Specifying Windows, Doors and Skylights Using Performance Standards
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Specifying Windows and Doors Using Performance Standards

Learning Objectives:

• Understand the evolution of window and door standards and code references
• Recognize how to use the standard to specify product type, performance level and key performance attributes
• Analyze special requirements for different window and door types
• Learn to use the short form specification
The North American Fenestration Standard
AAMA/WDMA/CSA 101/I.S.2/A440-11
Getting to NAFS-11

1947
The first Guide Specification for Aluminum Windows was released.

1950
Performance levels for different applications were first defined.

1962
AAMA 302 aluminum window standard was released.

1985
AAMA “101” standard for aluminum windows and doors was released.

1986
AAMA “101” standard for vinyl windows and doors was released.

1988
AAMA “101” standard for aluminum windows and doors is updated from 1985 document and released.
Getting to NAFS-11 (cont.)

1993
AAMA “101” standards for aluminum and vinyl windows and doors combined and released.

1994
AAMA and NWWDA begin work to consolidate the two major U.S. standards for windows and glass doors.

1997
ANSI/AAMA/NWWDA 101/I.S. 2-97 was released, encompassing products made of aluminum, vinyl, fiberglass or wood, as well as those with aluminum- or vinyl-clad wood framing members.

1997
ANSI/AAMA/NWWDA 101/I.S. 2-97 was released, encompassing products made of aluminum, vinyl, fiberglass or wood, as well as those with aluminum- or vinyl-clad wood framing members.

2002
ANSI/AAMA/WDMA 101/I.S. 2/NAFS - 02, was released, incorporating skylights, sidelites and transoms for the first time.

2005
AAMA/WDMA/CSA 101/I.S. 2/A440-05 was issued, fully consolidating U.S. and Canadian standards and adding four more operator types, eight additional materials and requirements for side-hinged doors.

2008
AAMA/WDMA/CSA 101/I.S.2/A440-08 (NAFS-08) was issued, consolidating Performance Classes.

2011
NAFS-11 was published, now including 36 product types; parallel opening windows and secondary storm products added.
Key Features of AAMA/WDMA/CSA 101/I.S.2./A440-11

• Performance Based
Key Features of AAMA/WDMA/CSA 101/I.S.2./A440-11

- Performance Based
- Material Neutral
Key Features of AAMA/WDMA/CSA 101/I.S.2./A440-11

- Performance Based
- Material Neutral
- Referenced by IBC and IRC
Key Features of AAMA/WDMA/CSA 101/1.S.2./A440-11

• Performance Based
• Material Neutral
• Referenced by IBC and IRC
• Multinational in Scope
Using NAFS-11

- What type of product?
- What application?
- What performance level?
What Type of Product?
Product Types

- 36 Product Types are identified in the 2011 standard by a specific letter code
Application: What Kind of Building?
Performance Class

2005: R LC C HC AW

2008/2011: R LC CW AW

5 4
# Performance Grade

<table>
<thead>
<tr>
<th>Product Performance Class</th>
<th>Minimum Performance Grade</th>
<th>Minimum Design Pressure (psf)</th>
<th>Wind Speed Equivalent (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Windows and Doors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>15</td>
<td>15.0</td>
<td>77</td>
</tr>
<tr>
<td>LC</td>
<td>25</td>
<td>25.0</td>
<td>99</td>
</tr>
<tr>
<td>CW</td>
<td>30</td>
<td>30.0</td>
<td>108</td>
</tr>
<tr>
<td>AW</td>
<td>40</td>
<td>40.0</td>
<td>125</td>
</tr>
</tbody>
</table>
Product Designation System

PRODUCT KEY

A = Performance Class: R

B = Performance Grade: Design Pressure = 15 psf

C = Maximum Size Tested: Width x Height (63x44)

D = Product Type: Horizontal Sliding Window (HS)
Basic Performance Requirements

• Structural adequacy to withstand design wind loads
• Resistance to water penetration
• Resistance to air leakage
• Resistance to forced entry
Technical Bulletin August 30, 2011
Relating ASCE/SEI 7-10 Design Wind Loads to Fenestration Product Ratings

The American Society of Civil Engineers (ASCE) and the Structural Engineering Institute (SEI) have published the 2010 edition of ASCE/SEI 7, Minimum Design Loads for Buildings and Other Structures. This updated standard is approved for reference in the 2012 International Codes and in the 2010 Florida Building Code, replacing the text taken from the previous edition, ASCE/SEI 7-05.

This bulletin is intended to inform building specifiers and other interested users:
1. that the 2010 version of ASCE/SEI 7 cannot be intermixed with earlier versions;
2. that exterior fenestration products (windows, doors and skylights) do not need to be tested differently as a result of the new 2010 version of ASCE/SEI 7; and
3. how the design loads from the new 2010 edition of ASCE/SEI 7 relate to exterior fenestration (windows, doors and skylights) product ratings and performance grades.

This bulletin is not intended to highlight all the changes from version 2005 to 2010 of ASCE/SEI 7, such as those related changes where opening protection in windborne debris regions is required. Please review ASCE/SEI 7-10 in its entirety for full details.

ASCE/SEI 7-10 revised the method used for establishing basic wind speed, resulting in three different wind speed maps of the United States. ASCE/SEI 7-10 also revised the mechanics of the calculations used to incorporate building design considerations and convert wind speed into appropriate load requirements for fenestration, based on the wind speeds shown in the updated maps. Further, ASCE/SEI 7-10 calculations now provide design wind pressure values based on design strength/loads and resistance factor design in place of previously used allowable stress design. ASCE/SEI 7-10 allows for conversion from strength design to allowable stress design by applying a factor of 0.6. This conversion is important in correlating the correct design load to fenestration product ratings.

Because of the many, these three revisions relate to each other, editions of the ASCE/SEI 7 standard cannot be intermixed. Doing so could result in excessively high or inappropriately low load predictions for windows, exterior doors and skylights. However, except for a few locations where variances created by the new wind maps produce significantly different wind pressures, the products would not be specified by correctly using either version of the ASCE/SEI 7 standard are essentially the same.

The 2009 and 2012 International Building Code and International Residential Code references either the 2001 or 2006 edition of AAMA/WDMA/CMAA 101,1.5.1.440—NAWS North American Fenestration Standard/Specification for windows, doors, and skylights for fenestration testing, depending upon which edition of the codes are adopted in a particular jurisdiction. Both editions of NAWS assess a product’s ability to resist uniform loading based mainly on compliance testing, and assign Performance Grades based on allowable stress design. NFPA Performance Grades correlate directly with required design wind pressure, as those pressures are determined by ASCE/SEI 7 utilizing Combination Loading Equations for Allowable Stress Design. Regardless of which edition is used, therefore, the testing requirements for fenestration products to correlate to the design load requirements of ASCE/SEI 7, 2005 vs. 2010, have not changed.

Below is an example of design pressures determined for vertical fenestration products using both the 2010 and 2005 editions of ASCE/SEI 7. The analytical method in ASCE/SEI 7-10 was used for these calculations. Calculations for sloped (i.e. roof) products produce different loads.
### DesignWind Load Table (psf)

Excerpt from ASCE 7-05

<table>
<thead>
<tr>
<th>Mean Roof Height (ft.)</th>
<th>Positive Pressure All Areas</th>
<th>Negative Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Area 4</td>
<td>Area 5</td>
</tr>
<tr>
<td><strong>BASIC WIND SPEED – 70 MPH</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>16.6</td>
<td>-17.6</td>
</tr>
<tr>
<td>20</td>
<td>18.0</td>
<td>-19.1</td>
</tr>
<tr>
<td>25</td>
<td>19.2</td>
<td>-20.4</td>
</tr>
<tr>
<td>30</td>
<td>20.3</td>
<td>-21.5</td>
</tr>
<tr>
<td>40</td>
<td>21.9</td>
<td>-23.3</td>
</tr>
<tr>
<td>50</td>
<td>23.4</td>
<td>-24.8</td>
</tr>
<tr>
<td>60</td>
<td>24.6</td>
<td>-26.1</td>
</tr>
<tr>
<td>70</td>
<td>25.7</td>
<td>-27.2</td>
</tr>
<tr>
<td>80</td>
<td>26.7</td>
<td>-28.3</td>
</tr>
<tr>
<td>90</td>
<td>27.7</td>
<td>-29.4</td>
</tr>
</tbody>
</table>
Structural Loading
Uniform Load Deflection Test at the Design Pressure

• A minimum uniform design pressure load is applied to the test specimen, first to the exterior surface (positive) and then to the interior surface (negative).

• Deflection at design pressure is reported for all products. For CW and AW products, the deflection must not exceed L/175.
## Minimum Performance Requirements Listed by Class

<table>
<thead>
<tr>
<th>Window/Door Classes</th>
<th>Design Pressure (psf)</th>
<th>Structural Test Pressure (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>15</td>
<td>22.5</td>
</tr>
<tr>
<td>LC</td>
<td>25</td>
<td>37.5</td>
</tr>
<tr>
<td>CW</td>
<td>30</td>
<td>45</td>
</tr>
<tr>
<td>AW</td>
<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>
Structural Load Requirements

2011 Version

Uniform Load Structural Test

“There shall be no permanent deformation of any mainframe, sash, sash member, leaf, or threshold/sill in excess of 0.4% of its span for R and LC class products, 0.3% of its span for CW class products or 0.2% of its span for AW class products.”

0.4%, 0.3% or 0.2%
Water Penetration
Minimum Water Test Pressure

20% of Design Pressure

15% of Design Pressure
(or 2.9 minimum as shown)

Pressure in psf

R: 2.9 (15)
LC: 3.8 (25)
CW: 4.5 (30)
AW: 8.0 (40)

psf (min)
## Minimum Performance Requirements Listed by Class

<table>
<thead>
<tr>
<th>Window/Door Classes</th>
<th>Design Pressure (psf)</th>
<th>Structural Test Pressure (psf)</th>
<th>Water Resistance Test Pressure (psf)</th>
<th>Required Percentage For Water Testing</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>15</td>
<td>22.5</td>
<td>2.9</td>
<td>*</td>
</tr>
<tr>
<td>LC</td>
<td>25</td>
<td>37.5</td>
<td>3.8</td>
<td>15%</td>
</tr>
<tr>
<td>CW</td>
<td>30</td>
<td>45.0</td>
<td>4.5</td>
<td>15%</td>
</tr>
<tr>
<td>AW</td>
<td>40</td>
<td>60.0</td>
<td>8.0</td>
<td>20%</td>
</tr>
</tbody>
</table>
Performance Considerations Related to Design Pressure

Performance Grade = Design Pressure

Structural Test = 1.5 Design Pressure

Water Resistance Test Pressure = 0.15 Design Pressure for R, LC, CW
0.20 Design Pressure for AW
Air Leakage

Air Leakage Test Control Panel
Air Leakage Test Pressure

FOR THE VARIOUS PERFORMANCE CLASSES

<table>
<thead>
<tr>
<th>Class</th>
<th>Pressure (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>1.6</td>
</tr>
<tr>
<td>LC</td>
<td>1.6</td>
</tr>
<tr>
<td>CW</td>
<td>1.6</td>
</tr>
<tr>
<td>AW</td>
<td>6.2</td>
</tr>
</tbody>
</table>
Maximum Air Leakage

For the various performance classes and product types.
Resistance to Forced Entry

ASTM F 588 - Windows
ASTM F 842 - Sliding Doors
AAMA 1304 - Hinged Doors
Window Testing
Minimum Test Size Requirements

Test Sample Requirements
(Example: Casement Windows)

<table>
<thead>
<tr>
<th>Window Designation</th>
<th>2011 Minimum Frame Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>R-PG15-C</td>
<td>24&quot; (600 mm) x 60&quot; (1500 mm)</td>
</tr>
<tr>
<td>LC-PG25-C</td>
<td>32&quot; (800 mm) x 60&quot; (1500 mm)</td>
</tr>
<tr>
<td>CW-PG30-C</td>
<td>32&quot; (800 mm) x 60&quot; (1500 mm)</td>
</tr>
<tr>
<td>AW-PG40-C</td>
<td>36&quot; (900 mm) x 60&quot; (1500 mm)</td>
</tr>
</tbody>
</table>
Minimum Test Sizes

Largest Width

Largest Height

Must include all intermediate members to be qualified.
Maximum Size Tested

MFR Code: XXX-1
Series: XXX XX
AAMA/WDMA/CSA 101/I.S.2/A440-11
R-PG25-762x1524 (30x60)-C
Higher Performance Grades?
## Optional Performance Grades

<table>
<thead>
<tr>
<th>Optional Performance Grade</th>
<th>Applicable Performance Class</th>
<th>Design Pressure</th>
<th>Structural Test Pressure</th>
<th>Water Resistance Test Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>psf (Pa)</td>
<td>psf (Pa)</td>
<td>psf (Pa)</td>
</tr>
<tr>
<td>20</td>
<td>R</td>
<td>20.0 (960)</td>
<td>30.0 (1440)</td>
<td>3.00 (150)</td>
</tr>
<tr>
<td>25</td>
<td>R</td>
<td>25.0 (1200)</td>
<td>37.5 (1800)</td>
<td>3.75 (180)</td>
</tr>
<tr>
<td>30</td>
<td>R, LC</td>
<td>30.0 (1440)</td>
<td>45.0 (2160)</td>
<td>4.50 (220)</td>
</tr>
<tr>
<td>35</td>
<td>R, LC, CW</td>
<td>35.0 (1680)</td>
<td>52.5 (2520)</td>
<td>5.25 (260)</td>
</tr>
<tr>
<td>40</td>
<td>R, LC, CW</td>
<td>40.0 (1920)</td>
<td>60.0 (2880)</td>
<td>6.00 (290)</td>
</tr>
<tr>
<td>45</td>
<td>R, LC, CW, AW</td>
<td>45.0 (2160)</td>
<td>67.5 (3240)</td>
<td>6.75 (330) 9.00 (440)</td>
</tr>
<tr>
<td>50</td>
<td>R, LC, CW, AW</td>
<td>50.0 (2400)</td>
<td>75.0 (3600)</td>
<td>7.50 (360) 10.00 (480)</td>
</tr>
<tr>
<td>55</td>
<td>R, LC, CW, AW</td>
<td>55.0 (2640)</td>
<td>82.5 (3960)</td>
<td>8.25 (400) 11.00 (530)</td>
</tr>
<tr>
<td>60</td>
<td>R, LC, CW, AW</td>
<td>60.0 (2880)</td>
<td>90.0 (4320)</td>
<td>9.00 (440) 12.00 (580)</td>
</tr>
</tbody>
</table>

Water resistance test pressures in the U.S. are capped at 12 psf in the 2008 & 2011 versions of the standard. Ratings are capped at 100 psf above gateway in the 2008 & 2011 versions of the standard, except for the AW class.
## Optional Performance Grades (cont’d)

<table>
<thead>
<tr>
<th>Optional Performance Grade</th>
<th>Applicable Performance Class</th>
<th>Design Pressure</th>
<th>Structural Test Pressure</th>
<th>Water Resistance Test Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>psf</td>
<td>Pa</td>
<td>psf</td>
</tr>
<tr>
<td>65</td>
<td>R, LC, CW, AW</td>
<td>65.0</td>
<td>3120</td>
<td>97.5</td>
</tr>
<tr>
<td>70</td>
<td>R, LC, CW, AW</td>
<td>70.0</td>
<td>3360</td>
<td>105.0</td>
</tr>
<tr>
<td>75</td>
<td>R, LC, CW, AW</td>
<td>75.0</td>
<td>3600</td>
<td>112.5</td>
</tr>
<tr>
<td>80</td>
<td>R, LC, CW, AW</td>
<td>80.0</td>
<td>3840</td>
<td>120.0</td>
</tr>
<tr>
<td>85</td>
<td>R, LC, CW, AW</td>
<td>85.0</td>
<td>4080</td>
<td>127.5</td>
</tr>
<tr>
<td>90</td>
<td>R, LC, CW, AW</td>
<td>90.0</td>
<td>4320</td>
<td>135.0</td>
</tr>
<tr>
<td>95</td>
<td>R, LC, CW, AW</td>
<td>95.0</td>
<td>4560</td>
<td>142.5</td>
</tr>
<tr>
<td>100</td>
<td>R, LC, CW, AW</td>
<td>100.0</td>
<td>4800</td>
<td>150.0</td>
</tr>
</tbody>
</table>

Optional Performance Grades higher than those shown on the table may be used in increments of 5 psf.

Water resistance test pressures in the U.S. are capped at 12 psf in the 2008 & 2011 versions of the standard. Ratings are capped at 100 psf above gateway in the 2008 & 2011 versions of the standard, except for the AW class.
Optional Performance Grades

Must meet ALL minimum gateway performance requirements before testing at optional higher grades.
Examples – Optional Performance Grades

1. Tested Design Pressure @ 80 psf
   Tested Water Resistance @ 8.00 psf
   - AW40 / HC50
     - 97/02/05
   - AW-PG40 / CW-PG50
     - 2008/2011

2. Tested Design Pressure @ 50 psf
   Tested Water Resistance @ 12.00 psf
   - AW50 / HC50
     - 97/02/05
   - AW-PG50 / CW-PG50
     - 2008/2011

3. Tested Design Pressure @ 75 psf
   Tested Water Resistance @ 12.00 psf
   - AW75 / HC75
     - 97 & 05 only
   - AW60 / HC75
     - 02 only
   - AW-PG75 / CW-PG75
     - 2008/2011

The performance grade assigned must be consistent with the lowest test level achieved.
Special Requirements Per Window Type?
Deglazing
Life Cycle Testing
Concerns Addressed by AAMA 910 Life Cycle Testing

• Carelessness by the occupants or maintenance personnel.
• Lack of awareness of proper operating or maintenance procedures.
• Operating force beyond the limits of normal physical ability.
• Attempted operation without proper keys or devices.
AAMA 910 Life Cycle Testing Excludes:

- Vandalism
- Improper installation/handling practices
- Intentional abuse
- Detention or psychiatric applications
Requirements for Mullions
Mullions and Other Structural Members

• Must withstand the full design load for the project site
• Deflection for all AW & CW products cannot exceed 1/175 of the span length
• L/175 limitation applies to integral mullions in AW & CW products
• Evidence of compliance may be by structural analysis or AAMA 450
Glass and Glazing Materials

- Glass furnished by the manufacturers must meet the values given in ASTM E1300 for the design pressure rating of the product
Performance Requirements for Side-Hinged Entry Doors
Laboratory Testing
Field Testing
Short Form Specification

All (windows) (doors) (secondary storm products) (tubular daylighting devices) (roof windows) (unit skylights) shall conform to the _______________ requirements of the voluntary specification(s) in AAMA/WDMA/CSA 101/I.S.2/A440-11, be labeled with the AAMA, CSA and WDMA label, have the sash arrangement(s), leaf arrangement(s), or sliding door panel arrangement(s) and be of the size(s) shown on the drawings and be as manufactured by _____________________ or approved equal.
Short Form Specification

All windows shall conform to the **LC-PG25-HS** voluntary specification(s) in AAMA/WDMA/CSA 101/I.S. 2/A440-11, be labeled with the AAMA, CSA or WDMA label, have the sash arrangement, and be of the size(s) shown on the drawings and be as manufactured by **XYZ Windows** or approved equal.
Specifying Windows, Doors and Skylights Using Performance Standards
Seminar Evaluation

Please take a moment to complete the evaluation form. Thank you.