. If the assembly includes two latching locations, two impacts are required. If a single latch point is used, the threshold will be considered acceptable for two-point latching if two impacts are conducted at the same location.

11.2.6 Cycle Test

11.2.6.1 The same assembly used for the impact test in 11.2.3 shall be subjected to the cyclic pressure test prescribed by ASTM E1886.

11.2.7 Upon completion of these tests, the door assembly shall be operable and the threshold shall remain in place.

11.2.8 Thresholds shall be rated for the impact load successfully passed and for the latching load established in the structural load and cycle tests. Latching load (lbf) shall be calculated as design load (PSF) times the area (square feet) of the opening divided by 4 (the equivalent of one-quarter of the total load).

Appendix A (informative)

Determining Swinging Door Assembly Ratings for Severe Windstorm Resistance from Component Ratings

A1 The first step in determining if an assembly meets a code requirement for severe windstorm resistance is for the building designer to determine the required performance level for the opening. This will normally include a calculation of the required minimum wind load in pounds per square foot and the determination of whether or not impact resistance is required. In most cases ASCE 7 is specified by the applicable building code and requires a thorough analysis of the building design and location to determine design loads for each opening. Local building codes will generally specify when impact resistance is required and at what level.

A2 If impact resistance is required, determine the impact energy level required based on the code specification. For most situations, 350 foot-pounds, equivalent to a 9-pound missile impacting at a velocity of 50 feet per second, will apply. When impact resistance is required, each component of the opening shall have an impact rating equal to or greater than that specified.

A3 Determine the wall construction type for the opening (masonry, wood frame, steel, etc.). Select a frame and anchorage method that meets the minimum design load rating and impact criteria for the size specified.

A4 Calculate the hinge and latch loads by multiplying the assembly area in square feet by the opening design load and determine the tributary load at each attachment point.

A5 Select hinges and latch(es) which are rated for the loads calculated in step A4 and meet the impact resistance level specified. Latches must be rated as required for the door stiffness class of the door to be used.

A6 If a light kit is to be installed, select a light kit which is rated for the design load required, impact resistance if required, and for installation in the door type to be used.

A7 Select a door panel which meets the impact resistance and design load specified and that is of the minimum stiffness class required for the hardware to be used, or verify that hardware to be used has the required minimum ratings for the door stiffness classification of the door selected.

A8 All components must be installed in accordance with the components manufacturer's instructions. The assembly rating is equal to the lowest design load rating of the selected components and must equal or exceed the opening design load requirement determined in step A1.

Appendix B
(normative)

Tolerances and Conversion of Measurements to SI

I-P Value	I-P Unit	I-P Tolerance	SI Value	SI Unit	SI Tolerance
110	MPH	NA	49	M/s	NA
150	MPH	NA	67	M/s	NA
5	PSF	±0.5	239	Pa	±24
10	PSF	±0.5	479	Pa	±24
60	in	±0.25	1524	mm	±6
30	in	±0.25	762	mm	±6
40-5/16	in	±1/8	1024	mm	±3
1-1/4	in	±1/8	32	mm	±3
3/16	in	±1/32	4.8	mm	±1
16	in	±1	406	mm	±25
6	in	±1	152	mm	±25
3	in	±1/8	76	mm	±3
15	lbf	±0.5	67	N	±2
1	in	±1/16	25	mm	±2
350	ft-lb	±3.5	475	N-M	±5
100	lb	±1	45.4	Kg	±0.5
12	in	±1/8	305	mm	±3
24	in	±1/8	610	mm	±3
50	ft/sec	NA	1.52	M/s	NA
0.05	in/min	±0.005	1.3	mm/min	±0.1
300	lbf	±3	1334	N	±13
2.5	in	±0.1	64	mm	±2.5
1/4	in	±0.03	6	mm	±1
0.01	in	NA	0.25	mm	NA
0.5	in	NA	12.7	mm	NA
1.0	in	NA	25.4	mm	NA
2.0	in	NA	50.8	mm	NA
3.0	in	NA	76.2	mm	NA

Appendix C (informative)

Example

Opening design load: per ASCE 7 = 67 psf, requires 350 ft-lb impact per local code.

Opening size: 3'0" x 7'0" – Single In-Swing

Wall type: 2 x 6 wood stud 16 in o.c. with 1/2-inch exterior sheathing – wind load design rating 75 psf.

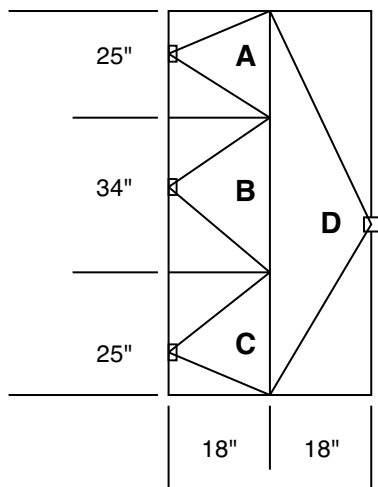
Frame: 16 ga. pressed steel with 5/8 inch stops.

Frame rating: for 3'0" x 7'0" with 1/4" x 3-1/2" lag screw anchors to wood studs at 24" o.c. = 75 psf. & 350 ft-lb – OK.

Hinges: (ABC Co. Model 1– 500 lbf – 350 ft-lb rating) 3 – 4" x 0.135" centered at 8" from top, center of door and 8" from bottom.

Latch: (XYZ Co. Model 2 – 1000 lbf – 350 ft-lb rating for class II doors) single point mortise, 5/8" throw.

Door: 3'0" x 7'0" Hollow Metal – Stiffness class II, 70 psf, 350 ft-lb rating. –OK.



Location	Area (ft ²)	Load @ 70 psf (lbf)
A Top Hinge	3.125	219 < 500 OK.
B Middle Hinge	4.25	298 < 500 OK.
C Bottom Hinge	3.125	219 < 500 OK.
D Latch	10.5	735 < 1000 OK.

Opening Design Load Rating = 70 psf based on door.

Qualifies for Impact rating of 350 ft-lbs.