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Differences in Design Pressure and Performance Grade

BY KEN BRENDEN

Fenestration products are undeniably becoming more complex as performance expectations diversify and tighten. The same is true of the standards that guide those who design and specify these products. The lynchpin of these standards is the AAMA/WDMA/CSA 101/I.S.2/A440, *The North American Fenestration Standard/Specification [NAFS] for Windows, Doors and Skylights*, the latest version of which is 2008 – although the 2011 version is waiting in the wings for adoption into the 2012 I-codes.

There is apparent widespread misuse of certain NAFS performance terms within the industry, especially design pressure performance class and performance grade. At times, marketplace confusion has led to specifying the wrong product for a given building application.

Design Pressure

Recall that wind force is the primary source of structural loading on an installed door or window. Wind exerts pressure directly proportional to the

square of the wind velocity. Design pressure thus serves to “localize” a design for the wind loading expected at the installation site, based on maximum expected wind speeds per the wind speed contour map in ASCE-7. Design pressure is the anchor from which the key attributes of structural strength and resistance to air and water penetration flow. It is a starting point for defining the performance of a given fenestration product, yet it is not a performance rating itself.

Performance Class

Performance class roughly describes the likely target application for a door or window. Like design pressure, it is not in itself a specific performance rating. The four classes defined in NAFS are:

- **R:** commonly used in one- and two-family dwellings;
- **LC:** commonly used in low-rise and mid-rise multi-family dwellings and other buildings where larger sizes and higher loading requirements are expected;
- **CW:** commonly used in low-rise

and mid-rise buildings where larger sizes, higher loading requirements, limits on frame member deflection and heavy use are expected; and

- **AW:** commonly used in high-rise and mid-rise buildings to meet extreme loading requirements and limits on deflection.

Performance Grade

The specific performance level of a fenestration product that falls within one or more performance classes is given by the performance grade. While this is related to the design pressure, that is not of itself the performance level indicator.

A product only achieves a performance grade rating if that product complies with all requirements of the NAFS standard for a certain design pressure corresponding to a maximum expected wind velocity regime at the given geographical location. This is the link between design pressure and performance grade – but the latter goes further by encompassing:

- a) Structural performance: The

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Performance Class Overview

Comparison of AAMA/WDMA/CSA 101/I.S.2/A440-05 and AAMA/WDMA/CSA 101/I.S.2/A440-08

Comparison Table (Inch-Pound)

Performance Grade (Design Pressure [psf])	AAMA/WDMA/CSA 101/I.S.2/A440-05					AAMA/WDMA/CSA 101/I.S.2/A440-08													
	Performance Class																		
	R	LC	C	HC	AW	R	LC	CW	AW										
Gateway Requirements	15	25	30	40	50 – 100 (5 psf increments)	> 100													
	*	--	--	--	--	*	--	--	--	*	--	--	--	--	--	--	--	--	--
	75 max	85 max	90 max	100 max	(no max)	(no limit)	100 max	100 max	100 max	(no max)	(no limit)	(no max)	(no limit)	(no max)	(no limit)	(no max)	(no limit)	(no max)	(no limit)

Source: AAMA

pressure applied for structural performance verification is 150 percent of design pressure for doors and windows and 200 percent for unit skylights and tubular daylight devices. This is a test that assesses any permanent damage associated with the assembly;

The essential takeaway from this abbreviated “seminar” is that there is a difference between design pressure and performance grade. Some manufacturers have erroneously marketed products solely based on the design pressure rating. Performance grade

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b) Water penetration resistance: The water penetration resistance test pressure, which simulates the force behind wind-driven rain, is generally based on 15 percent of the design pressure for R, LC, and CW performance classes and 20 percent of the design pressure for AW performance classes;

c) Air infiltration resistance;
 d) Uniform load-deflection test;
 e) Forced-entry resistance (if applicable);
 f) Operating force (if applicable);
 and
 g) Product type- or class-specific durability tests.

Each performance class has a least permissible threshold performance grade based on a minimum design pressure for the structural capacity, air infiltration resistance or water penetration resistance that a product must have for it to qualify for that class. This lowest level is known as the entry level or “gateway” performance requirement. Gateway performance grades for the four performance classes are:

- 15 psf (720 Pa) for R class;
- 25 psf (1,200 Pa) for LC class;
- 30 psf (1,440 Pa) for CW class; and
- 40 psf (1,920 Pa) for AW class.

Note that a single product may qualify for multiple performance classes.

means that the product was tested at the applicable design pressure for all performance requirements identified by NAFS.

Minimum performance grade and design pressure and the corresponding uniform load structural test pressures and water penetration resistance test pressures for the four NAFS performance classes are indicated in the table on page 18.

Optional higher performance grade may be specified in each performance class (except AW) above the minimum gateway requirement in increments of 5 psf (240 Pa), up to a maximum cap of 100 psf (4,800 Pa). For Classes R through CW, optional performance classes are capped at 60 psf (2,880 Pa) above the minimum gateway design pressure. There is no maximum performance grade limit for AW products.

Per NAFS, unit skylights are specified as either R or CW class, with the minimum performance grades shown. Optional performance grades within these classes for unit skylights are the same as those for doors and windows. AW and LC classifications are not available for unit skylights. ■

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