AAMA DISTANCE EDUCATION
Specifying Windows and Doors Using Performance Standards

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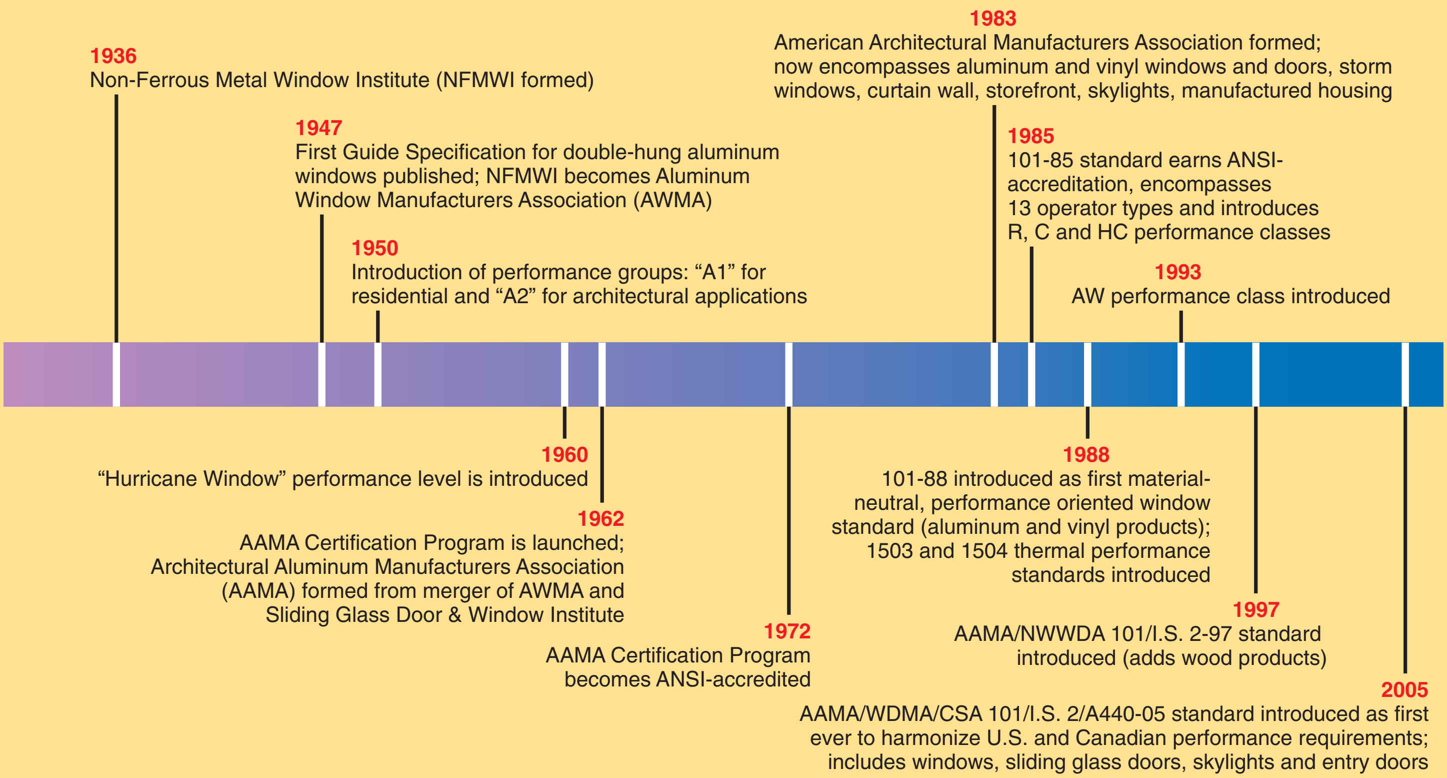
Performance-based standards for windows and doors rate completely fabricated products according to how they perform under actual job site conditions rather than attempting to prescribe detailed physical attributes such as framing member thickness, assembly details, etc. They thereby provide a uniform basis for comparing key performance attributes of different manufacturers' windows of the same type, class and grade for a given application, thereby taking into account the unique properties and comparative strengths and weaknesses of all profile materials. For windows and doors, these essential performance characteristics are structural performance under wind loading and the level of resistance to air leakage, water penetration and forced entry. From this platform, currently represented by the AAMA/WDMA/CSA 101/I.S. 2/A440-05 standard, other performance requirements for specific window types (e.g., casement, horizontal sliding, etc.), as well as for optional energy efficiency attributes (e.g., thermal performance and condensation resistance), can be referenced to meet specific markets or job criteria.

The specifier or product designer determines the level of performance desired under defined conditions. Then, factoring the well-understood characteristics of the material and components into the equation, the manufacturer builds a window that meets the specified performance level. In general, the required performance drives the product's design.

How Window Standards Have Evolved

The evolution of window standards traces an increasingly sophisticated approach to window design and an evolving understanding of the factors influencing window performance, as well as increasingly more stringent performance requirements in response to the demands of architects and specifiers. These efforts have culminated in combined, material-neutral, performance-oriented guidelines for excellence in the design and fabrication of window and door products that recognize their important role in today's complex building systems.



It is the buyer's task to first determine the tradeoff between performance level and cost that is acceptable for the job at hand. Given equal performance requirements, the choice of framing material (aluminum, fiberglass, vinyl, wood, etc.) basically reduces to one of preference with regard to operating features, appearance, economics, etc., rather than determining which material is "better" than another at some absolute level. Because performance-based standards effectively eliminate the basis for competitive argument as to which fenestration framing material performs the "best," they are said to be "material-neutral."

Like its predecessors, AAMA/WDMA/CSA 101/I.S. 2/A440-05 encompasses all framing materials, offering a basis for comparing the key characteristics and quality attributes of all window and door materials and products for the same market applications from a material-neutral point of view. It also serves as the cornerstone for an interlocking system of third-party product performance certification and component-level quality control to establish a uniquely credible total quality management system for manufacturers as well as a reliable specifying mechanism for architects. The International Residential Code (IRC) and International Building Code (IBC) both currently reference the 2005 standard. Both of its predecessors from 1997 and 2002 were previously recognized. All three may serve as the basis for third-party certification, although earlier versions will eventually be phased out.

Because it is the foundation of today's state-of-the-art performance standards, the 2005 standard and its requirements serve as the basis for this article.

What Kind of Window Do You Want?

The first step is to select a product operator type, indicated by a letter code. There are 30 distinct product types identified in the 2005 standard, as shown in the following table:

AAMA/WDMA/CSA 101/I.S. 2/A440-05 Product Type Designation System

TYPE CODE	WINDOW OR GLASS DOOR TYPE	TYPE CODE	WINDOW OR GLASS DOOR TYPE
Sliding Seal Window Products		**Specialty Window Products**	
H	Single/Double/Triple Hung	BW	Basement Window
HS	Horizontal Sliding	HE	Hinged Egress (rescue window)
VS	Vertical Sliding	GH	Greenhouse
Compression Seal Window Products		J	Jalousie
AP	Awning, Hopper or Projected	JA	Jal-Awning
C	Casement	TA	Tropical Awning
VP	Vertically Pivoted	TR	Transom
HP	Horizontally Pivoted	SP	Specialty Products*
SHW	Side-Hinged Inswinging	**Door Products**	
TH	Top-Hinged	ATD	Architectural Terrace Door
Fixed Window Products		FD	Fixed Door
FW	Fixed	SHD	Side-Hinged Door
Unit Skylight Products		LW SHD	Limited Water Side-Hinged Door
SKG	Skylights/Glass Glazed	SLT	Side lite
SKP	Skylights/Plastic Glazed	SD	Sliding Door
RW	Roof Window	DASHD	Dual Action Side Hinged Door
Dual Action Window Products		LW DASHD	Limited Water Dual Action Side-Hinged Door
DAW	Dual Action Window		

(NOTE: The products in blue are new or revised in the 2005 standard.)

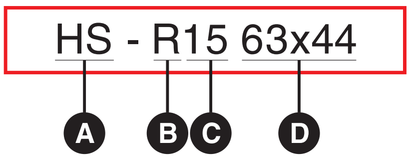
** The Specialty Products category was established to clarify how performance is to be measured for size and shape variations of other product types (e.g., half-rounds, trapezoids and other configurations) and is congruent with current NFRC terminology. Note that this does not replace the "Specialty Window Products" grouping defined in the 1997 standard, where the existing categories for basement, greenhouse, jalousie, etc. windows are still applicable.*

What Kind of Building?

Once the type of window is decided upon (e.g., double hung, casement, slider, etc.), the next step is to define the kind of structural environment in which the window is to be installed. The 2005 standard helps by defining a product nomenclature and Performance Designation System. These designations can be quickly and easily used to specify windows.

An example of a complete four-part product designator for a horizontal sliding window would thus look like:

Product Designation System



PRODUCT KEY
A = Product Type: Horizontal Sliding Window (HS)
B = Performance Class: R
C = Performance Grade: Design Pressure = 15 psf
D = Maximum Size Tested: Width x Height (63x44)

Let's take closer look at the elements of this designator and how it provides essential information on its performance. The four parts include:

- Product Type (operator type per the previous table)
- Performance Class
- Performance Grade
- Maximum Size Tested

Performance Class

The second part of the product designator is the Performance Class. The 2005 standard recognizes five Performance Classes, each of which addresses the needs of a particular market segment by requiring increasingly stringent basic performance requirements:

R = typically one- and two-family structures
LC = typically low-rise multi-family, offices, motels, professional buildings
C = typically light industrial, hotels, retail buildings
HC = typically mid-rise hospitals, schools, government buildings
AW = typically larger institutional or high-rise buildings, or demanding usage situations

Performance Grade

The third element of the product designator is the Performance Grade, the key to Class designation. Entry into each Performance Class is keyed to a minimum (or "gateway") Performance Grade, which is equal to the Design Pressure (wind load) at which the products have been tested, expressed in Pascals (Pa) in the metric system, and in pounds per square foot (psf) in the IP system. A given design pressure corresponds to a wind velocity as the table below shows.

This is a good time to note that, unlike its predecessors, metric units are the primary measurement system in the 2005 standard, with "inch-pounds" (IP) units secondary and shown in parentheses after the metric units, as the Minimum Design Pressures shown below. While this article will be presented hereafter in terms of IP units, given its primarily American audience, the IP figures must be considered approximate as conversions are not precise. The metric requirements must be met when products are tested for conformance to the standard.

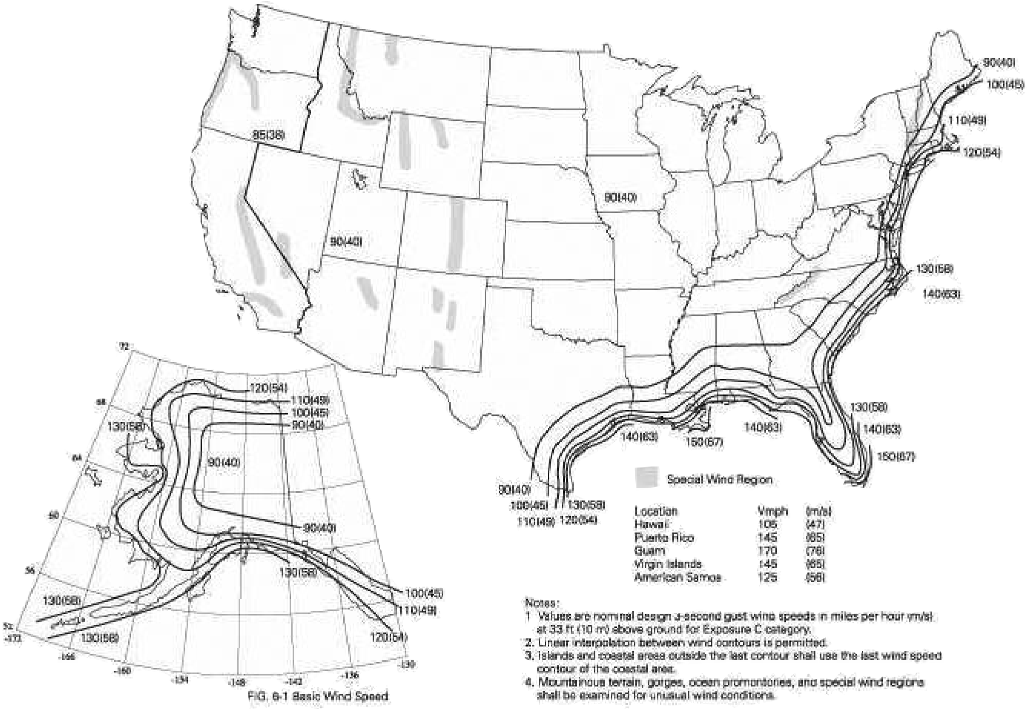
Product Performance Class	Minimum Performance Grade	Minimum Design Pressure	Equivalent Wind Speed (mph)
R	15	720 Pa (15 psf)	77
LC	25	1200 Pa (25 psf)	100
C	30	1440 Pa (30 psf)	109
HC	40	1920 Pa (40 psf)	126
AW	40	1920 Pa (40 psf)	126

Note: Wind speeds indicated are not to be used for building code compliance.

What Performance Level Do I Need?

The 2005 standard defines four mandatory performance requirements within each Performance Class for a completely fabricated window:

- Structural adequacy to withstand wind loads at the design pressure
- Resistance to water penetration due to wind-driven rain
- Resistance to air infiltration
- Forced entry resistance (FER)



Map reprinted with permission of ASCE.

The first two of these – arguably the most important for a window's functioning as a structural element – are keyed to the Design Pressure (Performance Grade) for the building site. The Design Pressure is a result of wind loading – that is, the force of wind blowing against the installed window. Water penetration is dependent upon the wind pressure behind rain that strikes the window. So, the first order of business must be to determine the wind conditions to which the window will be exposed.

The classic 2005 standard reference for determining design wind load is ASCE 7-02, "Minimum Design Loads for Buildings and Other Structures."

The design wind speed for the building's location (typically a maximum likely to be experienced at that site) is determined by reference to the following wind speed map from ASCE-7-02*.

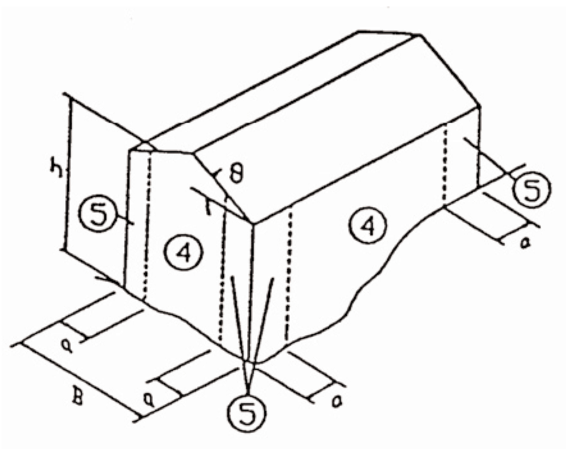
Once the height of the building is known, the Design Pressure can be determined from the second column of ASCE-7-02* "Table 1," a portion of which is excerpted for illustrative purposes from ASCE-7-02 and AAMA TIR A10, "Wind Loads on Components and Cladding for Buildings less than 90 Feet Tall," which also includes more complete information on all four versions of ASCE-7-02*. As implied in the document title, the table applies only to windows in buildings less than 90 feet tall, and with a sloped roof (pitch greater than 10°).

TABLE 1: DESIGN WIND LOAD TABLES (psf)

Mean Roof Height (ft.)	Positive Pressure All Areas	Negative Pressure	
		Area 4	Area 5
BASIC WIND SPEED - 70 MPH			
15	16.6	-17.6	-22.6
20	18.0	-19.1	-24.6
25	19.2	-20.4	-26.2
30	20.3	-21.5	-27.7
40	21.9	-23.3	-29.9
50	23.4	-24.8	-31.9
60	24.6	-26.1	-33.6
70	25.7	-27.2	-35.0
80	26.7	-28.3	-36.4
90	27.7	-29.4	-37.8
BASIC WIND SPEED - 80 MPH			
15	21.6	-22.9	-29.5
20	23.5	-24.9	-32.1
25	25.1	-26.7	-34.3
30	26.5	-28.1	-36.1
40	28.7	-30.4	-39.1
50	30.5	-32.4	-41.7
60	32.2	-34.1	-43.9
70	33.5	-35.6	-45.7
80	34.9	-37.0	-47.6
90	36.2	-38.4	-49.4

**Source: ASCE-7-02, "Minimum Design Loads for Buildings and Other Structures," American Society of Civil Engineers (ACSE) © 2002, www.pubs.asce.org. For further information, the complete text of the manual should be referenced [http://www.pubs.asce.org/ASCE7.html?9991330].*

Note that the ASCE-7-02* table shows both positive and negative pressures. This is because windows experience winds that blow against them from the windward side, tending to push the window in (positive loads), as well as "suction" winds tending to pull the window outward (negative loads) due to the aerodynamic characteristics of the building on its leeward side. These negative loads are further broken down according to whether or not the window is located near the corner of the building ("Area 5"), where aerodynamics cause the suction load to increase in comparison to that experienced away from the corners ("Area 4"). As a rule of thumb, the width of the corner area in which "area 5" conditions apply is considered to be 0.4 times the roof height (h) at the eaves or 10% of the building's least width, whichever is smaller.



While there are other factors to consider for a given project, such as building use category and coastal locations, the design pressure for the building is the largest absolute value of the positive and negative pressures.

Because negative pressures generally exceed positive pressures, the 2005 standard permits products to have a secondary designator that shows the negative design pressure separately.

PRIMARY DESIGNATOR:
Limited Water Side-Hinged Dual Door
or
LW SHD DD LC50 900 x 2100 (36x83)

SECONDARY DESIGNATOR:
Design Pressure = 2400 Pa (50.0 psf)
Negative Design Pressure = 2880 Pa (60.0 psf)
Water Penetration Resistance Test Pressure = 140 Pa (2.9 psf)
Canadian Air Infiltration/Exfiltration Level = A3

As a simplified example, consider a 25′ tall (typically three-story) building located in an area with a basic design wind speed of 70 mph. All of the windows will experience a positive design pressure of 19.2 psf. Windows located nearer the center of a wall will experience a negative load of 20.4 psf. As the largest number governs, and since windows are rated for design pressure in increments of 5 psf, this translates to a rounded-up product Performance Grade of 25 psf for the application of the 2005 standard. Windows to be located in the corner areas of the building (Area 5), however, will experience a negative load of 26.2 psf. and must be rated for a minimum design pressure of 30 psf.

Note that as the design pressure increases, the required product class for the application would seem to move upward from R to AW Class, although the more stringent requirements can also be met within the same class by specifying a higher optional grade. All are keyed to the design pressure (Performance Grade) for the particular Class.

What Kinds of Performance Do the Different Class Designations Indicate?

The Design Pressure (a.k.a. Design Wind Load or Performance Grade) anchors the major performance considerations of structural loading and resistance to water penetration, and the performance requirements for these aspects get progressively more stringent as the design pressure increases.

Structural Loading

As indicated in the following table, the design pressure indicates the pressure levels applied in testing for structural integrity.

Window/Door Classes	Design Pressure (psf)	Structural Test Pressure (psf)
R	15	22.5
LC	25	37.5
A	30	45.0
HC	40	60.0
AW	40	60.0

**Source: ASCE-7-02, "Minimum Design Loads for Buildings and Other Structures," American Society of Civil Engineers (ACSE) © 2002, www.pubs.asce.org. For further information, the complete text of the manual should be referenced [http://www.pubs.asce.org/ASCE7.html?9991330].*

Two structural tests are conducted: the Uniform Load Deflection Test (conducted at the product's design pressure), and the Uniform Load Structural Test (conducted at 150% of the design pressure for windows [200% for unit skylights and roof windows]). For example, the Uniform Load Structural Test pressure for an HC class window – whose minimum design pressure is 40 psf – would be 60 psf. The Deflection Test checks for temporary deflection of structural members; the Structural Test checks for permanent deflection (permanent 'set'), which remains after the test load is removed.

Deflection Limits and Permanent Deformation

HC and AW classes impose frame deflection limits at design loads. This must be checked for compliance prior to specifying.

Uniform Load Deflection Test

While the design and test pressures remain the same in the 2005 standard as in previous versions, the deflection performance bar has been raised for the HC Performance Class. Note that at this point we are talking about temporary deflection, not permanent deformation. While normal operation after the application of the structural load is required for all classes and actual deflection of the sash or frame members is recorded, HC and AW grades require a maximum deflection of 1/175 of its span, usually denoted as L/175.

Uniform Load Structural Test

Permanent deformation is defined as the amount of deflection left in a member after release of an applied load. Under the 2005 standard, there can be no permanent deformation of any main frame, sash, panel or sash member in excess of 0.4% of its span for R and LC products, or 0.3% for C and HC classes. This represents a tightening of prior requirements for the latter two classes. AW class products must still meet the heftier requirement of maximum permanent deformation no more than 0.2% of the span.

Water Penetration

As the expanded table below shows, testing for water penetration resistance – intended to simulate wind-driven rain – is generally conducted at a pressure equal to 15% of the design pressure. Each Performance Class thus has a progressively larger minimum test pressure.
This is subject to two exceptions:

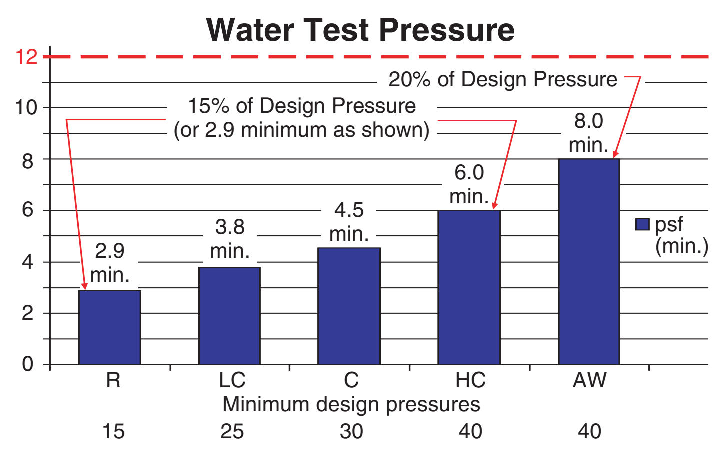
- In the R class, the minimum test pressure is 2.9 psf. It would otherwise be 2.25 psf if it were 15% of the 15 psf minimum design pressure for that class.
- In the AW class, the water test pressure is 20% of the design pressure.

As will be discussed later, products can qualify for optionally higher design pressures within their classes, which would automatically increase the water penetration test pressure. For example, an optional 100 psf design pressure for an AW window would imply a water test pressure of 20% of that, or 20 psf. However, a maximum water test pressure of 12 psf is recommended, as water test pressures this high equate to unusually extreme natural conditions.

In addition, the test methods employed to determine water penetration resistance are dependent upon performance class. R, LC and C products are tested to ASTM E 547, while HC and AW products are tested to both ASTM E 547 and ASTM E 331. To pass these tests, no water (as defined by the appropriate ASTM standard) is permitted to pass the interior plane of the framing in any of the water penetration resistance test procedures. In addition, no water is permitted to penetrate the corner seals of the tested assembly and enter the building wall cavity.

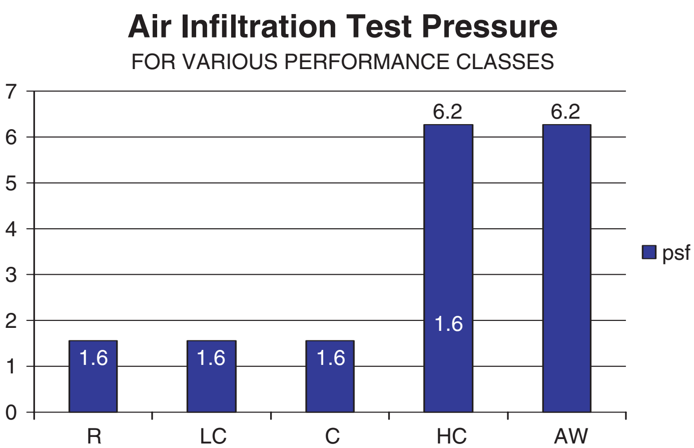
Window/ Door Classes	Design Pressure (psf)	Structural Test Pressure (psf)	Water Resistance Test Pressure (psf)	Required Percentage for Water Testing
R	15	22.5	2.9	*
LC	25	37.5	3.8	15%
C	30	45.0	4.5	15%
HC	40	60.0	6.0	15%
AW	40	60.0	8.0	20%

*R15 products are tested at 2.9 psf, which is higher than the 15% of design pressure, as required for other higher ratings within the R class.



Then There's Air Infiltration...

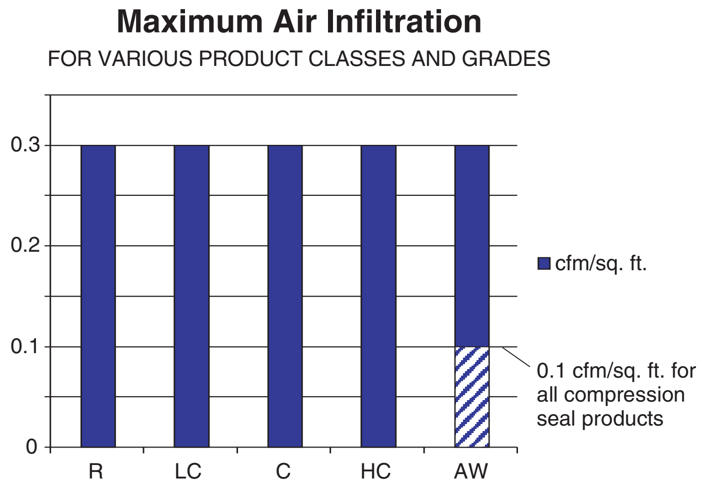
The 2005 standard also addresses air infiltration, once merely a drafty nuisance but today a key element of important energy-efficiency criteria. Air infiltration testing involves two specific requirements: applied test pressure and maximum air leakage permitted. Minimum air test pressures for each Performance Class are not keyed to the design pressure, but vary by operator type and Performance Class. All window types in the R, LC and C Classes are tested at 1.6 psf – the approximate static pressure generated by a 25 mph wind. All HC and AW windows are tested for air leakage at 6.2 psf, the approximate static pressure generated by a 50 mph wind. All air infiltration tests are per ASTM E 283.



Maximum Air Infiltration

When tested as described, windows must exhibit a maximum air infiltration rate of 0.3 cubic feet per minute per square foot of frame area (cfm/ft2) or 0.1 cfm/ft2, depending on Performance Class and operator type. For all except the AW class, the allowable air infiltration rate is 0.3 cfm/ft2 (although they may be tested to 0.1 cfm/ft2 as an option). All AW compression seal and fixed products are limited to 0.1 cfm/ft2 while AW horizontal sliding (HS) windows, hung (H) windows and sliding doors (SD) are permitted a 0.3 cfm/ft2 maximum.

Note that while the AW air leakage test pressure is the same as that used for the HC Class (hung and sliding windows excepted), the allowable air leakage rate for AW class compression seal and fixed products is greatly reduced from the HC class. Both are more stringent than the other classes.



Field air infiltration is permitted to be 1.5 times values shown above.

Size Considerations

The Maximum Size Tested (MST) is the last part of the four-part product code and is dependent on the window or door operator type and performance class of the product. Although often omitted when writing a specification, MST is included in performance test results and is also called out on AAMA Certification labels. MST is often confused with *minimum* test size.

Test size is a critical factor in determining compliance with the standard. Each product type has a defined "gateway" or "passport" set of primary requirements before entry into a given product Performance Class is permitted. To provide a uniform basis for comparing the performance of different manufacturers' windows of the same type and class, product specimens must be tested at the same *minimum* (or larger) test size. This is because, the smaller the test sample, the easier it is for a window to pass a structural test due to the smaller area exposed to wind loading and shorter frame spans between corners. Specifying a minimum test size is thus a valuable equalizer when evaluating various suppliers.

QUESTION: *Can you guess why these pressures of 1.6 and 6.2 psf were chosen in the Air Infiltration Test Pressure chart above?*

ANSWER: They are the equivalent static air pressures generated by a 25 or 50 mph wind velocity, respectively. They, therefore, loosely correspond to a light storm and a heavy storm exposure of the wall.

The chart below shows how the minimum frame size tested varies by Performance Class for casement (C) and horizontal sliding (HS) windows. Note that while the test specimen size for some of the classes are the same, the design load and therefore the structural test pressure increases from R to AW classes. The required test size is expressed as width by (x) height, rounded to the nearest inch or 10 mm.

Window Designation	Minimum Frame Size (Width x Height)
HS–R15	63″ (1600mm) x 44″ (1100 mm)
HS–LC25	71″ (1800mm) x 56″ (1400 mm)
HS–C30	71″ (1800mm) x 60″ (1500 mm)
HS–HC40	99″ (2500mm) x 79″ (2000 mm)
HS–AW40	99″ (2500mm) x 79″ (2000 mm)

For the vast majority of product types and classes, the 2005 standard – as did its immediate 2002 predecessor – increases the minimum size of units submitted for test for initial ("gateway") qualification of a product within a given performance class, effectively ensuring that those products are more robust.

The *Maximum* Size Tested comes into play when a manufacturer wants to qualify an entire product line of a given product type. The manufacturer will typically select a product test size that represents the largest product width and height dimensions in the product line for which compliance is sought (and which is at least equal to or larger than the minimum test size gateway requirement for the performance class). When this largest unit complies, all smaller units of the same design and performance class – i.e., all units in that particular product line – qualify as well.

Simply put, a product label should indicate an MST equal to or larger than the building opening in which the product is to be installed in order to deliver full benefits of the advertised performance class.

The Complete Story…

Pulling it all together, the following table, excerpted from the 2005 standard, summarizes the test pressures and performance requirements for all Classes of two different product types:

Window/Door Designation (Minimum Test Size)		Design Pressure		Structural Test Pressure		Water Resistance Test Pressure		Air Infiltration Test Pressure		Air Infiltration Maximum Rate	
		psf	Pa	psf	Pa	psf	Pa	psf	Pa	$ft^3/min/ft^2$	$m^3/hr/m^2$
GROUP I		**Sliding Seal Window Products**									
Single/Double/Triple Hung Windows											
H-R15	(40″ x 63″)	15	720	22.5	1080	2.9	140	1.6	75	.03	1.5
H-LC25	(44″ x 75″)	25	1200	37.5	1800	3.8	180	1.6	75	.03	1.5
H-C30	(56″ x 91″)	30	1440	45.0	2160	4.5	220	1.6	75	.03	1.5
H-HC40	(60″ x 99″)	40	1920	60.0	2880	6.0	290	6.2	300	.03	1.5
H-AW40	(60″ x 99″)	40	1920	60.0	2880	8.0	390	6.2	300	.03	1.5
GROUP II		**Compression Seal Window Products**									
Casement Windows											
C-R15	(24″ x 60″)	15	720	22.5	1080	2.9	140	1.6	75	.03	1.5
C-LC25	(32″ x 60″)	25	1200	37.5	1800	3.8	180	1.6	75	.03	1.5
C-C30	(32″ x 60″)	30	1440	45.0	2160	4.5	220	1.6	75	.03	1.5
C-HC40	(36″ x 60″)	40	1920	60.0	2880	6.0	290	6.2	300	.03	1.5
C-AW40	(36″ x 60″)	40	1920	60.0	2880	8.0	390	6.2	300	0.1	0.5

What if I Want to Specify a Higher Performance Level than the Minimum?

The 2005 standard makes it possible to specify higher uniform load structural and water penetration resistance test pressures than the required performance class gateway minimums, such as in cases where the installed product will be subject to severe weather conditions or excessive wind loadings.

All products tested under optional performance grades are required to conform to all of the minimum requirements of the standard for the product designation under consideration. Only after successful entry into the Performance Class at the minimum Performance Grade, when tested at the minimum test specimen size, can a product be tested for an optional Performance Grade.

Using Optional Performance Grades, products can be tested to meet design loads beyond the minimum value for a given Performance Class in increments of five psf. Note that in such cases, the structural test load and the water penetration resistance test pressure increase correspondingly, since they are keyed to the design pressure (150% of the design pressure for uniform load structural test and 15% for water penetration testing [20% for AW products]), up to a maximum of 12 psf.

The requirements of the simple example cited earlier – a window with a design pressure of 25 – can be met by an R class product tested to a 25 psf design pressure (rather than the minimum of 15 psf for that Class). Products with higher design pressures (e.g., 30, such as an R class product tested at 30 psf or an LC 30 product) will of course meet the requirement, but may be more expensive than necessary for the application.

New from the original 1997 version is that the 2005 standard sets maximum performance levels at which a product (except skylights) may qualify within each Performance Class (except for the AW grade), by capping the maximum performance grade (design pressure) at 60 psf above the minimum (gateway) level for each class (except AW, for which there is no maximum). This is intended to discourage artificially high performance grade ratings in a given class. For example, qualifying an LC product at a performance grade of 100 makes less sense than qualifying it as an HC or AW product.

Optional Performance Grades

Optional Performance Grade	Applicable Product Designation	Design Pressure		Structural Test Pressure		Water Resistance Test Pressure			
						R,LC,C and HC		AW	
		psf	Pa	psf	Pa	psf	Pa	psf	Pa
20	R	20.0	(960)	30.0	(1400)	3.00	(150)	—	—
25	R	25.0	(1200)	37.5	(1800)	3.75	(180)	—	—
30	R,LC	30.0	(1440)	45.0	(2160)	4.50	(220)	—	—
35	R,LC,C	35.0	(1680)	52.5	(2520)	5.25	(260)	—	—
40	R,LC,C	40.0	(1920)	60.0	(2880)	6.00	(290)		
45	R,LC,C,HC,AW	45.0	(2160)	67.5	(3240)	6.75	(330)	9.00	(440)
50	R,LC,C,HC,AW	50.0	(2400)	75.0	(3600)	7.50	(360)	10.00	(480)
55	R,LC,C,HC,AW	55.0	(2640)	82.5	(3960)	8.25	(400)	11.00	(530)
60	R,LC,C,HC,AW	60.0	(2880)	90.0	(4320)	9.00	(440)	12.00	(580)
65	R,LC,C,HC,AW	65.0	(3120)	97.5	(4680)	9.75	(470)	12.00	(580)
70	R,LC,C,HC,AW	70.0	(3360)	105.0	(5040)	10.50	(510)	12.00	(580)
75	R,LC,C,HC,AW	75.0	(3600)	112.5	(5400)	11.25	(540)	12.00	(580)
80	LC,C,HC,AW	80.0	(3830)	120.0	(5750)	12.00	(580)	12.00	(580)
85	LC,C,HC,AW	85.0	(4080)	127.5	(6110)	12.00	(580)	12.00	(580)
90	C,HC,AW	90.0	(4320)	135.0	(6470)	12.00	(580)	12.00	(580)
95	HC,AW	95.0	(4560)	142.5	(6840)	12.00	(580)	12.00	(580)
100	HC,AW	100.0	(4800)	150.0	(7200)	12.00	(580)	12.00	(580)

Optional Performance Grades higher than those shown on the table may be used in increments of 5 psf. Water resistance test pressures are capped at 15 psf in the 2002 version of the standard. Ratings are capped at the entry level plus 60 psf in the 2002 & 2005 version of the standard, except for the AW class.

Note that all conditions for a given class must be met, not just the design pressure. This is an important distinction.

Consider the following examples of higher performance ratings for a window that meets all of the gateway requirements for the AW performance grade: (as it relates to design pressure and water resistance only):

- **Example #1–A window tested at a design pressure of 80 psf and for water resistance at 8 psf.** This window is actually only an AW 40 since it only meets the 8 psf water test (20% of 40 = 8 psf). It could also be rated as an HC 50 based on the 8 psf water test (15% of 50 = 7.5 psf).
- **Example #2–A window tested at a design pressure of 50 psf and for water resistance at 12 psf.** This window is either an AW 50 or an HC 50 since it exceeds the water test pressure at both the 15% and 20% level (15% of 50 = 7.5 psf and 20% of 50 = 10 psf).
- **Example #3–A window tested at a design pressure of 75 psf and for water resistance at 12 psf.** According to the 2005 standard, this window is either an AW 75 or an HC 75 since it meets the maximum 12 psf water test for both classes.

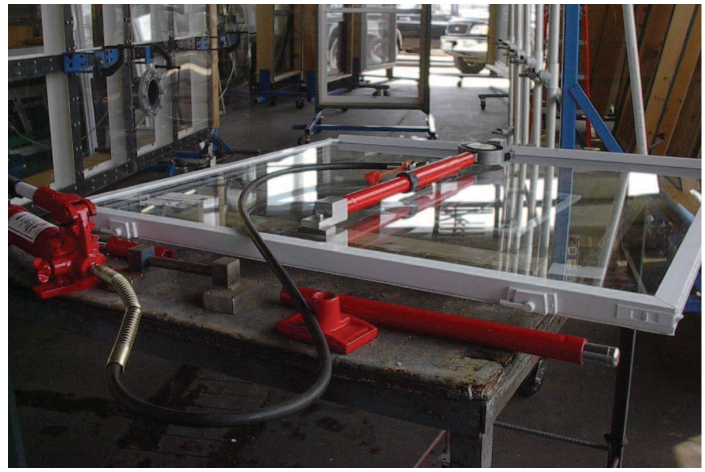
Does the Type of Window I Chose Have Its Own Requirements?

The primary Class gateway requirements for structural performance, air infiltration and water penetration are specified for all operating types, but each type has additional unique requirements, such as operating force for hung windows or racking tests for projected windows. Products where the sash is operated by pulling on its edge must be tested for the ability to resist deglazing during operation. All AW products are required to undergo life cycle testing according to the test specification AAMA 910.

Maximum Operating Force

Maximum operating force is a requirement for all sliding seal products, such as the example shown below for hung windows. In the 2005 standard, the force needed to initiate motion must be tested (per ASTM E 2068) and recorded, but is not a performance requirement.

Window Designation	Force To Initiate Motion	Force To Maintain Motion
R	Report Only	30 lbf (135 N)
LC	Report Only	35 lbf (155 N)
C, HC, AW	Report Only	45 lbf (200 N)



Deglazing Test

This is performed on the operable window sash only for vertical and horizontal sliding units. When tested in accordance with ASTM E 987, operating sash members must not move from their original position, in relation to the glazing materials, by more than 90% of the original glazing bite. As an example, the load for horizontal rails of a hung window must be 70 lb, and 50 lb for all other sash members.

Life Cycle Testing

Life Cycle Testing is required for AW products only. Described separately in AAMA 910, "Voluntary 'Life Cycle' Specifications and Test Methods for Architectural Grade Windows and Sliding Glass Doors," life cycle testing is of particular interest to those specifying AW Class products, but may be optionally applied to any class of product. These tests employ accelerated testing and usage simulation methods to model the normal wear that can be expected due to the typical number of vent operating and locking hardware opening/closing cycles experienced during the life of a typical AW class product. Loading conditions are also applied to simulate real-world operating and maintenance conditions and predictable misuse such as:

- Carelessness by the occupants or by building maintenance personnel
- Lack of knowledge of proper operating or maintenance procedures
- Application of operating force beyond the limits of normal physical ability
- Attempted operation without proper keys or devices

Note that damage due to vandalism, improper installation or handling practices, intentional abuse, and detention or psychiatric applications are not addressed by these tests. Environmental conditions, such as temperature cycling, UV exposure, etc., are also not addressed.

Air leakage and water penetration test results must meet the gateway performance requirements for the desired product class and performance grade, both before and after accelerated cycling. In addition, there must be no damage to fasteners, hardware, sash balances and other components that would render the window inoperable.

AAMA 910 outlines the life cycle testing procedures and stipulates the order in which testing is to be done as follows:

Before Cycling:

- Operating Force (Hung and Sliding Windows and Sliding Glass Doors only)
- Air Infiltration Test
- Water Penetration Resistance Test

Product Testing:

- Vent Cycle Testing (1st half)
- Locking Hardware Testing (1st half)
- Access Panel Cycling (if applicable)
- Misuse Testing (Racking, deglazing, torsion, etc.)
- Vent Cycle Testing (2nd half)
- Locking Hardware Testing (2nd half)

After Cycling:

- Operating Force (Hung and Sliding Windows and Sliding Glass Doors only)
- Air Infiltration Test
- Water Penetration Test

AAMA 910 carefully stipulates that in order to pass the life cycle tests, no window shall be partially tested or have any limitations or restrictions. No adjustments are permitted during the testing sequence. In other words, this is a pass/fail specification and the fenestration product either meets *all* of the requirements for its class and performance grade or it fails to pass.

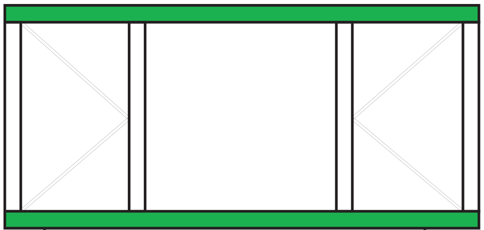
What if the Window has Mullions?

The 2005 standard imposes additional requirements on intermediate framing members such as mullions. Note that in window lingo, a mullion is defined as an intermediate connecting member used to join (or "mull") two or more fenestration products together in a single rough opening. It should not be confused with a "muntin," which is often a decorative profile that divides a lite of glass or panel into smaller sections.

The standard addresses two different types of mulled units: composite units with integral mullions and combination assemblies joined or mated by mullions. It imposes limits on some integral mullions and requires that combination mullions meet project or code requirements that may place limits on mullion deflection. The most important of the requirements for mullions is that structural members must be designed to withstand the full wind load for the project site and that all AW and HC products must not exceed a deflection limit of one 175th of the span (typically expressed as L/175 where L is the span length). AAMA 450, "Voluntary Performance Rating Method for Mulled Fenestration Assemblies," describes the method for determining the structural capabilities of mulled units including multiple window or door assemblies combined into a composite unit.

Understanding the definition of composite vs. combination units is also very important.

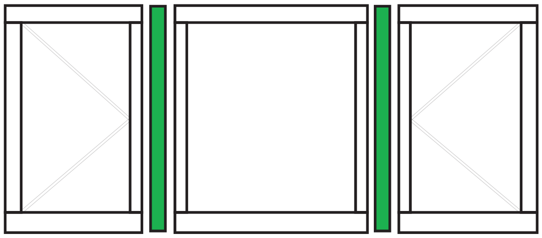
A composite unit is a window or glass door product consisting of two or more sash or panels within a single frame, utilizing an integral mullion running between continuous perimeter framing members and shipped from the factory as a single unit. The mullions are tested with the unit and deflection limits applied to the unit also apply to the integral mullions. Products using integral mullions are rated as a single unit and can be identified as meeting the standard with a single label



Composite Unit with Integral Mullions

MULLION:	**INTEGRAL**
TESTED:	**SINGLE UNIT**
COMPLIANCE:	**TEST ENTIRE UNIT**

INDICATES CONTINUOUS STRUCTURAL FRAMING MEMBER



Combination Assembly with Reinforcing Mullion

MULLION:	**COMBINATION**
TESTED:	**EACH UNIT, MULLION**
COMPLIANCE:	**TEST EACH UNIT & CALCULATE OR TEST MATING MULLION**

$$\Delta = \frac{5\,WL^3}{384\,EI}$$

(Formula for evaluating loaded single span beams should you choose to perform the calculation.)

By contrast, combination assemblies are normally shipped as separate window or glass door units to be stacked or joined in the field (i.e., "field mulled") using combination mullions. The distinct window units are tested individually and each unit is rated and labeled separately (the illustrated example would require three such labels). The structural framing (mullion) provided to join these individual units in the field is not covered in the 2005 standard and is not tested with the window units. Evidence of compliance for these joining members is normally provided by calculation or separate test for compliance with AAMA 450.

Dealing with Doors

The 2005 standard achieves a new milestone with the inclusion of performance requirements for side-hinged exterior doors.

A unique aspect of these requirements is that they recognize that side-hinged exterior doors are quite different from windows, sliding glass doors and their "French door" cousins in three key aspects: accessibility requirements, operating frequency and water penetration. In order to allow for accessibility requirements, sill heights are limited. This has the potential of reducing the product's ability to resist water leakage. Such doors, however, are typically installed in weather-protected areas – such as under a porch or opening into a garage – reducing the potential of significant water leakage.

The 2005 standard, therefore, introduces the new "Limited Water" (LW) rating concept for water leakage that allows for testing and rating doors for water penetration resistance at an air pressure differential that ranges from zero up to any selected pressure less than the 15 or 20% of design pressure indicated by the performance class. The standard also requires testing according to standards governing the following additional operating parameters:

- Operating Cycle Performance (AAMA 920-03)
- Vertical Load Resistance (AAMA 925-03)
- Hardware Load & Water Penetration Resistance (AAMA 930-03)
- Forced Entry Resistance (AAMA 1304-02)

Note that while the 2005 standard is now referenced by the 2006 I-codes, the section on side-hinged doors is temporarily exempted until in-field component substitution – often done by jobbers and door pre-hangers to satisfy individual customers – is addressed. However, certification to these requirements is currently available to manufacturers.

Optional Requirements

There are several optional requirements that can be specified under the umbrella of the 2005 standard. Some of these address issues as timely as today's headlines.

Impact Strength

For example, impact strength requirements are a direct result of recent severe hurricane impacts along the Atlantic and Gulf coasts.

Wind loading is the first thing that comes to mind when hurricanes are considered, and windows with optional performance grades can be specified to be robust enough to stand up to the worst Category 5 gusts. However, studies have shown that a significant majority of window breakage in major storms, despite the use of storm shutters and protective coverings, is caused by impacts from airborne objects, rather than by wind pressure alone. Furthermore, if an opening is penetrated by flying debris, the highly pressurized air can often blow off the roof and cause the building to collapse.

The solution is to use hurricane-resistant windows, typically featuring laminated glass, a strong framing system and appropriate sealant that, together, help to resist both the structural and impact loads. Hurricane-prone regions are busily adopting new code requirements and test standards to protect buildings against debris impelled by hurricane-force winds.

Not surprisingly, the most stringent performance requirements, which are described in Miami-Dade standards PA-201, PA-202 and PA-203, apply in Florida's Miami-Dade and Broward counties, located in the defined High Velocity Hurricane Zone (HVHZ). Elsewhere, ASTM E 1886 and ASTM E 1996 are cited.

The impact tests required under these standards are not trivial. For example, for windows to be located less than 30 feet above ground level, the impact of large objects is simulated by impelling a 2 x 4 stud into the product at 50 feet per second (fps), equivalent to 34 mph. For windows located more than 30 feet above ground, the impact of roof gravel and other small objects is simulated by firing a shotgun-like pattern of two-gram ball bearings into the window at a speed of 130 fps (88 mph). To pass these tests, there can be no penetration upon impact and no opening formed larger than 3 inches in diameter or no tear longer than 5 inches.

A key component of hurricane resistance testing is the pressure cycling that follows impact testing. To pass the cycling testing, the product must be subjected to relatively short intervals of positive and negative pressures at varying percentages of the design load. Given the correct glass configuration, products may pass the impact portion but, of those that fail the test, most fail during pressure cycling. It is important that the product pass both portions of the impact strength testing.

The 2005 standard offers optional requirements for impact performance. To demonstrate this ability, products must be tested per ASTM E 1996 or AAMA 506.

Acoustical Performance

For situations where external noise is excessive or disruptive, such as for hospitals and schools, or for locations near airports or commuter rail lines, the ability of a window or door to attenuate sound transmission can be an important factor.

When required, windows and doors can be rated for either Sound Transmission Class (STC) – usually used to indicate sound transmission through interior walls – or for Outdoor-Indoor Transmission Class (OITC) – for exterior sound sources.

Acoustical ratings are developed per ASTM E 413 for STC and ASTM E 1332 for OITC, based on testing conducted per ASTM E 90, ASTM E 1425 or AAMA 1801.

Rating	Rating Calculation	Test Method
STC	ASTM E 413	ASTM E 90
OITC	ASTM E 1332	ASTM E 90 ASTM E 1425 ASTM E 1801

Thermal Efficiency

Energy efficiency is, of course, always an important consideration, and it can be the subject of an entire course on its own. Suffice for this article's purposes to note that windows and doors can be optionally rated for thermal performance in addition to compliance to the 2005 standard by evaluating them per AAMA 1503, or NFRC 100, published by the National Fenestration Rating Council.

Akin to thermal performance is condensation resistance, which can be optionally rated by the Condensation Resistance Factor (CRF) per AAMA 1503, or Condensation Resistance (CR) per NFRC 500.

Are the Materials Good Enough?

While the product performance requirements of the standard are material neutral, Section 6.0 of the 2005 standard provides guidance for materials issues, which may affect the performance of window and door products. Key material-specific requirements and material standards referenced are:

- Aluminum extrusions must have a minimum ultimate tensile strength of 11,000 psi and a minimum yield strength of 9,000 psi. Commercial alloy 6063-T5 is one of the several alloys that will meet the requirements. Thermal barrier extrusions shall comply with the structural performance requirements of AAMA TIR A8. Dry shrinkage and shear retention of thermal break materials shall comply with AAMA 505.
- Rigid vinyl extrusions where used as a sash, frame or other structural or glass-retaining member, must comply with AAMA 303. Other polymeric materials are covered by similar 300-series specifications.
- Wood parts, where used, must be wood or wood composites that have been kiln-dried to a moisture content no greater than 12% at the time of fabrication. All exposed wood surfaces must be sound. Defects and discolorations are permitted, provided the surface is suitable for an opaque finish.

Specifications for other materials are added as standards are developed. For example, ABS Plastic (AAMA 304), Fiberglass (AAMA 305), Cellular vinyl (AAMA 308), Cellulosic Composites (AAMA 309, 311 and 312 and WDMA I.S. 10), Fiber Reinforced vinyl (AAMA 310) are also referenced. Standards for coatings are listed as well.

What About the Glass?

The performance requirements for glass and glazing are often very specifically outlined in applicable building codes. Governing standards typically cited for annealed glass (ASTM C 1036), safety glazing (ANSI Z97.1 or CPSC 16 CFR 1201), tempered glazing (ASTM C 1048 [Kind FT]) and insulating glazing (ASTM E 774 Level A are incorporated into both standards.

Requirements for glass strength are addressed by reference to ASTM E 1300, "Standard Practice for Determining the Minimum Thickness and Type of Glass Required to Resist a Specified Load." Performance testing per the 2005 standard must be performed on units glazed with the minimum strength glazing as called for by ASTM E 1300 for the design load of the product. This is required so that the glazing cannot artificially increase the performance of the product being tested. The latest version of ASTM E 1300 allows the user to determine glass strength based on 1, 2, 3 or 4 sided support of the edge of the glazing.

Note that products tested with plastic glazing materials do not qualify glass glazing materials, nor do products tested with glass qualify plastic glazing materials. Products tested with sealed insulating glass do not qualify single glazed products.

A Specification "Cheat-Sheet"

A specification writer is burdened with the responsibility for a great many building elements. The good news is that once you've figured out the requirements and designation for your windows, there's no need for word-smithing a complicated window specification. The 2005 standard provides a short, fill-in-the-blank, specification form that includes all of the elements we have just discussed.

Short Form Specification

All (windows) (doors) (unit skylights) shall conform to the ____________________ voluntary specification(s) in AAMA/WDMA/CSA 101/I.S. 2/A440-05, be labeled with the AAMA, CSA or WDMA label, have the sash arrangement(s) leaf arrangement(s), or sliding panel arrangement(s) and be of the size(s) shown on the drawings and be as manufactured by ______________ or ______________ or approved equal.

All that is necessary is to insert the product designator in the first blank and any preferred supplier in the last blanks.

Some Working Examples

The following examples (based on a now-obsolete edition of a state building code) illustrate how the 2005 standards can be used to specify and select products that meet code requirements. Compliance with other codes can be assured in the same manner.

Example #1

The first example is a low rise hotel building. The information required to correctly specify the project are location, design wind velocity, building type, building footprint, building height, roof slope and window operator type.

The building is located in Morehead City, North Carolina. The design wind velocity is 110 mph as determined by using the ASCE 7-02 wind load map. The architect is designing a new hotel which she has decided will be rated as a C performance class. (Refer to pages 4-6 for a review of how to determine performance classes and grades). The hotel has a rectangular footprint of 300 feet by 150 feet. This will be a low rise (three-story) building with a mean roof height of 35 feet. The roof will be flat and gravel covered. The architect has chosen casement windows for this building in order to take advantage of their maximum opening area and capture the prevailing sea breezes. Impact resistance has not been included in this example because the architect has designed the building as a partially open structure.

The first step in building a window specification based on these criteria is to determine the velocity pressure based on the given wind speed. Looking at the wind load tables in the local code, we find that for 110 mph and 3 stories (35 feet), the velocity pressure is 47 psf. While not indicated in the wind load table, notes and exceptions in the actual table allow a 10% reduction in this design pressure to 42.3 psf for windows located within four feet of the building corners (where wind loads tend to concentrate) due to the effects of the flat roof, while the design pressure for windows located more than four feet from the corners can be further reduced to 36.8 psf.

The product specifications require three pieces of information: the window operator type, the product performance class and the product performance grade. There are two performance grades on this project for the corner window and the non-corner windows. Therefore:

- Window Operator Type = Casement
- Window Performance Class = C
- Window Performance Grade = 40
  (Design Pressure = 40)
- Window Performance Grade @ corners = 45
  (Design Pressure = 45)

Note: The values of 40 and 45 psf must be used because windows are rated in the standards in 5 psf intervals.

The window, skylight and door standards provide a short form guide specification as presented earlier. Using this guide specification, the project specification becomes:

> *"All windows and doors within **4 ft of building corners** shall conform to the **C - C45** and all other windows and glass doors shall conform to the **C - C40** voluntary specification(s) in AAMA/WDMA/CSA 101/I.S. 2/A440-05, be certified and labeled with the AAMA, CSA or WDMA label, have the sash arrangement(s), leaf arrangement(s), or sliding panel arrangement(s) and be of the size(s) shown on the drawings and be as manufactured by **Preferred Manufacturer** or approved equal."*

If impact resistance were required for this coastal location, we could add it to our specification as an extra criterion.

The last stage in the process is selecting products that comply with the specification we have just developed. AAMA publishes a Certified Products Directory of all products authorized for certification by their program to any or all of the three versions of the performance standard. Note that products are not actually certified until the manufacturer applies the AAMA certification label. The first step is to identify the products which meet or exceed the project requirements.

Manufacturer	Operator Type	Model Number	Perf Class	Framing Matl	Perf Grade	TAS 201-203	AAMA 506
Window Manufacturer 1	C	ABC 1	C	AL	60	No	Yes
Window Manufacturer 2	C	ABC 2	C	PVC	50	No	Yes
Window Manufacturer 3	C	ABC 3	C	AL	30	No	No
Window Manufacturer 4	C	ABC 4	C	PVC	40	No	No

The second step is to review the list of manufacturers with compliant products. From this list of manufacturers, a limited list of those who will be permitted to bid on the project can be developed. Please note that the online CPD also includes columns for "TAS 201/203" and "AAMA 506," which reference impact resistance qualification criteria.

Manufacturer	Operator Type	Model Number	Perf Class	Framing Matl	Perf Grade	TAS 201-203	AAMA 506
Window Manufacturer 1	C	ABC 1	C	AL	60	No	Yes
Window Manufacturer 2	C	ABC 2	C	PVC	50	No	Yes
Window Manufacturer 3	C	ABC 3	C	AL	30	No	No
Window Manufacturer 4	C	ABC 4	C	PVC	40	No	No

Acceptable products have been highlighted.

Please note that as you locate products in the CPD, an asterisk by Performance Class or Maximum Size Tested dimensions indicates that performance grade was achieved by testing a small-than-gateway-sized unit (i.e., downsized unit) after passing the standard requirements for that performance class at the gateway size.

Example #2

The next example is a single family residence.

For the second example, let's assume the residence is located in Fayetteville, North Carolina. The design wind velocity is 90 mph. The architect is designing a new home which he has decided that the windows/doors will be rated R. (Again, refer to pages 4-6 for a review of how to determine performance classes and grades). The house has a rectangular footprint of 90 feet by 50 feet. This will be a low rise (one story) building with a mean roof height of 15 feet. The roof will be sloped at a 6/12 pitch. The architect has chosen horizontal sliding windows for this building because he wants the windows to remain in the plane of the wall and wishes to provide the maximum viewing area. Impact resistance has not been included because it is not considered necessary this far from the coast.

As before, the first step in building a window specification is to determine the velocity pressure based on the given wind speed. Looking at the wind load table in the local code, we find that for 90 mph and one-story buildings, the velocity pressure is 25 psf. This time, notes and exceptions do not permit a reduction of the design pressure to 90% of the velocity pressure because the roof is sloped. Therefore, the corner design pressure remains 25 psf. However, the design pressure may be reduced to 21.8 psf for windows or doors that are more than 4 feet from the building corners.

Again, the product specifications require just three pieces of information: the window operator type, the product performance class and the product performance grade. Therefore:

- Window Operator Type = Horizontal Slider
- Window Performance Class = R
- Window Performance Grade = 25
  (Design Pressure = 25) (as specified in the code)

In this case, there is a requirement of 25 psf at the corners and then 21.8 psf in the non-corner areas, which is rounded up to the next higher 5 psf increment. Therefore, there is only one performance grade on this project, which is higher than the gateway minimum for the R class. This time, because this project involves combination windows with non-integral mullions, a requirement must be added to the specification requiring calculations. Using the guide specification as before, the project specification is easily developed:

*"All windows and doors shall conform to the **HS-R25** voluntary specifications in AAMA/WDMA/CSA 101/I.S. 2/A440-05, be labeled with the AAMA, CSA or WDMA label, have the sash arrangement(s), leaf arrangement(s), or sliding panel arrangement(s) and be of the size(s) shown on the drawings and be as manufactured by **Preferred Manufacturer** or approved equal. All intermediate mullions not tested as part of the window or door qualification shall provide deflection limited to L/175 as proven either by separate test or mathematical calculation."*

Again, the AAMA Certified Products Directory provides easy reference to locate products which meet or exceed the project requirements and their manufacturers.

The Value of Certification

As the basis for AAMA's nationally-recognized, ANSI-accredited Certification Program, the 2005 standard offers a truly uniform basis for comparing the key characteristics and quality attributes of window and door products.

After AAMA introduced the first window performance standard in 1947, architects and specifiers soon realized the benefits of including performance standards in their project specifications. While analysis of tested products helped in product selection, the problem of quality assurance still remained to be addressed. AAMA began offering a product quality assurance program in 1962. This program has evolved and has been assimilated into the product certification programs offered by several associations today. Seeking national recognition of its program, AAMA achieved accreditation of the program by the American National Standards Institute (ANSI) in 1972, the first such program to obtain this prestigious recognition.
There are three basic formats for certification programs:

- Self Certification (essentially an enhanced warranty)
- Second-Party Certification (the most common format)
- Third-Party Certification (the most independent format)

The differences basically pertain to the ways in which manufacturing, administration and inspection/certification are interrelated. To select the appropriate level of certification for a particular project, the specifier should understand the meaning of each level of certification.

Self-Certification

Many project specifications allow proof of compliance by submission of a test report. Manufacturers who have tested their products to the performance standards indicated in the specification may choose to apply a company label to their own products drawing attention to the performance level achieved. This label generally states something along the lines of "meets or exceeds the requirements of ..." and is usually supported by some sort of testing. The manufacturer administers its own testing and certification program and performs in-house inspections as part of its own Quality Control program.

This is the lowest level of certification in which the manufacturer is using testing to an industry standard to enhance what is essentially a product warranty. Unless the manufacturer participates as a licensee in the AAMA Certification Program, there is no independent verification of test results and no follow-up inspection to verify that actual production-line units continue to meet the requirements.

Second-Party Certification

Second-party certification is probably the most prevalent format currently specified. The second party is frequently a trade association which developed the program for its members but now offers the service publicly. A published Procedural Guide usually establishes rules for participation in the program and expulsion from it if the requirements are not met. The manufacturer voluntarily submits its product to an independent laboratory for testing and rating, and the trade association staff performs both the administrative and plant inspection functions, and grants the certification.

While this is the most popular form of certification, the potential exists for influencing the staff of the association if the manufacturer is a member. If the program is to have meaning and benefit for the specifier or consumer, it must include barriers to any such interference on the part of the manufacturer.

This may be accomplished by requiring control of the procedures used by the testing laboratory, in-plant inspections and administration of the program by a staff of inspectors and certifiers who are independent of the manufacturer's direct control. Maintenance of this independence is critical to the success of the program.

Third-Party Certification

The highest and most independent level of certification is third-party certification. In this type of program, the certifying or inspection agency is independently under contract to the administering agency, often a trade association to which the manufacturer may belong. There is no direct link between the certifying/inspection agency – those who ultimately grant or deny certification of the product – and the manufacturer. The sponsoring trade association acts as a buffer between the product manufacturer and the certifying agency. Program procedures for testing and laboratory accreditation are normally similar to those for second-party programs.

Testing is performed by an independent laboratory. Inspection and granting of certification is performed by a separate Validator organization under contract to the sponsoring trade association. Acting as administrator, the association audits the Validator but never sees the test reports and never certifies a product. The key to independence is that the Validator is employed by the program administrator, not the manufacturer. This level of certification has been offered by AAMA since 1962.

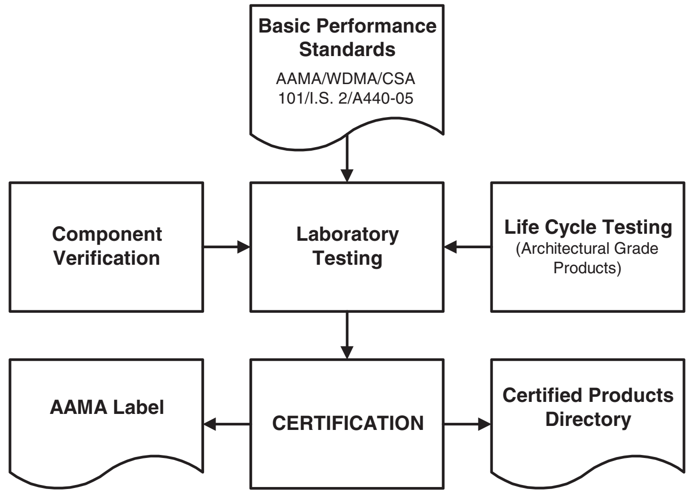
If the program is ANSI-accredited, ANSI also audits both the specifying trade association and the Validator annually to ensure that program independence is being maintained. Laboratory independence is maintained by not permitting them to be directly involved in either the design or manufacture of the products being tested for certification. Currently, AAMA is the only fenestration association that accredits independent test labs.

Product Certification Scope

Several types of product certification are available.

- **Air, Water, Structural** – This is the most common type of certification and was the first program developed. Most specifiers are somewhat familiar with the air, water and structural programs.
- **Thermal** – Due to recent code activity, government mandates at all levels and the acceptance of the International Energy Conservation Code (IECC) by many states.
- **Component** – Because AAMA recognized that a window or door is a complex system of integrated components, its certification program requires verification that components have been tested and meet applicable performance standards.
- **Acoustical** – This most recent certification program was first introduced by AAMA in 1996.

A closer look at the AAMA program reveals several levels and stages that must be successfully navigated before a manufacturer's products can be approved to bear the AAMA label.



First of all, the essential performance requirements are dictated by the 2005 standard. Other applicable standards referenced within it include AAMA and ASTM Forced Entry, AAMA Components, AAMA 1503 and NFRC 100 Thermal, AAMA 910 Life Cycle Testing, and various other American Society for Testing and Materials (ASTM), Builders Hardware Manufacturers Association, Door and Access Systems Manufacturers Association, Steel Door Institute, Canadian General Standards Board, Canadian Standards Association, Insulating Glass Manufacturers Alliance and Screen Manufacturers Association standards.

Independent Energy Performance Certification

Manufacturers may also certify product thermal performance to either the AAMA 1503 standard or NFRC 100, without the prerequisite of certification for basic air - water - structural, performance requirements specified in the 2005 standard. This allows specifiers to more easily identify products that comply with code requirements and market pressures for substantiated energy performance.

Component Verification Addresses the Total Window System

AAMA certification goes beyond basic quality assurance for completed window units by recognizing that a window is a complex system of components that must perform properly and continuously over a long service life. Accordingly, the AAMA Certification Program includes a system for verification and documentation of components' compliance with the applicable standards referenced within the 2005 standard.

As noted earlier, these standards reference specific test methods and performance requirements that apply to aluminum extrusions and cladding, vinyl extrusions and cladding and wood framing members and parts, as well as components such as reinforcing members, glass, aluminum finishes, weatherstrip, gaskets, glazing beads, sealants, hardware and screens.

All polymeric framing or sash members (vinyl, ABS, fiberglass, etc.) must be separately certified by AAMA before they can be used in an AAMA certified window, door or skylight.

If a component supplier cannot demonstrate that its product complies with applicable standards via testing at an accredited laboratory, the component may not be used in products authorized to bear the AAMA Certification Label.

Laboratory Testing

Actual testing of the complete product may be carried out at an AAMA-accredited independent laboratory of the manufacturer's choosing. The laboratory conducts the requisite tests on prototype samples of the particular window type, class, grade and size according to methods specified in the 2005 standard and other applicable standards and submits a test report to the Validator, who reviews them to verify that the laboratory followed the proper procedures.

Once all tests and conformance to requirements are verified, the Validator issues an Authorization for Product Certification (APC) to the association for approval. Once that is received, the association issues the APC to the manufacturer, who may then purchase AAMA Certification Labels for application to production line units that conform to the design that was tested. The product will also be listed in the AAMA Certified Products Directory (CPD), widely recognized by specifiers as the definitive guide to performance-certified windows and doors. However, note that a product is only certified if it is labeled.

At least once every four years, the manufacturer must retest the product to verify that the design continues to comply with the standard's requirements.

This consistent and carefully documented testing and inspection procedure, carried out by accredited independent laboratories, is the reason why the AAMA Certification Label has earned a reputation throughout the construction industry as a credible indicator of product quality and documented performance.

The AAMA Label

The AAMA "gold label" is permanently affixed to the qualifying product, typically on the frame in an area concealed by the operable sash when the window is closed. Labels include the manufacturer's code, reference to the performance standard, the certifying agency's identification and the rating achieved by the labeled product. Directories of certified products are available from AAMA, and a searchable CPD is available on the AAMA web site at aamanet.org.

QUESTION: *How can you be sure that if an AAMA-certified product is specified, there will be sufficient competitive products available to meet the project requirements?*
ANSWER: In 2005, 56 million AAMA certification labels were distributed for certified products in the marketplace, representing over 60% of all windows sold.

LABEL KEY

A = Manufacturer's Code Number (Company name may also be shown)
B = Specification Identification
C = Manufacturer's Series Number
D = Product Grade and Class Designation
E = Maximum Size Tested

What Does Product Certification Mean to the Building Owner?

The presence of the label tells the end user that a quality assurance process was used and allows him to compare products in a fair and credible way without in-depth knowledge of product design and testing. Knowing that the products were uniformly rated allows the consumer to concentrate on selection of product operator type and appearance.

Owners of large buildings rely on the architect or specifier to select the proper product and assure that only quality products are used. However, most windows and doors are installed in buildings where there is no agent representing the builder or the owner. By providing a fair and accurate rating system and assurance that the products used meet the tested performance levels, the certification process permits the owner or developer to concentrate on the issues of operator type and appearance

Many state building codes now require third-party labeled products.

What Does Product Certification Mean to the Manufacturer?

One aspect of the certification process that is often overlooked is that it provides value to the manufacturer as well. He is provided with a simplified, uniformly accepted process whereby his product performance can be substantiated by an independent third party. When the specifier requires independent certification and labeling, the manufacturer enjoys a measure of protection from unsubstantiated claims by his competitors that could skew the product selection process.

What Does Product Certification Mean to the Specifier?

Building specifications cover a huge number of individual components and the process of becoming knowledgeable on all of them can be an overwhelming task. If the specifying agency is also charged with maintaining compliance, the task becomes even more burdensome.

Most specifiers have determined that the use of nationally accepted performance-based standards and test methods helps simplify product selection. Specifying products that are certified to meet these standards not only enhances the selection process, it also greatly reduces the complexity of determining product compliance. Third-party certification offers the best way to assure quality on the job, reduce the complexities of performance requirements into a systematic approach, and allow restriction of bidders to only those who have pre-qualified their products — without having to read and understand enigmatic test reports or interpret manufacturer's advertising claims.

For the comparison and evaluation of different types, classes and designs of fenestration products, third-party certification to the IBC/IRC-referenced 2005 standard offers that proverbial level playing field.