AMERICAN NATIONAL STANDARD

STANDARD METHOD FOR TESTING GARAGE DOORS: DETERMINATION OF STRUCTURAL PERFORMANCE UNDER MISSILE IMPACT AND CYCLIC WIND PRESSURE

Door & Access Systems Manufacturers' Association, International

Sponsor:

DASMA
Door & Access Systems Manufacturers Association International

1300 Sumner Ave
Cleveland, Ohio 44115-2851

AMERICAN NATIONAL STANDARD

Standard Method for Testing Garage Doors: Determination of Structural Performance Under Missile Impact and Cyclic Wind Pressure

Sponsor

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Suggestions for improvement of this standard are welcome.
They should be sent to the Door & Access Systems Manufacturers' Association, International.

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Foreword (This foreword is included for information only and is not part of DASMA 115, *Standard Method for Testing Garage Doors: Determination of Structural Performance Under Missile Impact and Cyclic Wind Pressure.*)

This standard was developed by the Technical Committee of the DASMA Commercial & Residential Garage Door Division. It incorporates years of experience in testing sectional doors commonly found in garages. The committee and division believe the existence of the standard will provide a uniform basis of testing and rating the structural performance of such doors under missile impact and cyclic wind pressure.

The DASMA Commercial & Residential Garage Door Division approved the standard as a DASMA standard on July 7, 1999. DASMA employed the canvass method to demonstrate consensus and to gain approval as an American National Standard. The ANSI Board of Standards Review granted approval as an American National Standard on March 21, 2005. The document was reviewed and revised to expand the scope to include rolling doors and other products in 2010. The revised standard was finalized in 2012 and the ANSI Board of Standards Review granted recognition of the revised standard as an American National Standard on November 18, 2014.

DASMA recognizes the need to periodically review and update this standard. Suggestions for improvement should be forwarded to the Door & Access Systems Manufacturers' Association, International, 1300 Sumner Avenue, Cleveland, Ohio, 44115-2851.

ANSI/DASMA 115-2012

Standard Method for Testing Sectional Garage Doors, Rolling Doors, and Flexible Doors: Determination of Structural Performance Under Missile Impact and Cyclic Wind Pressure

1.0 SCOPE

1.1 This test method determines the structural performance of sectional garage doors, rolling doors, and flexible door assemblies impacted by missiles and subsequently subjected to cyclic static pressure differentials.

1.2 The performance determined by this test method relates to the ability of the sectional garage door or rolling door to remain unbreached during a windstorm due to windborne debris.

1.3 Water exposure conditions shall not be a part of this standard.

1.4 The proper use of this test method requires a knowledge of the principles of pressure and deflection measurement.

1.5 This test method describes the apparatus and the procedure to be used for applying missile impact and cyclic static pressure loads to a specimen.

1.6 This test method 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 to determine the applicability of regulatory limitations prior to use.

1.7 This test method incorporates applicable provisions from TAS 201, TAS 203, TDS 1-95, SSTD 12-97, ASTM E 1886-02, ASTM E 1996-03 and fatigue load testing referenced in the Florida Building Code, Building.

1.8 For products intended for installation in the Florida High Velocity Hurricane Zone (Miami-Dade and Broward Counties), the testing procedure in Appendix B and Appendix C shall be used.

2.0 DEFINITIONS

2.1 Air Pressure Cycle - beginning at zero air pressure differential, the application of positive (negative) pressure to achieve a specified air pressure differential and returning to zero pressure differential.

2.2 Air Pressure Differential - the specified differential in static air pressure across the specimen, creating a positive (negative) load, expressed in pounds per square foot (or pascals).

2.3 Basic Wind Speed - also known as design wind speed, the wind speed as determined by the specifying authority.

2.4 Design Pressure - also known as design load or design wind load, the specified difference in static air pressure (positive or negative) for which the specimen is to be tested, expressed in pounds per square foot (or pascals).

2.5 Flexible Door: A door, excluding rolling sheet doors as defined in DASMA 207, in which a flexible fabric or other flexible sheet material forms the panel portion, even though it may have a rigid frame, rigid reinforcements, rigid support means for one or more edges thereof, or combinations of these features.

2.6 Full Operability – the ability for the door to be fully opened and closed.

2.7 Maximum Deflection – the maximum displacement of the specimen measured to the nearest 0.125 inch (3 mm) attained from the original position while the maximum test load is being applied.

2.8 Missile - the object that is propelled toward a test specimen.

2.9 Positive (Negative) Cyclic Test Load - the specified difference in static air pressure, creating an inward (outward) loading, for which the specimen is to be tested under repeated conditions, expressed in pounds per square foot (or pascals).

2.10 Recovery - The ratio of the differential measurement between the test specimen surface at rest (following cyclic test loading in one direction) and the maximum deflection measured (for such cyclic test loading), to the maximum deflection measured.

2.11 Section/Slat Joint - The section to section (slat to slat) interface defined by the longitudinal surfaces that move relative to each other as the door opens and closes.

2.12 Specifying Authority - the entity responsible for determining and furnishing information required to perform this test method.

2.13 Specimen Failure - deterioration under repeated load or incipient failure, as defined in the pass/fail criteria of this standard.

2.14 Test Chamber - an airtight enclosure of sufficient depth to allow unobstructed deflection of the specimen during pressure cycling, including ports for air supply and removal, and equipped with instruments to measure test pressure differentials.

2.15 Test Loading Program - the entire sequence of air pressure cycles to be applied to the test specimen.

2.16 Test Specimen - the complete installed door assembly and mounting hardware as specified on the submitted drawing.

2.17 Windborne Debris - objects carried by the wind in windstorms.

2.18 Windstorm - a weather event, such as a hurricane, with high sustained winds and turbulent gusts capable of generating windborne debris.

3.0 SUMMARY OF TEST METHODS

3.1 A test series shall consist of three identical test specimens.

3.2 Each test specimen shall be subjected to the large missile impact test and then to the cyclic pressure loading test.

3.3 A test specimen is considered to have passed the test if it satisfies the acceptance criteria of this standard.

4.0 TEST APARATUS

4.1 Test Chamber - See Section 2.12 for definition.

4.2 Air System - shall consist of a controllable blower, a compressed-air supply, an exhaust system, a reversible controllable blower, or other air-moving system capable of providing a variable pressure from zero to the required pressures, both positive and negative.

4.3 Large Missile - shall be a nominal 2x4 Southern Pine lumber, minimum Stud grade, with no knots within 12 inches (305 mm) of the impact end. The missile shall have a length of not less than 7 feet (2.13 m) and not more than 9 feet (2.75 m). The end of the missile subjected to impact shall be permitted to be rounded to no less than a 48 inch (1219 mm) diameter sphere, with sharp edges permitted to be rounded to no more than a 1/16 inch (2 mm) radius. The missile may be marked/ticked in dark ink at one inch (25 mm) intervals on center, and congruently numbered every three inches (76 mm). A sabot shall be attached to the trailing edge of the missile to facilitate launching. The weight of the sabot shall not exceed 0.5 lbs. (227 g). The combined weight of the timber and sabot, which constitutes the missile, shall be between 9 lbs. (4.08 kg) and 9.5 lbs. (4.31 kg). The missile shall be propelled through a cannon as described in section 4.4.

4.4 Large Missile Cannon - shall be capable of producing impact at the speed specified in Section 8.2. The missile cannon may use compressed air to propel the large missile, and if using compressed air shall consist of the following major components: a compressed air supply, a pressure release valve, a pressure gauge, a barrel and support frame, and a timing system for determining the missile speed. The barrel of the missile cannon shall consist of either a 4 inch (102 mm) inside diameter pipe or a nominal 2 inch (51 mm) by 4 inch (102 mm) rectangular tube, and shall be at least as long as the missile. The barrel of the large missile cannon shall be mounted on a support frame in a manner to facilitate aiming the large missile so that it impacts the test specimen at the desired location.

4.5 Timing System - shall be capable to measure speeds accurate to +/- 2%. One method shall be comprised of two, through-beam photoelectric sensors spaced at a known distance apart and used to start and stop an electronic clock, and shall be capable to measure speeds accurate to +/- 2%. The speed of the missile shall be measured anywhere between the point where 100% of the missile is outside of the cannon, to the point where the missile is 1 ft. (300 mm) away from the test specimen. The missile speed shall not be measured while the missile is accelerating. The speed of the missile shall be determined by dividing the distance between the two through-beam photoelectric sensors by the total time interval counted by the electronic clock.

5.0 HAZARDS

5.1 If failure occurs during testing, hazardous conditions may result.

5.2 Take proper safety precautions to protect observers in the event that a failure occurs.

5.3 All observers shall be isolated from the path of the missile during the missile impact portion of the test.

5.4 Keep observers at a safe distance from the test specimen during the entire procedure.

6.0 TEST SPECIMENS

6.1 Three test specimens shall be supplied. Each test specimen shall be as per the manufacturer's detailed drawings and/or written instructions. Any horizontal track and hanging brackets may be shortened to fit the test chamber.

6.2 All parts of the test specimen, including glazing and structural framing, shall be full size.

6.3 The test specimen shall consist of the same materials, details, methods of construction and methods of attachment as proposed for actual use.

6.4 The specimen shall consist of the entire assembled unit attached to a given type of structural framing of the building, and shall contain all devices used to resist wind forces and windborne debris.

6.5 When testing doors which include glazed products, the material used to make such glazed products windborne debris resistant (i.e. fillers, film and similar) shall be an integral part, factory applied, of such glazed products.

6.6 Install the door system per the manufacturer's installation instructions.

6.6.1 For garage doors and rolling doors, the door shall be counterbalanced where no more than the larger of 5% of door weight or ten pounds applied force is required to open the door manually from the fully closed position, or a simulated counterbalance condition (including locking mechanism) shall be achieved by shimming up the bottom corners of the door.

7.0 CALIBRATION OF TIMING EQUIPMENT

7.1 The timing system shall be calibrated and certified by an independent approved qualified agency, at six-month intervals. See Appendix A for recommended methods.

7.2 The calibration report shall include the following:

7.2.1 The date of the calibration.

7.2.2 The name of the agency conducting the calibration.

7.2.3 The distance between the through-beam photoelectric sensors (if used).

7.2.4 The speed of the missile as measured by the timing system.

7.2.5 The speed of the missile as determined from the calibration system.

7.2.6 The percentage difference in speeds.

7.3 The system shall be determined to be accurate if the speed of the missile measured by the timing system and the speed measured by the calibration system agree within +/- 2%.

8.0 LARGE MISSILE IMPACT TEST

8.1 The test shall be conducted using a large missile cannon.

8.2 The large missile shall be as described in Section 4.3. The speed of the large missile shall be at least 50 ft/s (15.2 m/s). The speed of the large missile shall be measured as described in Section 4.5.

8.3 The large missile shall impact the surface of the test specimen "end on".

8.4 Impacts

8.4.1 For sectional garage doors, impacts shall be defined as follows:

8.4.1.1 Within a 5 inch (127 mm) radius circle having its center on a section joint at a hinge location nearest the midpoint of the test specimen.

8.4.1.2 Within a 5 inch (127 mm) radius circle having its center located in the thinnest section of the test specimen, equidistant between the lower two section joints and centered between vertical stiles.

8.4.1.3 Within a 5 inch (127 mm) radius circle having its center at a point 6 inches (152 mm) horizontally and vertically away from a bottom corner.

8.4.2 For rolling doors impacts shall be defined as follows:

8.4.2.1 Within a 5 inch (127 mm) radius of the center of the door.

8.4.2.2 Within a 5 inch (127 mm) radius circle having its center at a point 6 inches (152 mm) horizontally and vertically away from a bottom corner.

8.4.3 For flexible doors, impacts shall be defined as follows:

8.4.3.1Within a 5 inch (127 mm) radius of the center of the largest unsupported area of the door.

8.4.3.2 Within a 5 inch (127 mm) radius circle having its center at the location of the weakest panel reinforcing member.

8.4.3.3 Within a 5 inch (127 mm) radius circle having its center at a point either 6 inches (152 mm) horizontally and vertically away from a bottom corner or 6 inches (152 mm) above a bottom reinforcing member if present.

8.5 Each specimen shall receive at least two (2) impacts from the large missile.

8.5.1 For sectional garage doors, the first specimen shall receive one impact complying with Section 8.4.1.1 and one impact complying with Section 8.4.1.3.

8.5.2 For sectional garage doors, the second specimen shall receive one impact complying with Section 8.4.1.2 and one impact complying with Section 8.4.1.3.

8.5.3 For sectional garage doors, the third specimen shall receive one impact complying with Section 8.4.1.1 and one impact complying with Section 8.4.1.2.

8.5.4 For rolling doors, each specimen shall receive impacts complying with Section 8.4.2.

8.5.5 For flexible doors, the first specimen shall receive one impact complying with Section 8.4.3.1 and one impact complying with Section 8.4.3.3.

8.5.6 For flexible doors, the second specimen shall receive one impact complying with Section 8.4.3.2 and one impact complying with Section 8.4.3.3.

8.5.7 For flexible doors, the third specimen shall receive one impact complying with Section 8.4.3.1 and one impact complying with Section 8.4.3.2.

8.6 For doors that contain glazing, the glazing shall be impacted, in addition to the impact locations set forth in Section 8.5.

8.6.1 Glazing panels greater than or equal to 3 square feet (.28 sq m) in area shall receive two impacts. The first impact within a 5 inch (127 mm) radius circle having its center at a point 6 inches horizontally and vertically away from a corner of the glazing. The second impact within a 5 inch (127 mm) radius circle having its center at the midpoint of the glazing panel.

8.6.2 Glazing panels less than 3 square feet (.28 sq m) in area shall receive one impact located within a 5 inch (127 mm) radius circle having its center at the midpoint of the glazing panel.

8.6.3 For doors that contain multiple panels of glazing, the innermost panel shall be impacted.

8.6.4 For doors that contain different glazing thicknesses and/or glazing types, each different glazing thickness and glazing type shall be impacted.

9.0 TEST PROCEDURES - LARGE MISSILE IMPACT

9.1 Preparation

9.1.1 Remove from the test specimen any sealing or construction material that is not intended to be used when the unit is installed in or on a building. Support and secure the test specimen into the mounting frame in a vertical position using the same number and type of anchors normally used for product installation as defined by the manufacturer or as required for a specific project. If this is impractical, install the test specimen with the same number of equivalent fasteners located in the same manner as the intended installation. The test specimen shall not be removed from the mounting frame at any time during the test sequence. The test shall be recorded using video equipment.

9.1.2 Secure the test specimen mounting frame such that the large missile will impact the exterior side of the test specimen as installed.

9.1.3 Locate the end of the propulsion device from which the large missile will exit at a minimum distance from the specimen equal to 9 feet (2.74 m) plus the length of the large missile.

9.1.4 Weigh each large missile within four hours prior to each impact.

9.1.5 Align the large missile propulsion device such that the large missile will impact the test specimen at the specified location.

9.2 Large Missile Impact.

9.2.1 Propel the large missile at the specified impact speed and location.

9.2.2 Examine damage in light of the pass/fail criteria found in Section 9.3.

9.2.3 Repeat steps 9.2.1 through 9.2.2 at all additional impact locations specified for the test specimen.

9.3 Pass/Fail Criteria.

9.3.1 The test specimen shall be subjected to evaluation for operability, and shall be acceptable by the following:

9.3.1.1 The door system shall remain in the opening throughout the duration of the test.

9.3.1.2 The door shall be evaluated for full operability at the conclusion of the test. The door shall pass only if the test engineer deems that the door system has full operability.

9.3.2 Latches, locks and fasteners shall not become disengaged during the testing.

9.3.3 Excluding section/slat joints or fabric jamb engagement, no crack or tear shall form longer than 5 inches (127 mm) and wider than 1/16 inch (1.6 mm) through which air can pass.

9.3.4 For sectional garage doors and rolling doors, no opening shall form through which a 3 inch (76 mm) diameter sphere can pass.

9.3.5 For flexible doors, no opening shall form creating a perimeter greater than 15 9/16 inches (395 mm).

9.3.6 All three test specimens shall be required to pass this testing.

9.4 Post Impact Test Procedure.

9.4.1 If the test specimen passes the acceptance criteria of the large missile impact test, it shall then be subjected to the cyclic pressure loading test specified in Section 10.

10.0 CYCLIC WIND PRESSURE LOADING TEST

10.1 General.

10.1.1 This test shall apply to doors that have passed the acceptance criteria of the large missile impact test.

10.1.2 The test specimens tested for impact shall be used for the cyclic pressure loading test.

10.1.3 If air leakage through the test specimen is excessive, tape may be used to cover any joints through which air leakage is occurring.

10.1.4 Cracks due to impact testing shall not be restrained with tape.

10.1.5 Tape shall not be used when there is a probability that it may significantly restrict differential movement between adjoining members.

10.1.6 Both sides of the entire test specimen and mounting panel shall be permitted to be covered with a single thickness of polyethylene film no thicker than 2 mils (.050 mm), in order that the full load is transferred to the test specimen and that the membrane does not prevent movement or failure of the specimen. The film shall be applied loosely with extra folds of material at each corner and at all offsets and recesses. When the load is applied, there shall be no fillet caused by tightness of the plastic film.

10.2 Loading Sequence Alternatives.

10.2.1 Loading Sequence 1 shall be as follows:

#1: Range of Test: 0 to +0.5p Cycles: 600
#2: Range of Test: 0 to +0.6p Cycles: 70
#3: Range of Test: 0 to +1.3p Cycles: 1
#4: Range of Test: 0 to -0.5p Cycles: 600
#5: Range of Test: 0 to -0.6p Cycles: 70
#6: Range of Test: 0 to -1.3p Cycles: 1

10.2.2 Loading Sequence 2 shall be as follows:

#1: Range of Test: +0.2p to +0.5p Cycles: 3500
#2: Range of Test: 0 to +0.6p Cycles: 300
#3: Range of Test: +0.5p to +0.8p Cycles: 600
#4: Range of Test: +0.3p to +1.0p Cycles: 100
#5: Range of Test: -0.3p to -1.0p Cycles: 50
#6: Range of Test: -0.5p to -0.8p Cycles: 1050
#7: Range of Test: 0 to -0.6p Cycles: 50
#8: Range of Test: -0.2p to -0.5p Cycles: 3350

10.2.3 The parameter “p” shall be defined as door design wind load pressure, based on where the assembly will be used.

10.3 Test Procedure.

10.3.1 For non-glazed doors, cyclic static pressure differential loading shall be applied in accordance with either Loading Sequence 1 or Loading Sequence 2 as described in Section 10.2.

10.3.2 For glazed doors, cyclic static pressure differential loading shall be applied in accordance with either Loading Sequence 1 or Loading Sequence 2 as described in Section 10.2.

10.3.3 Each cycle shall have duration not to exceed 20 seconds, where the cycles shall be applied as rapidly as possible and shall be performed in a continuous manner.

10.3.4 Interruptions for equipment maintenance and repair shall be permitted.

10.3.5 The test specimen shall not contact any portion of the test chamber at any time during the application of the cyclic static pressure differential loading.

10.3.6 Successful testing of a door assembly containing glazing shall qualify a door assembly of the same type that does not contain glazing.

10.4 Post-Test Pass/Fail Criteria.

10.4.1 The test specimen shall be subjected to evaluation for operability, and shall be acceptable by the following:

10.4.1.1 The door system shall remain in the opening throughout the duration of the test.

10.4.1.2 The door system shall be evaluated for full operability at the conclusion of the test. The door shall pass only if the test engineer deems that the door system has full operability.

10.4.2 Latches, locks and fasteners shall not become disengaged during the testing.

10.4.3 Excluding section/slat joints or fabric jamb engagement, no crack or tear shall form longer than 5 inches (127 mm) and wider than 1/16 inch (1.6 mm) through which air can pass.

10.4.4 For sectional garage doors and rolling doors, no opening shall form through which a 3 inch (76 mm) diameter sphere can pass.

10.4.5 For flexible doors, no opening shall form creating a perimeter greater than 15 9/16 inches (395 mm).

10.4.6 All three test specimens shall be required to pass this testing.

11.0 **TEST REPORTS**

11.1 Date of the test.

11.2 Date of the report.

11.3 A description of the test specimens, prior to impact and cyclic pressure loading, including all parts and components of a particular system of construction together with manufacturer’s model number, if appropriate, or any other identification.

11.4 Detailed drawings of the test specimens, showing dimensioned section profiles, door dimensions and arrangement, framing location, weatherstripping, locking arrangements, hardware, sealants, glazing details, test specimen sealing methods, and any other pertinent construction details.

11.5 Proper identification of each test specimen, particularly with respect to distinguishing features or differing adjustments. A separate drawing for each test specimen shall not be required where all differences between them are noted on the drawings provided.

11.6 Design pressure used as the basis for testing.

11.7 Information on the large missile Appendix used:

11.7.1 Description of the missile, including dimensions and weight.

11.7.2 Missile speed measured.

11.7.3 Whether or not certification of the calibration equipment was required.

11.7.4 Missile orientation at impact.

11.7.5 Description of the location of each impact.

11.8 Information on the cyclic loading Appendix used:

11.8.1 The positive and negative cyclic test load sequence.

11.8.2 The number of cycles applied for each sequence.

11.8.3 The minimum and maximum duration for each cycle.

11.9 A description of the condition of the test specimens after testing, including details of any damage and any other pertinent observations.

11.10 When the tests are made to check conformity of the specimen to a particular specification, an identification or description of that specification.

11.11 A statement that the tests were conducted in accordance with the test method.

11.12 A statement of whether or not, upon completion of all testing, the test specimens meet the pass/fail criteria of this standard for both missile impact and cyclic loading.

11.13 A statement as to whether or not tape or film, or both, were used to seal against air leakage, and whether in the judgment of the test engineer, the tape or film influenced the results of the test. The name and author of the report.

11.14 The names and addresses of both the testing agency that conducted the tests and the requester of the tests.

11.15 Signatures of persons responsible for supervision of the tests and a list of official observers.

11.16 Any additional data or information considered to be useful to a better understanding of the test results, conclusions, or recommendations. This additional data/ information shall be appended to the report.

REFERENCED DOCUMENTS:

1. Protocol TAS 201-94, Impact Test Procedures, Miami-Dade County Building Code Compliance Office
2. Protocol TAS 203-94, Criteria For Testing Products Subject To Cyclic Wind Pressure Loading, Miami-Dade County Building Code Compliance Office
3. Standard TDI 1-95, Test For Impact and Cyclic Wind Pressure Resistance of Impact Protective Systems and Exterior Opening Systems, Texas Department of Insurance
4. Test Standard for Determining Impact Resistance From Windborne Debris, SSTD 12-97, Southern Building Code Congress International
5. ASTM E 1886-05, Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials
6. ASTM E 1996-05, Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes
7. Fatigue Loading Testing, Section 1625.4, 2004 Florida Building Code, Building
8. ANSI/DASMA 207, Standard for Rolling Sheet Doors

ANSI/DASMA 115 Test Report Form

Missile Impact and Cyclic Loading

Date of Test _____ Date of Report _____

Test Specimen Identification:

Manufacturer _____

Manufacturer Location _____

Model Type/Number _____ Dimensions _____

Material Description _____

Test Specimen Selection Procedure _____

_____

_____

Applicable Drawing No.'s _____

_____

_____

Operating Hardware (Type, Quantity, Location(s)):

_____

_____

_____

Glazing Description: _____

Ambient Temperature: _____

Design pressure used as the basis for testing: _____

Large Missile Information:

Missile Dimensions _____ Missile Weight _____

Missile speed measured _____

Certification of the calibration equipment required? Yes No

Missile orientation at impact _____

Impact #1 Location _____

Maximum Crack Length _____ Maximum Crack Width _____

Maximum Diameter Sphere Penetrating the Impact Location _____

Impact #2 Location _____

Maximum Crack Length _____ Maximum Crack Width _____

Maximum Diameter Sphere Penetrating the Impact Location _____

Impact #3 Location _____

Maximum Crack Length _____ Maximum Crack Width _____

Maximum Diameter Sphere Penetrating the Impact Location _____

Glazing Impact Location (if applicable) _____

Maximum Diameter Sphere Penetrating the Impact Location _____

Test Result: Pass Fail

Notes:

_____

_____

_____

_____

ANSI/DASMA 115 Test Report Form

Missile Impact and Cyclic Loading

Cyclic Loading Information:

#	Applied Pressure	# Cycles	Min. Duration (sec)	Max. Duration (sec)

Maximum Diameter Sphere Penetrating the Test Specimen _____

Maximum Length of Crack Formed in Test Specimen _____ Crack Width _____

Test Result: Pass Fail

Notes:

_____

_____

_____

_____

Door Operable, after Evaluation for Full Operability? (Yes/No) _____

Certification: The signature of the tester attests that the testing was conducted in accordance with the referenced standard.

Testing Conducted by _____of_____

Signature of Tester _____ Date _____

Test Facility and Location _____

Official Observers

_____

The following appendices are informative only and are not a normative part of ANSI/DASMA 115.

Appendix A

Recommended Methods of Calibrating Timing Equipment

A.1 Photographically, using a stroboscope.

A.2 Photographically, using a high speed camera with a frame rate exceeding 500 frames per second.

A.3 Photographically, using a high speed video camera with a frame rate exceeding 500 frames per second.

A.4 Any other certified timing system calibration device with an accuracy of +/- 1%.

Appendix B
Impact Testing Procedure for the Florida High Velocity Hurricane Zone

1. Scope

1.1 This Appendix covers procedures for conducting the impact test of doors as required by Section 1626 of the Florida Building Code, Building.

2. Referenced Documents

2.1 2004 Florida Building Code, Building

3. Terminology

3.1 *Definitions* – For definitions of terms used in this Appendix, refer to Sections 1625, 1626 and/or Chapter 2 of the Florida Building Code, Building.

3.2 *Description of Terms Specific to This Appendix*

3.2.1 *Specimen* – The entire assembled unit submitted for test, including but not limited to anchorage devices and structure to which product is to be mounted.

3.2.2 *Test Chamber* – An airtight enclosure of sufficient depth to allow unobstructed deflection of the specimen during pressure cycling, including ports for air supply and removal, and equipped with instruments to measure test pressure differentials.

3.2.3 *Maximum Deflection* – The maximum displacement of the specimen, measured to the nearest 1/8" (3 mm), attained from the original position while the maximum test load is being applied.

3.2.4 *Permanent Deformation* – The permanent displacement of the specimen, measured to the nearest 1/8 inch (3 mm), from the original position to final position that remains after maximum test load has been removed.

3.2.5 *Test Load* – As determined by Sections 1606, 1625 and 1626 of the Florida Building Code, Building.

3.2.6 *Specimen Failure* – A change in condition of the specimen indicative of deterioration under repeated load or incipient failure, such as cracking, fastener loosening, local yielding, or loss of adhesive bond.

4. Significance and Use

4.1 The test procedures outlined in this Appendix provide a means of determining whether a door provides sufficient resistance to windborne debris, as stated in Section 1626 of the Florida Building Code, Building.

5. Test Specimen

5.1 *Test specimen* – All parts of the test specimen shall be full size, using the same materials, details, methods of construction and methods of attachment as proposed for actual use. The specimen shall consist of the entire assembled unit attached to a given type of structural framing of the building, and shall contain all devices used to resist wind forces and windborne debris. When testing glazed products, the material used to make such glazed product windborne debris resistant (i.e. fillers, film and similar), shall be an integral part, factory applied, of such glazed product.

5.1.1 Locking mechanisms shall be permanently mounted on the specimen. Such locking mechanism shall require no tools to be latched in the locked position. Devices such as pins shall be permanently secured to the specimen through the use of chains or wires that shall be of corrosion resistant material. This section shall not apply to specimens referenced in Section 2413 of the Florida Building Code, Building.

5.1.2 Products that are not categorized as means of egress/escape, and are provided with more than one single action locking mechanism, shall be provided with permanently posted instructions on latching for high wind pressures.

5.1.3 Specimen and fasteners, when used, shall not become disengaged during test procedure.

6. Apparatus

6.1 The description of the apparatus is general in nature. Any equipment, properly certified, calibrated, and approved by the Authority Having Jurisdiction capable of performing this test within the allowable tolerance, shall be permitted.

6.2 *Major Components*

6.2.1 *Cyclic Wind Pressure Loading* – Number of cycles and amount of pressure shall be as indicated in Section 1625.4, Table 1625 and Table 1626 of the Florida Building Code, Building. Design wind pressure shall be determined by using Section 1609 of the Florida Building Code, Building.

6.2.1.1 *Test Chamber* – The test chamber, to which the specimen is mounted, shall be provided with pressure taps to measure the pressure difference across the test specimen and shall be so located that the reading is unaffected by the velocity of air supplied to or from the

chamber. The specimen mounting frame shall not deflect under test load in such manner that the performance of the specimen will be affected.

6.2.1.2 *Air System* – A controllable blower, a compressed-air supply, an exhaust system, or reversible controllable blower designed to provide the required maximum air pressure difference across the specimen. The system shall provide an essentially constant air-pressure difference for the required test period.

6.3 *Missile Impact*

6.3.1 *Timing System* – The timing system, which is comprised of two, through-beam photoelectric sensors spaced at a known distance apart and used to start and stop an electronic clock, shall be capable to measure speeds accurate to +/- 2%. The speed of the missile shall be measured anywhere between the point where 90% of the missile is outside of the cannon, to the point where the missile is 1 ft. (305 mm) away from the test specimen. The missile speed shall not be measured while the missile is accelerating. The through-beam photoelectric sensors shall be of the same model.

The electronic clock shall be activated when the reference point of the missile passes through the timing system. The electronic clock shall have an operating frequency of no less than 10 kHz with a response time not to exceed 0.15 milliseconds. The speed of the missile shall be determined by dividing the distance between the two through-beam photoelectric sensors by the total time interval counted by the electronic clock.

6.3.1.1 *Calibration of Timing Equipment* – The timing system shall be calibrated and certified by an independent qualified agency approved by the Authority Having Jurisdiction, at six-month intervals using one of the following methods:

1. Photographically, using a stroboscope,
2. Photographically, using a high speed camera with a frame rate exceeding 500 frames per second,
3. Photographically, using a high speed video camera with a frame rate exceeding 500 frames per second, or
4. Any other certified timing system calibration device used by an independent certified agency approved by this office.

The calibration report shall include the date of the calibration, the name of the agency conducting the calibration, the distance between the through-beam photoelectric sensors (if used), the speed of the missile as determined from the calibration system, and the percentage difference in speeds. The system shall be determined to be accurate if the speed of the missile measured by the timing system and the speed measured by the calibration system agree within 2%.

6.3.2.1 *Large Missile* – The large missile shall be a solid S4S nominal 2x4 #2

surface dry Southern Pine. The weight of the missile shall be as specified in Section 1626.2.3 of the Florida Building Code, Building and shall have a length of not less than 7 feet (2.14 m) and not more than 9 feet (2.75 m). The missile shall be marked/ticked in dark ink at one-inch intervals on center, and congruently numbered every three inches. A sabot shall be attached to the trailing edge of the missile to facilitate launching. The weight of the sabot shall not exceed 1/2 lb (.228 kg). The combined weight of the timber and sabot, which constitutes the missile, shall be between 9 lb. (4.1 kg) and 9.5 lb (4.23 kg). The missile shall be propelled through a cannon as described in section 6.3.3 of this Appendix.

6.3.2.2 When testing any specimen with more than one component, in addition to complying with the impacts required by Section 1626.2 of the Florida Building Code, Building, the framing member connecting these components shall be impacted at one-half the span of such member with the large missile at a speed indicated in Section 1626.2.4 of the Florida Building Code, Building.

6.3.2.3 Any specimen that passes the large missile impact test shall not be tested for the small missile impact test if the specimen has no opening through which a 3/16 inch (5 mm) sphere can pass.

6.3.3 *Large Missile Cannon* – The large missile cannon shall be compressed air to propel the large missile. The cannon shall be capable of producing impact at the speed specified in Section 1626.2.4 of the Florida Building Code, Building. The missile cannon shall consist of four major components: a compressed air supply, a pressure release valve, a pressure gauge, a barrel and support frame, and a timing system for determining the missile speed. The barrel of the missile cannon shall consist of a 4-inch (102 mm) inside diameter pipe and shall be at least as long as the missile. The barrel of the large missile cannon shall be mounted on a support frame in a manner to facilitate aiming the missile so that it impacts the specimen at the desired location. The distance from the end of the cannon to the specimen shall be 9 feet (2.75 m) plus the length of the missile.

6.3.4 *Small Missile* –The missiles shall be propelled by the cannon as described in Section 6.3.5 of this Appendix. The small missile shall be launched in such a manner that each specimen shall be impacted simultaneously over an area not to exceed two square feet per impact as described in Section 1626.3.5 of the Florida Building Code, Building.

6.3.5 *Small Missile Cannon* – A compressed air cannon shall be used that is capable of propelling missiles of the size and speed defined in Section 1626.3.3 and 1626.3.4 of the Florida Building Code, Building. The cannon assembly shall be comprised of a compressed air supply and gauge, a remote firing device and valve, a barrel, and a timing system. The small missile cannon shall be mounted to prevent movement of the cannon so that it can propel missiles to impact the test specimen at points defined in Section 1626.3.5 of the Florida Building Code, Building. The timing system shall be

positioned to measure missile speed within 5 feet (1.53 m) of the impact point on the test specimen.

7. Hazards

7.1 Testing facilities shall take all necessary precautions to protect observers during the entire test procedure. All observers shall be at a safe distance away from specimen and apparatus. Safety regulations shall be followed in order to avoid any injuries to any and all observers.

8. Testing Facilities

8.1 Any testing facility wishing to perform this test shall first obtain the approval of the Authority Having Jurisdiction. Such approval shall only be given to those facilities that show they are properly equipped to perform the complete test, including the cyclic loading and the small and large missile impact test. Testing facilities shall request, in writing, approval of their facilities. Such request shall contain the ability of the facility to perform all aspects of the test, all equipment used in the performance of the test, name of independent agency calibrating their equipment, location of facilities, personnel involved in the testing, a quality control program, a safety program and any other pertinent information which shall clearly indicate that such facility is in the business of performing independent testing. A representative of the Authority Having Jurisdiction shall visit the site, and shall reserve the right to order any changes necessary to accept the facility for testing.

8.2 Approval of facilities to perform the test described in this Appendix does not constitute an approval of such facilities to perform other tests not specifically mentioned in this Appendix.

8.3 The testing lab shall be TAS301 certified.

9. Format of Test

The manufacturer shall notify the Authority Having Jurisdiction seven (7) working days prior to the performing of the test. The Authority Having Jurisdiction reserves the right to observe the test. The Authority Having Jurisdiction must be notified of the place and time the test will take place. The test must be recorded on video and retained by the laboratory per TAS301.

10. Test Reports

The following minimum information shall be included in the submitted report:

10.1 Date of the test and the report, and report number.

10.2 Name, location, and certification number of facilities performing the test.

10.3 Name and address of requester of the test.

10.4 Identification of the specimen (manufacturer, source of supply, dimension, model

types, material, procedure of selection and any other pertinent information).

10.5 Detailed drawings of the specimen showing dimensioned section profiles, type of framing to which specimen was attached, panel arrangement, installation and spacing of anchorage, locking arrangement, sealants, hardware, product markings and their location, and any other pertinent construction details. Any deviation from the drawings or any modifications made to the specimen to obtain the reported values shall be noted on the drawings and in the report.

10.6 Maximum deflection recorded and mechanism used to make such determination.

10.7 Permanent deformation (a cross-sectional diagram shall be provided to show where it occurred).

10.8 Name, address, signature and seal of Florida professional engineer, witnessing the test and preparing the report. Engineer shall be part of the laboratory's permanent staff or under laboratory's contract.

10.9 The results for all three specimens shall be reported, each specimen being properly identified, particularly with respect to distinguishing features or differing adjustments. A separate drawing for each specimen shall not be required if all differences between them are noted on the drawings provided.

10.10 Location of impacts on each test specimen.

10.11 The large and small missile velocities.

10.12 The weight of the missiles.

10.13 Maximum positive and negative pressures used in the cyclic wind pressure loading.

10.14 A description of the condition of the test specimens after testing, including details of any damage and any other pertinent observations.

10.15 When the tests are made to check conformity of the specimen to a particular specification, an identification or description of that specification.

10.16 A statement that the tests were conducted in accordance with this test method.

10.17 A statement of whether or not, upon completion of all testing, the specimens meet the requirements of Section 1626 of the Florida Building Code, Building.

10.18 A statement as to whether or not tape or film, or both were used to seal against air leakage, and whether in the judgment of the test engineer, the tape or film influenced the results of the test.

10.19 Signatures of persons responsible for supervision of the tests, and a list of official observers.

10.20 All data not required herein, but useful to a better understanding of the test results,

conclusions or recommendations, may be appended to the report.

11. Recording Deflections

Maximum Deflection

Permanent Deformation

12. Additional Testing

12.1 Following successful completion of this test, all specimens shall then be successfully tested as per Appendix C of this standard.

12.2 If a product is subjected to weathering that can affect its integrity, the manufacturer shall contact the Authority Having Jurisdiction for additional testing requirements such as but not limited to moisture, U.V., accelerated aging, and other similar tests.

12.3 The Authority Having Jurisdiction shall reserve the right to require any additional testing necessary to assure full compliance with the intent of the Florida Building Code, Building.

12.4 Products tested in accordance with this Appendix shall be required to be successfully tested under Appendix A of ANSI/DASMA 108 prior to conducting tests under this Appendix.

13. Product Marketing

13.1 Any and all approved products shall be permanently labeled with the manufacturer's name, city, and state, and the following statement: "Product Control Approved."

13.2 Permanently labeled shall be a metallic label fixed permanently to the frame of the specimen by rivets or permanent adhesive.

13.3 Any instructions for operations shall be permanently mounted on the specimen in an area not subject to be painted or concealed.

Appendix C
Cyclic Wind Pressure Testing Procedure for the Florida High Velocity Hurricane Zone

1. Scope

1.1 This Appendix covers procedures for conducting the cyclic wind pressure loading test required by the Florida Building Code, Building and Appendix B of this standard.

2. Referenced Documents

2.1 2004 Florida Building Code, Building.

3. Terminology

3.1 *Definitions* – For definitions of terms used in this Appendix, refer to the Florida Building Code, Building.

3.2 *Description of Terms Specific to This Appendix*

3.3 *Specimen* – The entire assembled unit submitted for test, including anchorage devices and structure to which product is to be mounted.

3.4 *Positive (negative) Cyclic Load* – The specified differential in static air pressure, creating an inward (outward) loading, for which the specimen is to be tested under repeated conditions, expressed in pounds per square foot.

3.5 *One cycle* – Beginning at the specified static air pressure, the application of positive cyclic test load, and returning to the specified static air pressure, followed by the application of negative cyclic test load.

3.6 *Design Pressure (Design Wind Load)* – The uniform static air pressure difference, inward or outward and expressed in pounds per square foot (Newtons per square meter), for which the specimen would be designed under service load conditions using Section 1606 of the Florida Building Code, Building.

3.7 *Test Chamber* – An airtight enclosure of sufficient depth to allow unobstructed deflection of the specimen during pressure cycling, including ports for air supply and removal, and equipped with a device to measure test pressure differentials.

3.8 *Maximum Deflection* – The maximum displacement, measured to the nearest 1/8 inch (3 mm), attained from an original position while the maximum load is being applied.

3.9 *Permanent Deformation* – The permanent displacement, measured to the nearest 1/8 inch (3 mm), from an original position that remains after the applied test load has been removed.

3.10 *Specimen Failure* – A change in condition of the specimen indicative of deterioration

under repeated load or incipient failure, such as cracking, fastener loosening, local yielding, or loss of adhesive bond.

4. Significance and Use

4.1 This test method is a standard procedure for determining compliance with Section 1625, Table 1625.4 and Table 1626 of the Florida Building Code, Building. This test method shall be intended to be used for installations of sectional garage doors, rolling doors and flexible doors. This test method shall consist of supplying air to and exhausting air from the chamber in accordance with a specific test loading program at the rate required to maintain the test pressure differential across the specimen, and observing, measuring, and recording the deflection, deformations, and nature of any distress or failures of the specimen.

5. Test Specimen

5.1 *Test specimen* – All parts of the test specimen shall be full size, using the same materials, details, methods of construction and methods of attachment as proposed for actual use. The specimen shall consist of the entire assembled unit attached to a given type of structural framing of the building, and shall contain all devices used to resist wind forces and windborne debris. When testing glazed products, the material used to make such glazed product windborne debris resistant (i.e. fillers, film and similar) shall be an integral part, factory applied, of such glazed product.

5.1.1 Locking mechanisms shall be permanently mounted on the specimen. Such locking mechanism shall require no tools to be latched in the locked position. Devices such as pins shall be permanently secured to the specimen through the use of chains or wires which shall be of corrosion resistant material.

5.1.2 Products that are not categorized as means of egress/escape, and are provided with more than one single action locking mechanism, shall be provided with permanently posted instructions on latching for high wind pressures.

5.1.3 Specimen and fasteners, when used, shall not become disengaged during test procedure.

5.2 If the impact test is to be performed on the test specimen, such test shall be conducted prior to performing the test described in this Appendix.

5.3 All locking mechanisms shall be in place when performing this test.

5.4 Doors shall be evaluated for operability after this test.

6. Procedure

6.1 *Preparation* – Remove from the test specimen any sealing or construction material that is not normally used when installed in or on a building. Fit the specimen with its structural framing into or against the chamber opening. The outdoor side of the

specimen shall face the higher pressure side for positive loads; the indoor side shall face the higher pressure side for negative loads. Support and secure the specimen by the same number and type of anchors to be approved for normal installation of the specimen in the building.

6.2 Support and secure the test specimen by the same number and type of anchors normally used in installing the unit in the building.

6.3 Load the specimen using the cycles specified in Table 1625.4 and/or Table 1626 of the Florida Building Code, Building, whichever of these apply.

6.4 In the case of Table 1625.4 of the Florida Building Code, Building, Section 6.3 of this Appendix shall be repeated for negative pressures.

6.5 Assemblies shall be tested with no resultant failure or distress, and shall have a recovery of at least 90% over maximum deflection.

7. Apparatus

7.1 The description of the apparatus is general in nature. Any equipment, properly certified, calibrated, and approved by the Authority Having Jurisdiction capable of performing this test within the allowable tolerance shall be permitted.

7.2 *Major Components*

7.2.1 *Test Chamber* – The test chamber, to which the specimen is mounted, shall be provided with pressure tabs to measure the pressure difference across the test specimen and shall be so located that the reading is unaffected by the velocity of air supplied to or from the chamber. The specimen mounting frame shall not deflect under test load in such manner that the performance of the specimen will be affected.

7.2.2 *Pressure-Measuring Apparatus* – The pressure-measuring apparatus shall measure the test pressure difference within a tolerance of +/-2%

7.2.3 *Deflection-Measuring System* – The deflection-measuring system shall measure the deflection within a tolerance of 0.01 inch (0.25 mm).

7.2.4 *Air System* – A controllable blower, a compressed-air supply, an exhaust system, or reversible controllable blower designed to provide the required maximum air pressure difference across the specimen. The system shall provide an essentially cyclic static air-pressure difference for the required test period.

7.3 *Calibration of Equipment* – The pressure-measuring apparatus and the deflection-measuring system shall be calibrated and certified by an independent qualified agency approved by the Authority Having Jurisdiction, at two-year intervals.

7.3.1 The calibration report shall include the date of the calibration, the name of the agency conducting the calibration, methods and equipment used in the

calibration process, the equipment being calibrated and any pertinent comments.

8. Hazards

8.1 Testing facilities shall take all necessary precautions to protect the observers during the entire test procedure. All observers shall always be at a safe distance away from specimen and apparatus. Safety regulations shall be followed in order to avoid any injuries to any and all observers.

9. Testing Facilities

9.1 Any testing facility wishing to perform testing on such products shall first obtain the approval of the Authority Having Jurisdiction. Such approval shall only be given to those facilities that show they are properly equipped to perform the complete test. Testing facilities shall request, in writing, approval of their facilities. Such request shall contain the ability of the facility to perform all aspects of the test, all equipment used in the performance of the test, name of independent agency calibrating their equipment, location of facilities, personnel involved in the testing, a quality control program, a safety program and any other pertinent information which shall clearly indicated that such facility is in the business of performing independent testing. A representative of the Authority Having Jurisdiction shall visit the site, and shall reserve the right to order any changes necessary to accept the facility for testing.

9.2 Approval of facilities to perform the test described in this Appendix shall not constitute an approval of such facilities to perform other tests not specifically mentioned in this Appendix.

9.3 The testing lab shall be TAS301 certified.

10. Format of Test

The manufacturer shall notify the Authority Having Jurisdiction seven (7) working days prior to the performing of the test. The Authority Having Jurisdiction reserves the right to observe the test. The Authority Having Jurisdiction must be notified of the place and time the test will take place. The test must be recorded on video and retained by the laboratory per TAS301.

11. Test Reports

The following minimum information shall be included in the submitted report:

11.1 Date of the test and the report, and report number.

11.2 Name and location of facilities performing the test.

11.3 Name and address of requester of the test.

11.4 Identification of the specimen (manufacturer, source of supply, dimension, model types, material, procedure of selection and any other pertinent information).

11.5 Detailed drawings of the specimen showing dimensioned section profiles, type of framing to which specimen was attached, panel arrangement, installation and spacing of anchorage, locking arrangement, sealant, hardware, product markings and their location, and any other pertinent construction details. Any deviation from the drawings or any modifications made to the specimen to obtain the reported values shall be noted on the drawings and in the report.

11.6 Maximum deflection recorded, and mechanism used to make such determination.

11.7 Permanent deformation (a cross-sectional diagram shall be provided to show where it occurred).

11.8 Name, address, signature and seal of Florida professional engineer, witnessing the test and preparing the report. Engineer shall be part of the laboratory's permanent staff or under laboratory's contract.

11.9 A tabulation of pressure differences exerted across the specimen during the test and their duration.

11.10 Maximum positive and negative pressures used in the test.

11.11 A description of the condition of the test specimens after testing, including details of any damage and any other pertinent observations.

11.12 When the tests are made to check conformity of the specimen to a particular specification, an identification or description of that specification.

11.13 A statement that the tests were conducted in accordance with this test method.

11.14 A statement of whether or not, upon completion of all testing, the specimens meet the requirements of Section 1609 of the Florida Building Code, Building and this Appendix.

11.15 A statement as to whether or not tape or film or both were used to seal against air leakage, and whether in the judgment of the test engineer, the tape of film influenced the results of the test.

11.16 Signatures of persons responsible for supervision of the tests and a list of official observers.

11.17 All data not required herein, but useful to a better understanding of the test results, conclusions or recommendations, may be appended to the report.

12. Recording Deflections

Maximum Deflection

Permanent Deformation

13. Additional Testing

13.1 Prior to conducting the test described in this Appendix, all specimens shall have successfully completed the test specified in Appendix B.

13.2 If a product is subjected to weathering that can affect its integrity, the manufacturer shall contact the Authority Having Jurisdiction for additional testing requirements such as but not limited to moisture, U.V., accelerated aging, and other similar tests.

13.3 The Authority Having Jurisdiction shall reserve the right to require any additional testing necessary to assure full compliance with the intent of the Florida Building Code, Building.

13.4 Products tested in accordance with this Appendix shall be required to be successfully tested under Appendix A of ANSI/DASMA 108 prior to conducting tests under this Appendix.

14. Product Marking

14.1 Any and all approved products shall be permanently labeled with the manufacturer's name, city, and state, and the following statement: "Product Control Approved."

14.2 Permanent label shall be a metallic label fixed permanently to the frame of the specimen by rivets or permanent adhesive.

14.3 Any instructions for operations shall be permanently mounted on the specimen in an area not subject to be painted or concealed.

Appendix D
Alternate Large Missile Test

D.1 The large missile shall be a nominal 2x4 Southern Pine lumber, minimum Stud grade, with no knots within 12 inches (305 mm) of the impact end. The missile shall have a length as given in Table D-1, based on the level of protection and wind zone for which the door is intended. The end of the missile subjected to impact shall be permitted to be rounded to no less than a 48 inch (1219 mm) diameter sphere, with sharp edges permitted to be rounded to no more than a 1/16 inch (2 mm) radius. The missile may be marked/ticked in dark ink at one inch (25 mm) intervals on center, and congruently numbered every three inches (76 mm). A sabot shall be attached to the trailing edge of the missile to facilitate launching. The weight of the sabot shall not exceed 0.5 lbs. (227 g). The combined weight of the timber and sabot, which constitutes the missile, shall be as given in Table D-1, based on the level of protection and wind zone for which the door is intended. The missile shall be propelled through a cannon as described in section D.2.

D.2. The large missile cannon shall be capable of producing impact at the speed specified in Table D-1. The missile cannon may use compressed air to propel the large missile, and if using compressed air shall consist of the following major components: a compressed air supply, a pressure release valve, a pressure gauge, a barrel and support frame, and a timing system for determining the missile speed. The barrel of the missile cannon shall consist of either a 4 inch (102 mm) inside diameter pipe or a nominal 2 inch (51 mm) by 4 inch (102 mm) rectangular tube, and shall be at least as long as the missile. The barrel of the large missile cannon shall be mounted on a support frame in a manner to facilitate aiming the large missile so that it impacts the test specimen at the desired location.

D.3. The timing system shall be capable to measure speeds accurate to +/- 2%. One method shall be comprised of two, through-beam photoelectric sensors spaced at a known distance apart and used to start and stop an electronic clock, and shall be capable to measure speeds accurate to +/- 2%. The speed of the missile shall be measured anywhere between the point where 100% of the missile is outside of the cannon, to the point where the missile is 1 ft. (300 mm) away from the test specimen. The missile speed shall not be measured while the missile is accelerating. The speed of the missile shall be determined by dividing the distance between the two through-beam photoelectric sensors by the total time interval counted by the electronic clock.

Table D-1, Large Missile Descriptions
a) Basic Protection

Wind Zone	Length	Weight	Impact Speed
1	4’ +/- 4” (1.2 +/- .1 m)	4.5 +/-.25 lbs (2050 +/- 100 g)	40 ft/s (12.2 m/s)
2	4’ +/- 4” (1.2 +/- .1 m)	4.5 +/-.25 lbs (2050 +/- 100 g)	40 ft/s (12.2 m/s)
3	8’ +/- 4” (2.4 +/- .1 m)	9.0 +/-.25 lbs (4100 +/- 100 g)	50 ft/s (15.3 m/s)
4	8’ +/- 4” (2.4 +/- .1 m)	9.0 +/-.25 lbs (4100 +/- 100 g)	50 ft/s (15.3 m/s)

b) Essential Facilities

Wind Zone	Length	Weight	Impact Speed
1	8’ +/- 4” (2.4 +/- .1 m)	9.0 +/-.25 lbs (4100 +/- 100 g)	50 ft/s (15.3 m/s)
2	8’ +/- 4” (2.4 +/- .1 m)	9.0 +/-.25 lbs (4100 +/- 100 g)	50 ft/s (15.3 m/s)
3	8’ +/- 4” (2.4 +/- .1 m)	9.0 +/-.25 lbs (4100 +/- 100 g)	80 ft/s (24.4 m/s)
4	8’ +/- 4” (2.4 +/- .1 m)	9.0 +/-.25 lbs (4100 +/- 100 g)	80 ft/s (24.4 m/s)

Where wind speeds based on any of the wind speed maps in ASCE 7-10 (ultimate design wind speeds as the basic wind speeds) are used, the following Wind Zones apply:
1: 130 mph (58 m/s) <= basic wind speed < 140 mph (63 m/s), and Hawaii.
2: 140 mph (63 m/s) <= basic wind speed < 150 mph (67 m/s) at greater than one mile (1.6 km) from the coastline. The coastline shall be measured from the mean high water mark.

3: 150 mph (67 m/s) <= basic wind speed <= 160 mph (72 m/s), or 120 mph (54 m/s) <= basic wind speed <= 140 mph (63 m/s) and within one mile (1.6 km) of the coastline. The coastline shall be measured from the mean high water mark.
4: basic wind speed > 160 mph (72 m/s).

Where wind speeds based on the wind speed map in ASCE 7-05 (allowable stress design wind speeds as the basic wind speeds) are used, the following Wind Zones apply:

1: 110 mph (49 m/s) <= basic wind speed < 120 mph (54 m/s), and Hawaii.
2: 120 mph (54 m/s) <= basic wind speed < 130 mph (58 m/s) at greater than one mile (1.6 km) from the coastline. The coastline shall be measured from the mean high water mark.
3: 130 mph (58 m/s) <= basic wind speed <= 140 mph (63 m/s), or 120 mph (54 m/s) <= basic wind speed <= 140 mph (63 m/s) and within one mile (1.6 km) of the coastline. The coastline shall be measured from the mean high water mark.
4: basic wind speed > 140 mph (63 m/s).