AN ARCHITECT'S GUIDE TO NAFS
USING THE NORTH AMERICAN FENESTRATION STANDARD IN CANADA

RDH BUILDING SCIENCE

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CONTENTS

INTRODUCTION

The introduction of the North American Fenestration Standard (NAFS) to Canadian building codes presented architects and other registered professionals with a new way to specify, test, and rate the structural-air-water properties of windows, doors, and skylights.

Known in the building code as the Harmonized Standard, NAFS was intended to harmonize Canadian and American performance testing and ratings standards to facilitate cross-border trade in fenestration products. While most issues were harmonized, significant differences remain between how NAFS is implemented under Canadian codes and how NAFS is utilized in the US.

In Canada, NAFS is referenced in Part 5 and Part 9 of the code, always in tandem with a document known as the Canadian Supplement to NAFS. Taken together, these documents are intended to help builders and building designers ensure that fenestration products effectively resist the environmental loads specific to each building in its geographic location.

With the title "North American Fenestration Standard," it is tempting to think that NAFS applies equally to all fenestration products and that it is the single reference for addressing their structural-air-water properties; however, this is not the case. While NAFS applies to a great many fenestration products, it excludes from its scope many products used in larger buildings. Fortunately, the code recognizes this and provides complementary compliance paths for products within and outside the scope of the standard.

This guide clarifies the intended use of NAFS for the products within its scope, and provides building designers with a rational methodology for specifying the structural-air-water properties of fenestration products in Canada. All code references hereafter are to the 2010 National Building Code, except where noted.

VERSIONS OF NAFS

There are two versions of NAFS in use in Canada, depending on what province or territory you are in:

NAFS

AAMA/WDMA/CSA 101/I.S.2/ A440-08, NAFS—North American Fenestration Standard/ Specification for windows, doors and skylights

NAFS 2011

AAMA/WDMA/CSA 101/I.S.2/ A440-11, NAFS 2011—North American Fenestration Standard/ Specification for windows, doors and skylights

In this document. the term NAFS refers to both versions except where the context also cites NAFS 2011.

NAFS AND THE CODE

APPLICABLE STANDARDS

The terms "NAFS" and "Canadian Supplement" are commonly used to refer to these complementary standards. The code and the Canadian Supplement provide the context for how NAFS is to be used in Canada.

The code's intended application of NAFS is presented in Subsection 5.10.2, titled "Windows, Doors and Skylights," where it is presented as one of two compliance paths to adress structural loads, air leakage, and water penetration.

5.10.2.3. Structural Loads, Air Leakage and Water Penetration

1) Windows, doors, skylights and their components shall be designed and constructed in accordance with

   a) Article 5.1.4.1., Section 5.4. and Section 5.6., or

   b) Article 5.10.2.2., where they are covered in the scope of the standards listed in Sentence 5.10.2.2.(1)

Article 5.10.2.3 requires that architects and other coordinating registered professionals are required to "design and construct" fenestration products with respect to the following portions of Part 5:

- → Article 5.1.4.1: Structural and Environmental Loads
- → Section 5.4: Air Leakage
- → Section 5.6: Precipitation

or to

- → Article 5.10.2.2, "where [the products] are covered in the scope of the standards listed in Sentence 5.10.2.2.(1)"

5.10.2.2. Applicable Standards

1) Windows, doors, and skylights shall conform to the requirements in

   a) AAMA/WDMA/CSA 101/I.S.2/A440, "NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights," and

   b) CSA A440S1, "Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS – North American Fenestration Standard/ Specification for Windows, Doors, and Skylights."

TWO CATEGORIES OF PRODUCTS, TWO COMPLIANCE PATHS

Use of the word "or" in Article 5.10.2.3 suggests that NAFS, used together with the Canadian Supplement, represents an alternative path to qualify products under the requirements of Article 5.1.4.1 and Sections 5.4 and 5.6, referred to in Clause 5.10.2.3.(1)(a). However, the code makes clear that this alternative compliance path is available only to products "covered in the scope" of NAFS and the Canadian Supplement.

This means that for products within the scope of NAFS—and only those products—testing in line with NAFS and the Canadian Supplement is a code-accepted way for products to demonstrate their ability to resist wind loads, air leakage, and water penetration. In this guide, these abilities are referred to as "structural-air-water" performance properties. Note that NAFS does not deal with the energy performance properties of fenestration products.

To clarify which products are eligible for compliance using NAFS and the Canadian Supplement, Article 5.10.2.3 defines two categories of fenestration products: those within the scope of NAFS, and those outside its scope. The 2015 NBC more clearly recognizes the distinction between these two categories of products by introducing the term "Other Fenestration Assemblies" for the products outside the scope of NAFS. Both categories are explored in this document.

In addition to discussing the two categories of fenestration products, this guide will compare the two compliance paths to show that they are not equivalent and that in order to fulfill the requirements of Clause 5.10.2.3.(1)(a), testing to NAFS and the Canadian Supplement needs to be augmented with additional measures.

Article 5.10.2.3 recognizes two compliance paths for the structural-air-water performance of fenestration products.

The use of NAFS in conjunction with the Canadian Supplement is an alternative compliance path applicable only to products within their scope.

PRODUCTS TO WHICH NAFS APPLIES

Because the code makes a clear distinction between products within the scope of NAFS and those outside, it is necessary for users of the standards to clearly understand this distinction too.

Clause 1.1 of NAFS states that the standard applies to "windows, doors, TDDs (tubular daylighting devices), and unit skylights installed into exterior building envelopes." These terms apply to the following product types:

- → Fixed and operable windows of all operating modes
- → Side-hinged doors, dual-action "tilt-and-turn" doors, and terrace doors (excluding commercial entrances and hollow metal doors)
- → Door transoms and sidelights
- → Sliding doors
- → Unit skylights (single lite fixed or operable), tubular daylighting devices (TDDs), and roof windows

NAFS AND SKYLIGHTS

The code recognizes that only manufactured factory-glazed skylights are within the scope of NAFS. Sentence 5.10.2.1.(3) states: "For the purpose of [Subsection 5.10.2], the term "skylight" refers to unit skylights, roof windows, and tubular daylighting devices."

Larger, multi-lite skylights are called "sloped glazing systems" in NAFS, where they are listed with other products that are outside the scope of the standard.

PRODUCTS OUTSIDE THE SCOPE OF NAFS

Clause 1.1 of NAFS lists the products that are outside the scope of the standard.

> Fenestration products not intended to be tested to this Standard/ Specification include:
>
> (a) interior windows and doors;
>
> (b) vehicular-access doors (garage doors) (see ANSI/DASMA 105, ANSI/DASMA 108, ANSI/DASMA 109, ANSI/DASMA 115, or other applicable DASMA Specifications);
>
> (c) sloped glazing (other than unit skylights or roof windows) (see AAMA TIR A7);

"OTHER FENESTRATION ASSEMBLIES"

The 2015 NBC uses the term "Other Fenestration Assemblies" for products outside the scope of NAFS, and identifies four categories of such products:

- → Curtain Wall
- → Window Wall
- → Storefront
- → Glazed Architectural Structures

The Notes to Part 5 specifically address these products. The term "Glazed Architectural Structures" encompasses the variety of products and systems not otherwise named in Part 5, from large multiple-lite skylight systems, to point-supported and all-glass structures.

The Notes to Part 5 also discuss the appropriate lab and field test methods for Other Fenestration Assemblies, which include:

- → Structural performance: ASTM E 330 (lab)
- → Air leakage: ASTM E 283 (lab) and ASTM E 783 (field)
- → Water penetration: ASTM E 331 or ASTM E 547 (lab) and ASTM E 1105 (field)

(d) curtain wall and storefront (see AAMA MCWM-1);

(e) storm windows and doors (except when incorporated in dual windows and dual doors) (see AAMA 1002.10, AAMA 1003, and AAMA 1102.7);

(f) commercial entrance systems (see AAMA SFM-1);

(g) sunrooms (see AAMA/NPEA/NSA 2100);

(h) revolving doors;

(i) site-built door systems, and

(j) commercial steel doors rated per SDI A250.8.2

This list is taken from NAFS-08. NAFS-11 originally excluded "folding door systems" from its scope; however, Technical Interpretation 15-03 from the Joint Document Management Group that manages NAFS clarified that the exclusion did not preclude the testing of folding door systems as "specialty products" under NAFS.

Note that, with only a few exceptions (interior windows and doors, revolving doors, and site-built door systems), products outside the scope of NAFS are excluded because they are more appropriately addressed by other standards, technical guides, or design manuals (shown in parentheses above). As these products are excluded from the scope of NAFS, Canadian designers are not obligated to utilize the standards associated with them.

It is clear, then, that many fenestration products used on large buildings are not intended to be tested to the NAFS standard.

All the fenestration products in this photo are outside the scope of NAFS—products the 2015 NBC calls "Other Fenestration Assemblies."

INTENDED USE OF NAFS

As article 5.10.2.3 makes clear, NAFS, like its predecessor standards—CSA A440, Windows and CGSB 82.1, Sliding Doors—is used primarily to prequalify the structural-air-water performance of fully assembled, factory-glazed fenestration products on the basis of laboratory testing.

It is important to appreciate that tested NAFS ratings are available for only the limited range of product sizes and configurations that are cost-effective for manufacturers to pretest. Many building designs rely on custom sizes and configurations that may not be pretested to the standard; therefore, project specifications should acknowledge that existing NAFS testing from manufacturers may not qualify all project conditions.

However, it is possible for project specifications to require NAFS testing at project sizes and configurations prior to product fabrication—provided that the specifications clearly provide for this and the window supply contract is issued early enough to allow sufficient lead time for such testing to be conducted.

For buildings other than one- and two-family homes or low-rise multifamily buildings, typically, it will be necessary to rely on measures such as post-award NAFS testing, project-specific engineering, field review, and field testing to qualify the performance of fenestration products at sizes and configurations other than those tested.

SITE-GLAZED AND SITE-BUILT PRODUCTS

The application of NAFS to site-glazed and field-assembled products within its scope (including casement and awning vents in curtain wall systems, terrace doors, and sliding balcony doors) is less straightforward than in the case of factory-glazed products.

The suppliers of commercial aluminum framing systems may advertise NAFS ratings for operable products tested at NAFS gateway sizes to demonstrate product

performance capabilities with respect to the highest achievable Performance Grade for a particular Performance Class; however, such ratings commonly indicate that a specimen has been tested to gateway requirements only and are not intended to qualify site-glazed products at project sizes and configurations.

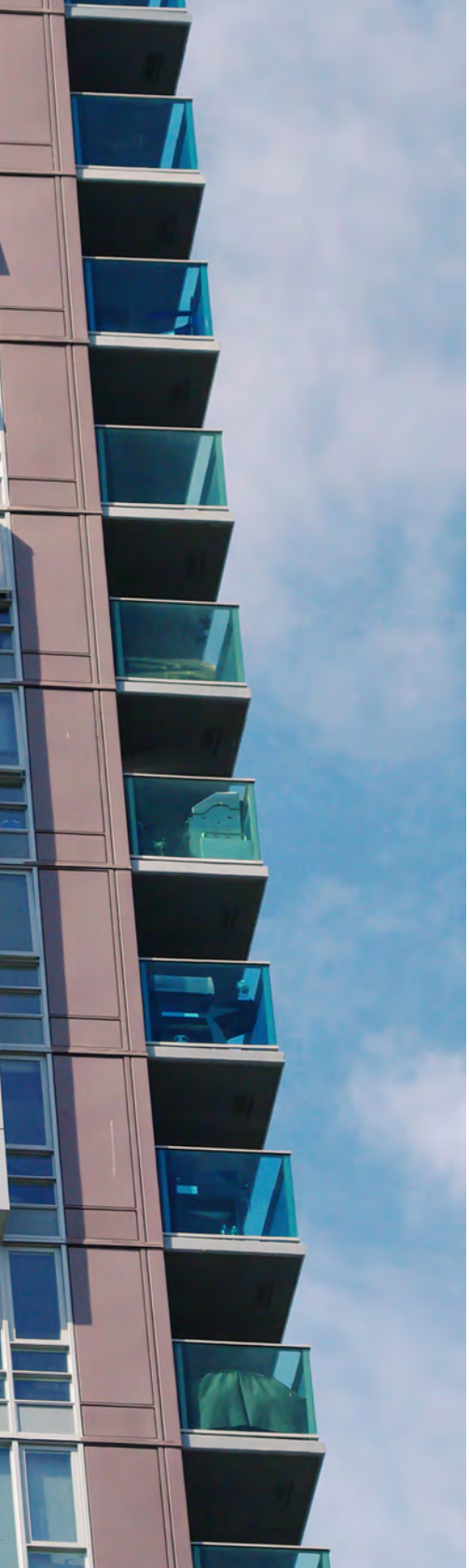
It should also be noted that testing performed by framing system suppliers cannot qualify the work of any particular glazing contractor As a result, it is common practice for project specifications to require post-award mockup testing by project participants at project sizes to confirm one or more of the structural-air-water properties of the products.

PRODUCT LABELING

Project specifications sometimes call for NAFS performance ratings to be reported on product labels. Architects should be aware that the performance rating labels required by the Canadian Supplement and referred to in the code are no more than a manufacturer's self-declaration of a product's tested performance ratings. There is no requirement in NAFS, the Canadian Supplement, or the code for product performance labels to be verified by an independent entity such as a Standards Council of Canada accredited certification organization.

NAFS labels are the logical way for windows and doors to demonstrate NAFS tested performance ratings on small buildings where no architect is involved. They are less useful on larger projects designed and constructed with the participation of an architect or a coordinating registered professional.

Given that NAFS labels are no more authoritative than any other form of documentation, it is customary for fenestration manufacturers to report NAFS tested ratings on project shop drawings. While product labels are impermanent and are rarely reviewed by architects and project consultants, NAFS ratings on reviewed shop drawings are permanently archived with other contract documents.



LIMITATIONS OF NAFS TESTING

The explicit intent of NAFS testing is to qualify the performance of the product only. As such, NAFS testing specifically excludes the installation and anchoring methods from its scope. The NAFS-08 clause dealing with test specimen installation reads as follows:

> These tests are used to evaluate the performance of the fenestration product only and are not intended to test the performance of the installation, particularly the perimeter sealants between the fixture and the test specimen and the anchoring of the test assembly to the test fixture… Evaluation of actual field installation details is not part of this Standard/ Specification.

NAFS testing does not qualify the strength of the glass either. Instead, the standard requires manufacturers to determine the wind load resistance of glass at project sizes with reference to the glass design standard referenced in the applicable building code.

For products both within or outside the scope of NAFS, project specifications must address the structural design of glass, the anchoring of fenestration products to the building structure, and the installation of fenestration products into wall or roof assemblies. None of these properties are qualified on the basis of NAFS testing.

NEW CONCEPTS IN NAFS

NAFS PERFORMANCE CLASS (R, LC, CW, AW)

The Performance Class attribute has a long history in the US but is new to the Canadian construction industry. It is an attribute not referenced in Part 5 and is of no interest to the code. It is, however, a useful attribute that architects can use to limit the range of acceptable products in a specification.

Performance Class places products into one of four serviceability categories, ranked from lowest to highest on the basis of progressively more demanding physical testing: R, LC, CW, and AW.

Performance Classes are defined by "gateway" threshold criteria defined with respect to minimum Performance Grade, minimum test size, minimum design pressure, minimum water test pressure, and a number of other criteria. The high-level gateway requirements are summarized in Table 1 below.

TABLE 1 - NAFS PERFORMANCE CLASS GATEWAY CRITERIA SUMMARY

Class	Minimum Performance Grade	Minimum Design Pressure	Minimum Water Test Pressure	Minimum Test Size (Typical)	Suggested Usage Indication*
R	PG15	720 Pa	140 Pa	Smallest	Light duty
LC	PG25	1200 Pa	180 Pa	>R size	Moderate duty
CW	PG30	1440 Pa	220 Pa	≥LC size	Heavy duty
AW	PG40	1920 Pa	390 Pa	>CW size	Severe duty

*Suggested usage indication designation by RDH

Other threshold criteria not shown in Table 1 include: the addition of a deflection limit of L/175 at the threshold from LC to CW, the requirement for significantly greater air leakage resistance and watertightness at the threshold from CW to AW, and the requirement for higher class products to be subjected to additional auxiliary tests.

The intended use of the Performance Class attribute is to allow specifiers and architects to more precisely limit the range of qualified products to those sharing similar performance characteristics. While products ranging from light-weight vinyl residential windows to heavy-duty institutional aluminum windows can meet the wind and water penetration requirements of most buildings in Canada (provided the sizes are not too large), adding a Performance Class attribute to the specification can ensure that the qualified products are more alike with respect to serviceability and perceived quality than they would be on the basis of location-based design pressures alone.

While the word "performance" suggests this attribute should be carefully considered, this is not the case. It is not a code regulated attribute, and has no application to any products except those to which Performance Class attributes are assigned within NAFS.

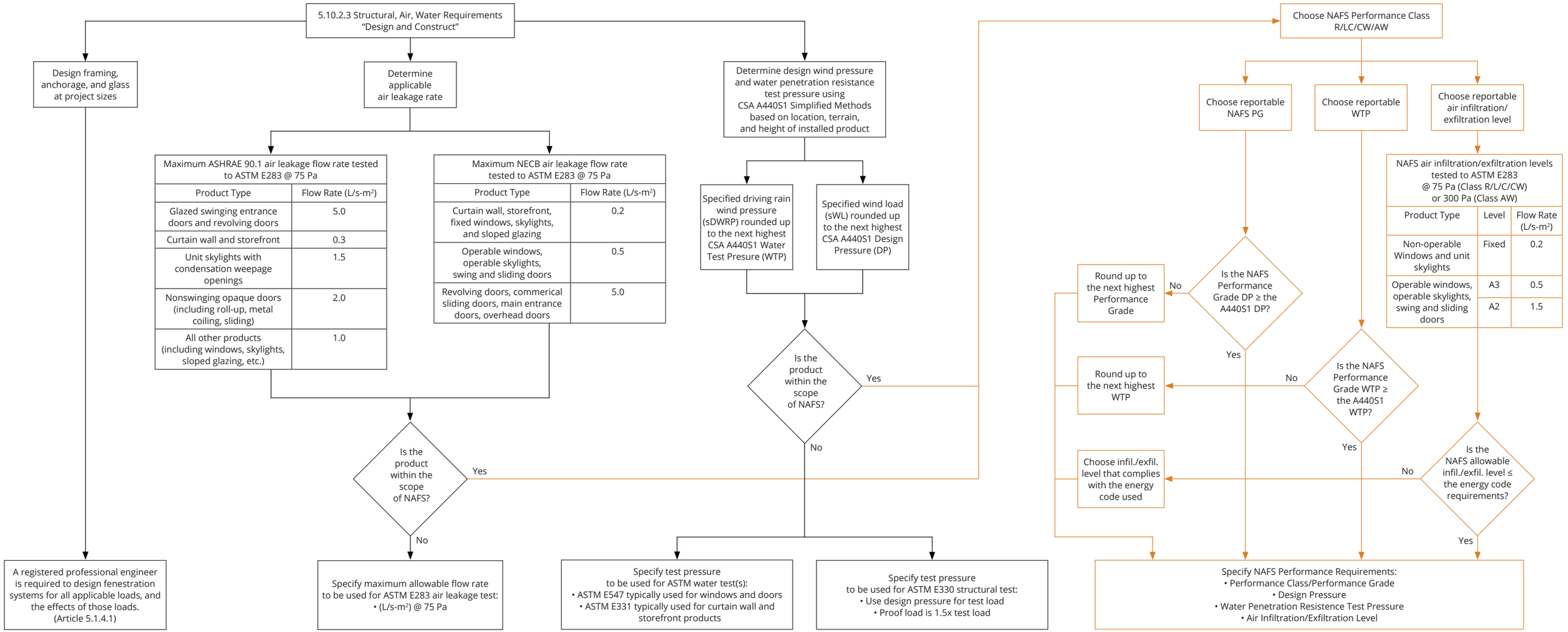
As Performance Class is new to Canada, few Canadian manufacturers have intentionally designed products to qualify for a particular class. Review of NAFS test reports suggests most Canadian window and door products have been found to qualify for classes LC or CW while there are relatively few products qualifying at the extremes of R and AW.

The novelty of Performance Class in Canada has also left some architects unclear about which class to choose. However, most architects already know the kind of windows they prefer to use for different building types. The best way for architects to acquaint themselves with how Performance Class affects product design and serviceability characteristics then is to inquire about the Performance Class of products they are already familiar with.

In NAFS-08, the complete table of gateway criteria—including minimum test sizes—is presented in Table 27. In NAFS-11, it is presented in Table 12.2.

FIGURE 1 - DETERMINING PART 5 STRUCTURAL-AIR-WATER PERFORMANCE VALUES

This chart illustrates measures that can be employed to address NBC 5.10.2.3 requirements for project specifications.



NAFS PRODUCT TYPES

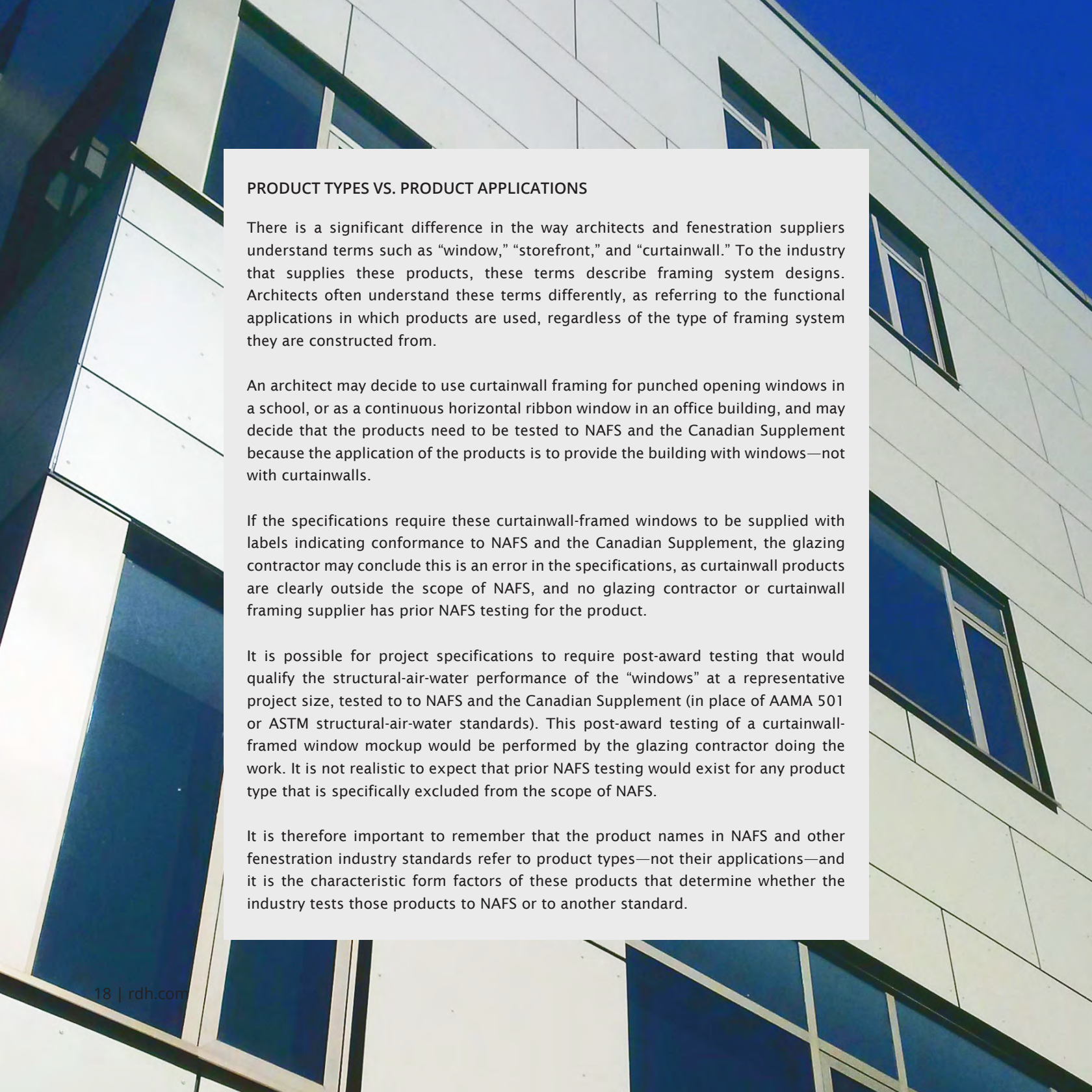
There are approximately thirty product types named in NAFS that have specific defined performance requirements.

There are also products not named in NAFS, but that are not excluded from its scope, either. These products can be tested under the Specialty Product type. Folding door systems are one example of a product type not named in NAFS, but that manufacturers voluntarily choose to test as Specialty Products. Because these products have no gateway test requirements, they cannot have Performance Class attributes. In NAFS, Specialty Products have the SP designation on test reports and product labels.

Not all products in the scope of NAFS have Performance Class attributes, and some qualify for only one or two classes. Table 2 summarizes the Performance Classes available for the various product types covered in NAFS-08 and NAFS-11.

TABLE 2 - NAFS PRODUCT TYPES

Abbreviation	Name	NAFS Version	Performance Classes
AP	Awning, hopper, projected window	2008, 2011	R, LC, CW, AW
ATD	Architectural terrace door		AW
BW	Basement window		R
C	Casement window		R, LC, CW, AW
DASHD	Dual-action side-hinged door		R, LC, CW
DAW	Dual-action window		R, LC, CW, AW
FD	Fixed door		R, LC, CW, AW
FW	Fixed window		R, LC, CW, AW
GH	Greenhouse window		R
H	Hung window		R, LC, CW, AW
HE	Hinged rescue window		R
HP	Horizontally projected window		R, LC, CW, AW
HS	Horizontal sliding window		R, LC, CW, AW
J	Jalousie window		R
JA	Jal-awning window		R
LW DASHD	Limited water dual-action side-hinged door		R, LC, CW
LW SHD	Limited water side-hinged door		R, LC, CW, AW
MA	Mullion assembly	2011 only	R, LC, CW, AW
POW	Parallel opening window	2011 only	R, LC, CW, AW
RW	Roof window	2008 only	R, CW
RWG	Roof window — glass glazed	2011 only	None
RWP	Roof window — plastic glazed	2011 only	None
SD	Sliding door	2008, 2011	R, LC, CW, AW
SHD	Side-hinged door		R, LC, CW, AW
SHW	Side-hinged (in-swinging) window		AW
SKG	Unit skylight — glass glazed	2008	R, CW
		2011	None
SKP	Unit skylight — plastic glazed	2008	R, CW
		2011	None
SLT	Side lite	2008, 2011	R, LC, CW
SP	Specialty product	2008, 2011	None
SSP	Secondary storm product	2011 only	None
TA	Tropical awning window	2008, 2011	R, LC, CW
TDD	Tubular daylighting device	2008 only	R, CW
TDDCC	Tubular daylighting device — closed ceiling	2011 only	None
TDDOC	Tubular daylighting device — open ceiling		None
TH	Top-hinged window	2008, 2011	CW, AW
TR	Transom		R, LC, CW
VP	Vertically pivoted window		R, LC, CW, AW
VS	Vertical sliding window		R, LC, CW



PRODUCT TYPES VS. PRODUCT APPLICATIONS

There is a significant difference in the way architects and fenestration suppliers understand terms such as “window,” “storefront,” and “curtainwall.” To the industry that supplies these products, these terms describe framing system designs. Architects often understand these terms differently, as referring to the functional applications in which products are used, regardless of the type of framing system they are constructed from.

An architect may decide to use curtainwall framing for punched opening windows in a school, or as a continuous horizontal ribbon window in an office building, and may decide that the products need to be tested to NAFS and the Canadian Supplement because the application of the products is to provide the building with windows—not with curtainwalls.

If the specifications require these curtainwall-framed windows to be supplied with labels indicating conformance to NAFS and the Canadian Supplement, the glazing contractor may conclude this is an error in the specifications, as curtainwall products are clearly outside the scope of NAFS, and no glazing contractor or curtainwall framing supplier has prior NAFS testing for the product.

It is possible for project specifications to require post-award testing that would qualify the structural-air-water performance of the “windows” at a representative project size, tested to to NAFS and the Canadian Supplement (in place of AAMA 501 or ASTM structural-air-water standards). This post-award testing of a curtainwall-framed window mockup would be performed by the glazing contractor doing the work. It is not realistic to expect that prior NAFS testing would exist for any product type that is specifically excluded from the scope of NAFS.

It is therefore important to remember that the product names in NAFS and other fenestration industry standards refer to product types—not their applications—and it is the characteristic form factors of these products that determine whether the industry tests those products to NAFS or to another standard.

NAFS PERFORMANCE GRADE: THE AMERICAN ABC RATING

The NAFS Performance Grade is a single rating that describes the structural-air-water performance attributes of a product. The rating comprises the letters PG followed by a two- or three-digit number ranging from 15 to 100. Under the older CSA A440 standard, these three properties could be specified independent of one another using ABC ratings:

- → Air leakage resistance: A1, A2, A3 (operable), or Fixed (non-operable)
- → Watertightness: B1to B7
- → Wind load resistance (structural): C1to C5

Under the older standard, a product could be rated with any combination of these three variables, (e.g., A1 B5 C3 or A3 B3 C2, etc.). The air, water, and structural ratings were not linked to each other in any way.

In the NAFS Performance Grade as used in the US, these three properties are combined into a single PG rating that signifies:

- → Maximum air leakage (pass-fail): A2 (operable), Fixed (non-operable)
- → Minimum watertightness: 15% of design pressure (Classes R, LC and C); 20% of design pressure (AW Class), reported in defined increments
- → Design pressure: reported in defined increments

A single Performance Grade rating such as PG40 indicates the product's tested design pressure (DP) is at least 1920 Pa (40 psf); its water penetration resistance is a minimum of 290 Pa (15% of DP in the case of Class R, LC, and CW products) or 390 Pa (20% of DP for Class AW), and its air leakage rate is less than the maximum allowable (A2 for operable products, or Fixed for non-operable products).

THE AMERICAN ABC RATING

In the US, a Performance Grade, such as PG40, reports the combined structural-air-water performance of a window, door or skylight product. In this sense, it may be considered "the American ABC rating."

In Canada, the Performance Grade is not sufficient on its own to describe a product's performance.

Note that the Performance Grade cannot report a higher-than-minimum level of air leakage or water penetration resistance.

In the US, a Performance Grade such as PG40 reports the combined structural-air-water performance of a window, door, or skylight product. In this sense, it may be considered "the American ABC rating." Table 3 presents the reportable NAFS Performance Grades from NAFS-08. Table 4 presents the reportable NAFS Performance Grades from NAFS-11. In Canada, the Performance Grade is not sufficient on its own to describe a product's performance.

PERFORMANCE CLASS AND PERFORMANCE GRADE: THE NAFS PRIMARY DESIGNATOR

Together, the Performance Class, Performance Grade, and Size Tested parameters make up the NAFS Primary Designator, and report everything it is possible to know about an American product's NAFS performance. The size tested could be larger, but not smaller, than the gateway size. The ratings apply to sizes up to and including the tested size.

Below are examples of Primary Designators for casement window products tested at the minimum gateway requirements for each class:

- → Class R - PG15, 600 x 1500 mm
- → Class LC - PG25, 800 x 1500 mm
- → Class CW - PG30, 800 x 1500 mm
- → Class AW - PG40, 900 x 1500 mm

CANADIAN NAFS PERFORMANCE GRADES: THE NAFS SECONDARY DESIGNATOR

In Canada, the Performance Grade alone is not sufficient to report structural-air-water performance. While it does denote that the minimum Canadian water penetration and air leakage requirements of NAFS were achieved, it does not allow better-than-minimum performance to be specified or reported.

To adapt the American Performance Grade for use in Canada where air leakage, water penetration, and wind load resistance have always been specified independently of one another, an additional performance designation was needed: the Secondary Designator.

The Secondary Designator reports:

- → Positive and negative design pressure (in Pa)
- → Water Penetration Resistance Test Pressure (in Pa)
- → Air Infiltration/Exfiltration Level

The Secondary Designator allows specifiers to request and manufacturers to report higher-than-minimum water penetration resistance test pressures, and a better-than-minimum air leakage resistance level.

Below is an example of the Canadian NAFS rating of a Class CW – PG30 casement window with higher-than-minimum tested values:

Class CW - PG30, 900 x 1550 mm	Primary designator
Design Pressure: + 1680 Pa / - 1440 Pa Water Penetration: 400 Pa Air Infiltration/Exfiltration: A3	Secondary designator

USING THE CANADIAN SUPPLEMENT TO DETERMINE LOCATION-SPECIFIC DESIGN PRESSURES

The Canadian Supplement to NAFS serves two important functions: first, to document requirements applicable to Canada that the parties involved in harmonizing the standard could not agree to put into the body of NAFS; second is to provide users of the standard with simplified methods for determining the appropriate minimum design wind pressure and driving rain wind pressure for fenestration products in Canada. These two values provide the basis for selecting the appropriate design pressures used to specify the NAFS Performance Grade and the Water Penetration Resistance Test Pressure that are appropriate for the building location. (For skylights, there is also a simplified method for converting snow loads to simple design pressures.)

To use the simplified methods, all one needs is the building location, the terrain, and the height of the fenestration product above grade. The location determines the reference climate loads, while the terrain and the height of the fenestration product above grade affect the wind exposure.

The simplified methods may result in more conservative (higher) design wind pressure values than would be determined using Part 4 methods. The simplified methods are provided to allow safe working values to be determined by non-specialists, and may be used to specify minimum test pressures for wind load resistance and water penetration resistance for all fenestration products, whether or not they are within the scope of NAFS.

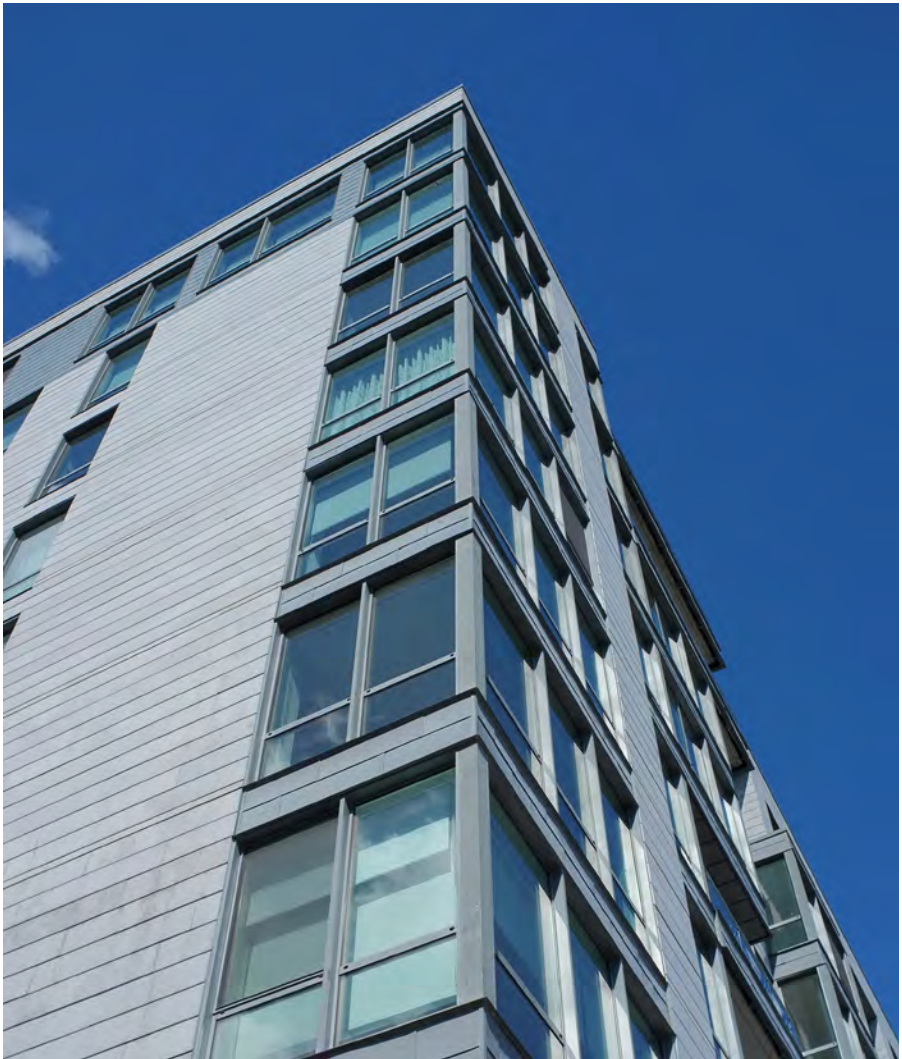
The simplified methods are available for use in a publicly available, online Performance Grade calculator from Fenestration Canada, a national association representing Canadian window, door, and skylight industry manufacturers and suppliers: www.fenestrationcanada.ca/calculator

CAN FENESTRATION PRODUCTS ON A GIVEN BUILDING HAVE DIFFERENT PERFORMANCE GRADES?

On low- and mid-rise buildings, it is customary to specify a single Performance Grade for all the windows and doors, based on the requirements at the highest floor. However, sometimes there are good reasons to deviate from this custom.

- → Positive design wind loads increase with height and at building corners. On tall buildings it may be justifiable and cost effective to allow fenestration products to be designed to the loads they will be subjected to, with different design pressure zones based on height and proximity to corners.
- → Doors under balconies or recessed from the exterior walls may be less exposed to driving rain, a factor that could be considered to reduce the required level of water penetration resistance.

Use of the simplified methods is not mandatory as the Canadian Supplement also allows more precise Part 4 methods to be used; however, precise values are not always available at the specification stage. While design values determined using the Canadian Supplement are appropriate for specifying minimum NAFS Performance Grades or test pressures for ASTM uniform load and water penetration resistance tests, specifications must allow registered professionals charged with the design of fenestration systems to determine the appropriate pressures to be used for design purposes.



SPECIFYING THE STRUCTURAL-AIR-WATER PERFORMANCE FOR PRODUCTS WITHIN OR OUTSIDE THE SCOPE OF NAFS

Specifiers sometimes struggle with how to determine the appropriate laboratory test pressures to be used in project specifications for wind load resistance, air leakage resistance, and water penetration resistance. When specialist guidance is not available from project consultants, or is not required, the Canadian Supplement can be used to provide test pressures for wind load and water penetration resistance lab testing purposes.

WIND LOAD RESISTANCE

Article 5.10.2.2 of the 2010 NBC directs users to use the Canadian Supplement to determine Performance Grades "appropriate for the conditions and the geographic location" in which the fenestration product will be installed.

While this direction is specified to products within the scope of NAFS, there is no reason why these values cannot be used to determine laboratory test pressures for products outside the scope of NAFS as well.

In the Canadian Supplement document this property is called "specified wind load," while in the online calculator based on the Canadian Supplement it is called "minimum positive design pressure."

WATER PENETRATION RESISTANCE

The Canadian Supplement may also be used to determine the minimum water resistance test pressure. In the Canadian Supplement document this property is called “specified driving rain wind pressure,” while in the online calculator based on the Canadian Supplement it is called “minimum water penetration resistance test pressure.”

It is noteworthy that Article 5.9.3.5 of the 2015 NBC requires the Canadian Supplement to be used to determine the required water penetration resistance for “other fenestration assemblies”, which are products that are outside the scope of NAFS. It is also noteworthy that it exempts the following exterior fenestration products from a water penetration resistance requirement because their specialized function is incompatible with it:

- → Vehicular access doors
- → Storm windows and storm doors
- → Commercial entrance systems
- → Revolving doors
- → Site-built door systems
- → Commercial steel doors

Water penetration resistance levels greater than those determined using the Canadian Supplement may be specified for products known to have superior performance characteristics.

AIR LEAKAGE RESISTANCE

Neither NAFS nor the Canadian Supplement provide any guidance on determining an appropriate level of air leakage resistance. Under NAFS and the Canadian Supplement, operable products have two air leakage resistance levels, A2 (good) and A3 (better), while non-operable windows have one: Fixed. The choice of an appropriate level is left to the customer or the specifier.

As air leakage is an energy performance property of fenestration products—and most buildings are now designed to energy performance standards such as the National Energy Code for Buildings (NECB) or ASHRAE 90.1—it is always wise to consult the appropriate energy design standard when specifying fenestration air leakage rates.

In determining an appropriate level of air leakage resistance, it is important to consider that greater levels may be required under certain conditions, such as when fenestration assemblies are the sole building enclosure assembly; when greater thermal comfort may be required (such as in hospitals or seniors' residences); when seeking to prevent condensation in concealed spaces or the migration of airborne contaminants (as in biological or research laboratories, or in manufacturing applications). Greater air leakage resistance may also be specified for products known to have superior performance characteristics, usually with respect to a higher test pressure and/or a lower leakage rate.

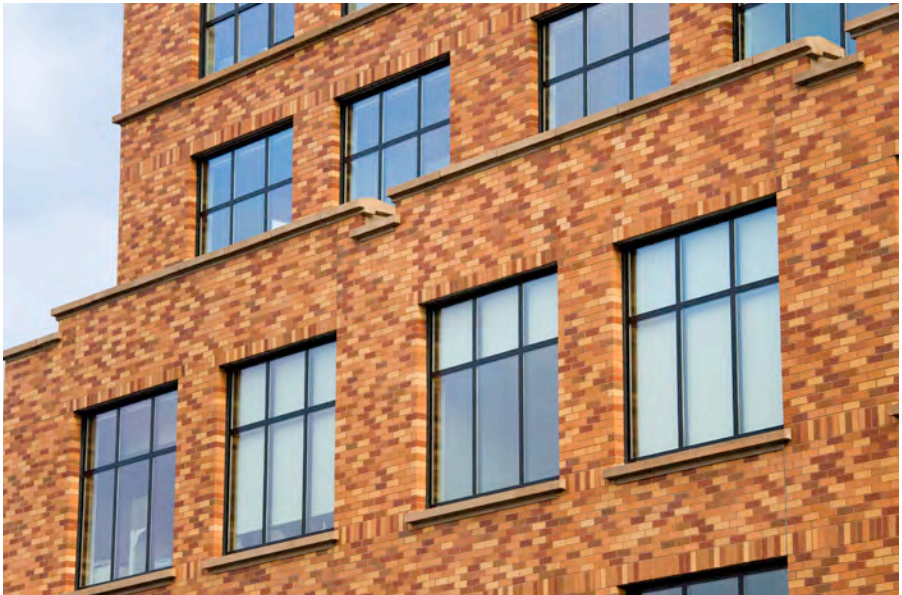
SPECIFYING LAB TEST PERFORMANCE VALUES

The flow chart on pages 14-15 illustrates a workflow that can be followed to determine the appropriate design values for lab-tested structural-air-water performance for vertical fenestration products, whether or not they are in the scope of NAFS.

The chart illustrates how the Canadian Supplement can be used to determine design pressures for testing load and water penetration resistance.

Also provided in the flow chart are allowable NAFS, NECB and ASHRAE 90.1 air leakage rates expressed in metric SI units to facilitate comparison between them.

Additionally, the flow chart recommends the engagement of a registered professional engineer by the fenestration supplier to design the fenestration system and its anchorage and also the glass infill to resist all applicable loads—including guard loads—in a way that accommodates expected movements of the building and the fenestration system. This is necessary for all fenestration products, whether or not they are within the scope of NAFS.



SUMMARY OF REPORTABLE CANADIAN NAFS-08 PERFORMANCE GRADES

Table 3 presents all the reportable Canadian NAFS-08 Performance Grades for the convenience of specifiers, combining Gateway Performance Grades from Table 2 and Canadian Optional Performance Grades from Table 3.

In NAFS, the SI metric units are normative. In NAFS-08, the psf values are expressed with two decimal places but rounded to the nearest pound. In NAFS-11, the psf values are also expressed with two decimal places but are converted accurately.

USING THE TABLE TO SELECT PERFORMANCE GRADE AND WATER TEST PRESSURE

The Canadian Supplement requires Performance Grade and Water Penetration Resistance Test Pressure values to be specified and reported only in the values given in the Gateway and Optional Performance Grade tables in NAFS standard.

First the Performance Grade (PG) is selected on the basis of Design Pressure, using the Specified Wind Load as determined using the Canadian Supplement or Part 4 of the Building Code. When the Specified Wind Load falls between the reportable Design Pressure values, select the higher Performance Grade (PG) value.

Next the Specified Driving Rain Wind Pressure (DRWP) is determined using the Canadian Supplement. When the Specified DRWP falls between the Water Penetration Resistance Test Pressure values in this table, select the higher value for specifying the required minimum water test pressure for project specifications.

Note that the Water Penetration Resistance Test Pressure can be higher than the value associated with the Performance Grade, but it cannot be lower: by definition, a PG30 product of Class R, LC, or CW cannot have a water penetration resistance less than 220 Pa, but it can be higher, as long as it is specified using reportable values. The need for a higher water test pressure does not imply the need for a higher Performance Grade.

TABLE 3 - REPORTABLE CANADIAN NAFS PERFORMANCE GRADES (COMBINING NAFS-08 TABLES 1 AND 3)

Reportable Performance Grades Arranged by Performance Class				Reportable Design Pressure		Reportable Water Penetration Resistance Test Pressure Values			
						R, LC, CW		AW	
R	LC	CW	AW	Pa	(psf)	Pa	(psf)	Pa	(psf)
15	—	—	—	720	(15.00)	140	(2.90)	—	—
20	—	—	—	960	(20.00)	150	(3.00)	—	—
25	25	—	—	1200	(25.00)	180	(3.75)	—	—
30	30	30	—	1440	(30.00)	220	(4.50)	—	—
35	35	35	—	1680	(35.00)	260	(5.25)	—	—
40	40	40	40	1920	(40.00)	290	(6.00)	390	(8.00)
45	45	45	45	2160	(45.00)	330	(6.75)	440	(9.00)
50	50	50	50	2400	(50.00)	360	(7.50)	480	(10.00)
55	55	55	55	2640	(55.00)	400	(8.25)	530	(11.00)
60	60	60	60	2880	(60.00)	440	(9.00)	580	(12.00)
65	65	65	65	3120	(65.00)	470	(9.75)	630	(13.00)
70	70	70	70	3360	(70.00)	510	(10.50)	680	(14.00)
75	75	75	75	3600	(75.00)	540	(11.25)	730	(15.00)
80	80	80	80	3840	(80.00)	580	(12.00)	730	(15.00)
85	85	85	85	4080	(85.00)	620	(12.75)	730	(15.00)
90	90	90	90	4320	(90.00)	650	(13.50)	730	(15.00)
95	95	95	95	4560	(95.00)	690	(14.25)	730	(15.00)
100	100	100	100	4800	(100.00)	730	(15.00)	730	(15.00)
—	—	—	No limit*	No limit*		730	(15.00)	730	(15.00)

* There is no limit for optional Performance Grades (PG) in the AW performance class, as long as they are specified in 5 psf (240 Pa) increments.

SUMMARY OF REPORTABLE CANADIAN NAFS-11 PERFORMANCE GRADES

Table 4 presents all the reportable Canadian NAFS-11 Performance Grades for the convenience of specifiers, combining Gateway Performance Grades from Table 6.5 and Canadian Optional Performance Grades from Table 6.3.

In NAFS, the SI metric units are normative. In NAFS-08, the psf values are expressed with two decimal places but rounded to the nearest pound. In NAFS-11, the psf values are also expressed with two decimal places but are converted accurately.

USING THE TABLE TO SELECT PERFORMANCE GRADE AND WATER TEST PRESSURE

The Canadian Supplement requires Performance Grade and Water Penetration Resistance Test Pressure values to be specified and reported only in the values given in the Gateway and Optional Performance Grade tables in NAFS standard.

First the Performance Grade (PG) is selected on the basis of Design Pressure, using the Specified Wind Load as determined using the Canadian Supplement or Part 4 of the Building Code. When the Specified Wind Load falls between the reportable Design Pressure values, select the higher Performance Grade (PG) value.

Next the Specified Driving Rain Wind Pressure (DRWP) is determined using the Canadian Supplement. When the Specified DRWP falls between the Water Penetration Resistance Test Pressure values in this table, select the higher value for specifying the required minimum water test pressure for project specifications.

Note that the Water Penetration Resistance Test Pressure can be higher than the value associated with the Performance Grade, but it cannot be lower: by definition, a PG30 product of Class R, LC, or CW cannot have a water penetration resistance less than 220 Pa, but it can be higher, as long as it is specified using reportable values. The need for a higher water test pressure does not imply the need for a higher Performance Grade.

TABLE 4 - REPORTABLE CANADIAN NAFS PERFORMANCE GRADES (COMBINING NAFS-11 TABLES 6.3 AND 6.5)

Reportable Performance Grades Arranged by Performance Class				Reportable Design Pressure		Reportable Water Penetration Resistance Test Pressure Values			
						R, LC, CW		AW	
R	LC	CW	AW	Pa	(psf)	Pa	(psf)	Pa	(psf)
15	—	—	—	720	(15.04)	140	(2.92)	—	—
20	—	—	—	960	(20.05)	150	(3.13)	—	—
25	25	—	—	1200	(25.06)	180	(3.76)	—	—
30	30	30	—	1440	(30.08)	220	(4.59)	—	—
35	35	35	—	1680	(35.09)	260	(5.43)	—	—
40	40	40	40	1920	(40.10)	290	(6.06)	390	(8.15)
45	45	45	45	2160	(45.11)	330	(6.89)	440	(9.19)
50	50	50	50	2400	(50.13)	360	(7.52)	480	(10.03)
55	55	55	55	2640	(55.14)	400	(8.35)	530	(11.07)
60	60	60	60	2880	(60.15)	440	(9.19)	580	(12.11)
65	65	65	65	3120	(65.16)	470	(9.82)	630	(13.16)
70	70	70	70	3360	(70.18)	510	(10.65)	680	(14.20)
75	75	75	75	3600	(75.19)	540	(11.28)	720	(15.04)
80	80	80	80	3840	(80.20)	580	(12.11)	720	(15.04)
85	85	85	85	4080	(85.21)	620	(12.95)	720	(15.04)
90	90	90	90	4320	(90.23)	650	(13.58)	720	(15.04)
95	95	95	95	4560	(95.24)	690	(14.41)	720	(15.04)
100	100	100	100	4800	(100.25)	720	(15.04)	720	(15.04)
—	—	—	No limit*	No limit*		720	(15.04)	720	(15.04)

* There is no limit for optional Performance Grades (PG) in the AW performance class, as long as they are specified in 5 psf (240 Pa) increments.

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