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Conspectus's Tech Tips received the national Communications Award from the Construction Specifications Institute September 2011.

ABSTRACT:

Window ratings set the expected performance. Understanding the system will allow you to select appropriate ratings for project requirements.

FILING:
UniFormat™
B2020 Exterior Windows
MasterFormat™
08 50 00 Windows

KEYWORDS:
Window, performance class, performance grade, air infiltration, water penetration, structural performance

REFERENCES:
AAMA/WDMA/CSA
101/I.S.2/A440 - North American Fenestration Standard/Specification for windows, doors, and skylights.
ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference

The Meaning of Window Ratings

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Primary Standard

Exterior windows are often tested and rated according to the North American Fenestration Standard published jointly by the American Architectural Manufacturers Association (AAMA), the Window & Door Manufacturers Association (WDMA), and the Canadian Standards Association (CSA). For purposes of this article, the standard will be referenced as AAMA 101. This reference standard sets minimum performance for three primary attributes to establish an overall performance grade:
Air leakage
Water penetration resistance
Structural adequacy to resist applied loads
AAMA 101 sets four basic performance classes based on common use for the type of facility (height of window above grade), expected wind loads, and expected use. These are listed in ascending order from least to greatest performance.

- R - One- and two-family dwellings
- LC - Low-rise and mid-rise multi-family dwellings and other buildings where larger sizes and greater loads are expected.
- CW - Low-rise and mid-rise buildings where larger sizes, greater loads, and heavy use are expected.
- AW - High-rise and mid-rise buildings where greater loads or frequent and extreme use are expected.

For each performance class, AAMA 101 sets minimum gateway requirements that the windows must meet. The gateway requirements include a minimum window size for testing purposes. The minimum sizes vary depending on performance class and the type of window.
Window design pressures are determined by the building code. The pressure is calculated from the wind speed, wind exposure factor, wind importance factor, height above grade, and location on the façade. Consult the project structural engineer to determine actual project wind loads.
For windows to be labeled as AAMA 101 compliant, the windows must be tested by an AAMA approved independent laboratory. Labeled windows are listed in the searchable Certified Products Directory on the AAMA website.

AAMA 101 Minimum Gateway Performance

Performance Class	Minimum Performance Grade	Minimum Design Pressure (psf)	Min. Test Pressures (psf)	
			Structural	Water
R	15	15.0	22.5	2.90
LC	25	25.0	37.5	3.75
CW	30	30.0	45.0	4.50
AW	40	40.0	60.0	8.00

Air Infiltration

Air infiltration is measured by ASTM E283. This is a static pressure test that measures total leakage through the entire window assembly. Because the leakage is dependent on the size and length of cracks, the actual window size can dramatically affect the leakage rate that is reported in cfm/sq ft. Windows smaller than the gateway size will likely have greater leakage rates because the cracks will be greater as a percentage of the window opening.

AAMA 101 sets the test pressure and allowable leakage by performance class and seal type. Most windows will have air leakage rates that are less than the maximum allowed by AAMA 101.

Performance Class	Test Pressure (psf)	Max. Air Leakage (cfm/sf)
R (jalousie only)	1.6	1.2
R, LC, CW (except Jalousie)	16.	0.3
AW (sliding seal)	6.2	0.3
AW (compression seal & fixed)	62.	0.1

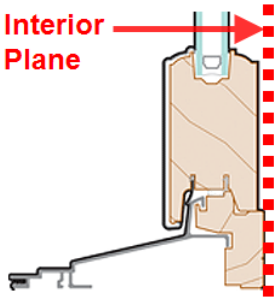
Air leakage will impact the HVAC system. Uncontrolled air infiltration requires additional capacity to maintain the building interior environmental design conditions.

Water Penetration

The test used to determine water penetration resistance is ASTM E547. This test alternates between a pressure cycle and a non-pressure cycle. The pressure is applied to the window exterior. AW windows are also tested to ASTM E331 with a uniform static pressure.

Water resistance is dependent on the sill height and effective seals. A sill 0.56 inches high will resist water penetration with a 2.90 psf differential pressure, without seals. Seals must remain in sufficient contact with the window sash under positive pressure to maintain an effective water barrier. Inward opening windows rely on the window hardware to maintain the water seal.

To pass the test, there must be no water penetration as defined by the ASTM tests. This means that no water may be observed beyond a plane parallel to the glazing and intersecting the innermost projection of the test specimen, excluding hardware and trim. This definition permits water to collect in the sill and then weep to the exterior when the test ends.



Water penetration observed on the interior window stool or jamb returns would be cause for failure.

Structural Performance

Structural performance is measured by applying a uniform positive and negative load to the window and recording the deflection. The test pressure is 150% of the design pressure. The test is conducted in accordance
with ASTM E330 Procedure A.

Observable permanent damage from the test is cause for failure. Permanent deflection of framing and sash members exceeding the allowable percentage of span also constitutes failure. Allowable deflections are 0.4% for R and LC, 0.3% for CW, and 0.2% for AW.

Conclusion:

When selecting windows by AAMA 101 performance class and performance grade, ensure that the minimum gateway size is greater than the size required for the project. Oversized windows may require additional testing to confirm the window will perform.

Specifying a performance grade will set the window design pressure. Be sure to consider the increased loads at the building upper floors and corners.

AAMA 101 performance classes and performance grades can be helpful for specifying windows. Specific project criteria for design loads and air infiltration must be specified to ensure the correct performance is attained.

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