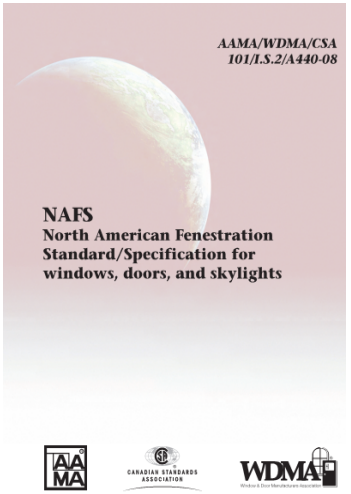
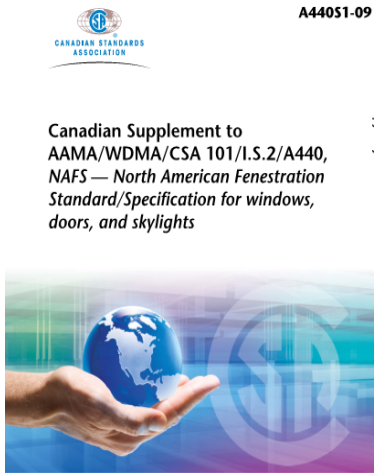
NAFS and The 2012 Building Code





Presented to BCBEC on 2013-04-18

Al Jaugelis B.Sc. Arch.

ajaugelis@rdhbe.com

RDH

NAFS changes everything . . .

- No more ABC's
- New concepts
- New terminology
- New rating system
- New product labels

- Need to learn new language to talk about it!

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Topics covered

1. NAFS in building codes
   - NAFS and Canadian Supplement
   - NAFS compared to CSA A440-00
2. New concepts in NAFS
   - Performance CLASS
   - Performance GRADE
   - Gateway requirements
   - Optional Performance Grades
   - Primary and secondary designators
   - Testing, rating and labeling
3. Specifying with NAFS – Canadian Supplement Example
4. NAFS challenges
5. Industry readiness (Canada)
6. Conclusion

RDH

1. NAFS in building codes

- What do we mean by NAFS?
- NAFS in building codes
- NAFS in 2012 BCBC
- NAFS and the Canadian Supplement
- NAFS compared to CSA A440-00

What is NAFS?

- A new, comprehensive standard addressing performance and quality requirements of windows, doors and skylights
- Harmonizes Canadian and American fenestration standards:

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

- Called the **Harmonized Standard** in the Building Code
- Called **NAFS-08** by the fenestration industry
- 2011 version not referenced in Canadian codes

NAFS-08 in building codes

- 2010 NBCC National Building Code of Canada
- 2012 BCBC British Columbia Building Code

- 2013 VBBL Vancouver Building Bylaw

- Future Alberta, Ontario and Quebec Building Codes

- "*A Cross-Canada, and International Standard*"

NAFS in BCBC Part 9

9.7.4.2. General

1) Manufactured and pre-assembled windows, doors and skylights and their installation shall conform to

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

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

NAFS in BCBC Part 5

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

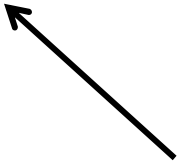
   b) **CSA A440S1, "Canadian Supplement to** AAMA/WDMA/CSA 101/I.S.2/A440, **NAFS** – North American Fenestration Standard/Specification for Windows, Doors, and Skylights."

Continued . . .

NAFS in BCBC Part 5

2) **Performance grades for windows, doors and skylights shall be selected according to the Canadian Supplement** referenced in Clause (1)(b) **so as to be appropriate for the conditions and geographic location in which the window, door or skylight will be installed.**

3) **Windows, doors and skylights shall conform to the performance grades selected in Sentence (2) when tested in accordance with the Harmonized Standard** referenced in Clause (1)(a).



= NAFS-08

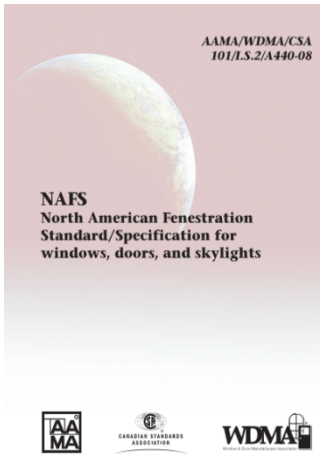
NAFS in BCBC

Code requires that windows, doors and skylights, including Tubular Daylighting Devices:

- Conform with NAFS-08 and Canadian Supplement to NAFS-08.
  - For all Part 9 buildings
  - For all Part 5 buildings
  - All new construction and renovation that requires a permit
- Have Performance Grades selected using Canadian Supplement
- Have minimum Performance Class: R

What does NAFS give us?

- Harmonizes—mostly—Canadian and American testing, ratings standards
- . . . But in Canada needs to be used with the Canadian Supplement
- A more refined performance testing, rating and labeling system
- An **unfamiliar and more complicated** testing, rating and labeling system
- More than performance ratings: provides mandatory auxiliary durability tests and many new component specifications
- Provides optional tests architects may choose to use



Why are there Canadian tables in NAFS-08?

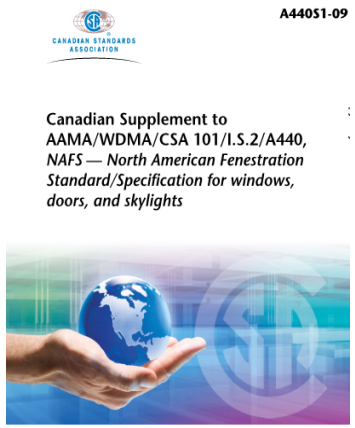
Not everything could be harmonized:

- Air leakage testing
  - US tests infiltration only, Canada tests both infiltration and exfiltration to arrive at A2, A3 or Fixed levels
- Operating force
  - Canadian products easier to operate
  - Operating force can affect air and water tightness!
- Water test pressure
  - US: 15 – 20% of design pressure, coupled with DP in Performance Grade, capped at 12 psf
  - Canada: Water test pressure separate from DP, determined by building height, terrain, and environmental data, capped at 15 psf (720 Pa)

Why is there a Canadian Supplement?

Not everything could be harmonized:

1. Canadian definition of water penetration
2. Insect screen serviceability test (60 N force in an outward direction)
3. Prescriptive material requirements
4. Canadian labeling requirements (“markings”)
   - Permanent label identifying manufacturer
   - Temporary label with product performance



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4. Canadian labeling requirements ("markings")
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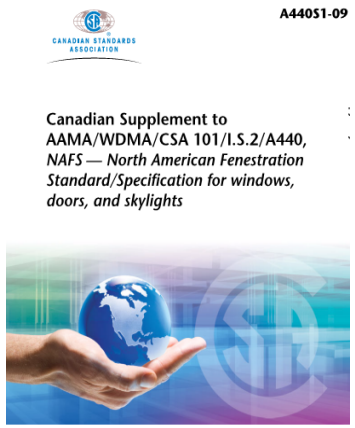
   - Temporary label with product performance
5. **Provides environmental data and simplified methods for determining appropriate performance grades for buildings anywhere in Canada, like the User's Guide to the A440-00 did.**



What standards does NAFS-08 replace?

- CSA-A440-00, *Windows*
- CAN/CGSB-82.1-89, *Sliding Glass Doors*
- CGSB 63.14-M89, *Plastic Skylights*
- CGSB 82.5-M88, *Insulated Steel Doors*

- *Special Publication* A440.1-00, *User Selection Guide to CSA Standard A440-00, Windows* *

  ** Replaced by A440S1-09, Canadian Supplement to NAFS-08*

NAFS-08 vs. CSA A440-00

- CSA A440 was a stand alone document
  - Canadian Supplement must be used with NAFS for all products sold in Canada, *including US-made products*
- CSA A440 labeled performance but not size
  - NAFS labels both *performance and size tested*
- CSA A440 applied to products ≤ 25% greater in size than tested specimen
  - NAFS ratings apply to *size tested or smaller*

NAFS-08 vs. CSA A440-00

- CSA A440 rated performance with – A, B, C's
  - NAFS and Canadian Supplement:
    - **Performance CLASS:** R, LC, CW, AW
    - **Performance GRADE** in: Pa (Pascals)
    - **Air infiltration/exfiltration:** Fixed, A2, A3
    - **Water penetration test pressure** in: Pa (Pascals)
    - **Design Pressure: + and - test pressure** in: Pa (Pascals)

What does NAFS say it applies to?

- Products installed into exterior building envelopes
- New and replacement products
- Material-neutral, minimum and optimal Performance Grades
- Performance based requirements where possible
- Prescriptive where necessary

What does NAFS exclude itself from?

- Interior (“indoor”) fenestration products
- Garage doors
- Sloped glazing (except unit skylights, roof windows, TDDs)
- Curtain wall and storefront
- Commercial entrance systems, revolving doors
- Sunrooms, storm windows, storm doors
- Site-built door systems
- Commercial steel doors rated to SDI A250.8

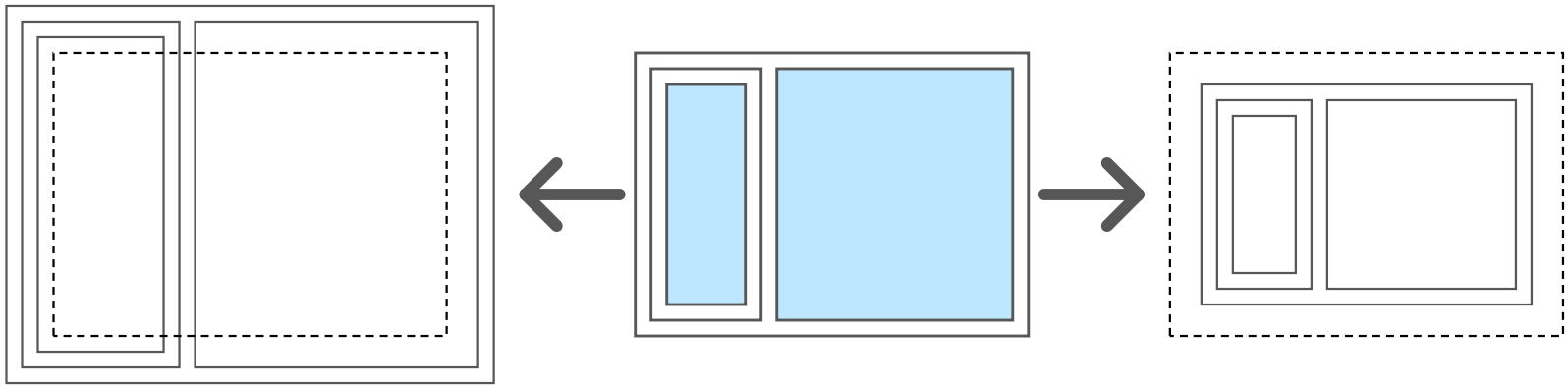
. . . however Code applies it to all “windows, doors and skylights” in Part 5 . . .

NAFS-08 vs. CSA A440-00

- A440-00 had mullion deflection limits
  - L/175 mullions
  - L/125 sliding sash rails
  - (But no one tested mullions . . . .)
- NAFS-08:
  - CW, AW Class have L/175 deflection limit
  - **R and LC Class have NO mullion or frame deflection limits**
  - R and LC DP = 2/3 of structural test pressure

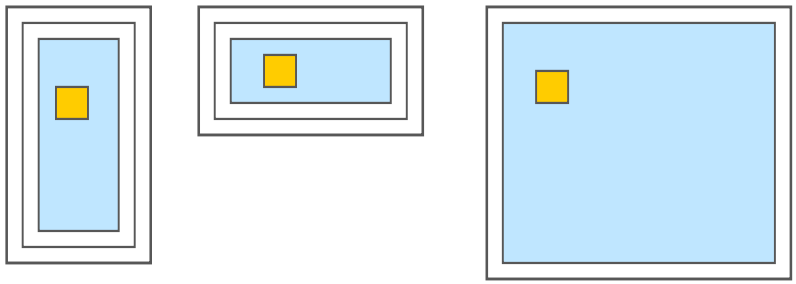
NAFS-08 vs. CSA A440-00

- CSA A440 ratings applied to sizes up to 25% larger than tested size
  - NAFS and Canadian Supplement **ratings apply only to tested size or smaller**



NAFS-08 vs. CSA A440-00

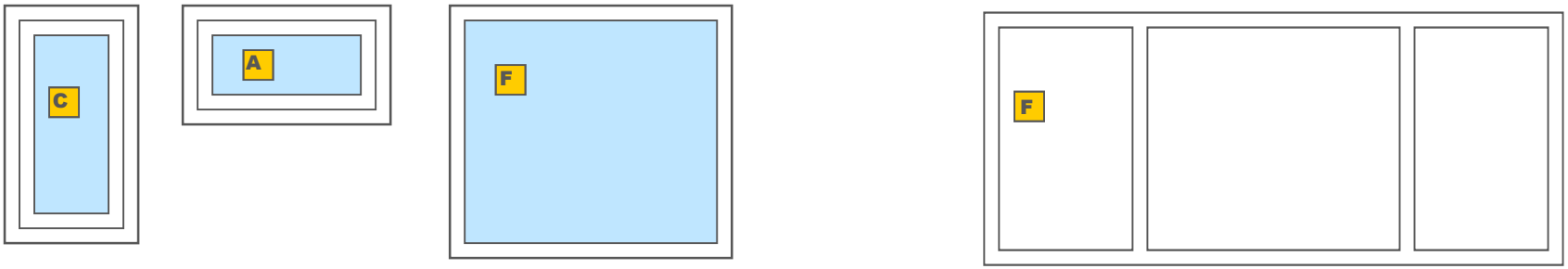
- CSA A440-00: mullion testing requirements were not clear
- Most manufacturers, certifiers ignored mullions, tested single operators only



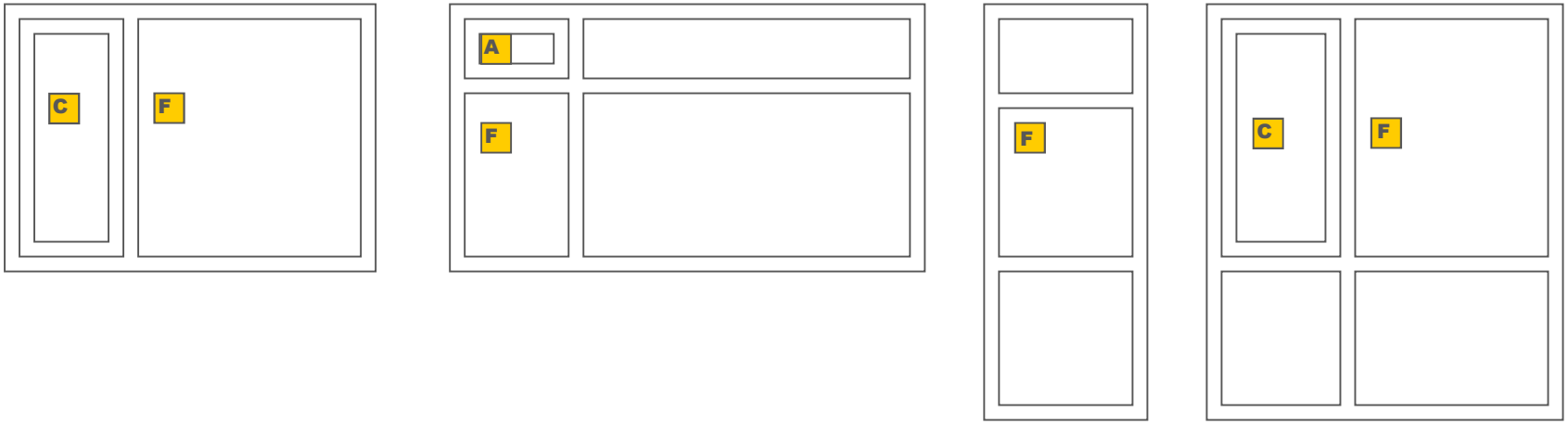
NAFS-08 vs. CSA A440-00

- Single operator labels were applied to untested mullion configurations, with multiple labels

Typical tested products

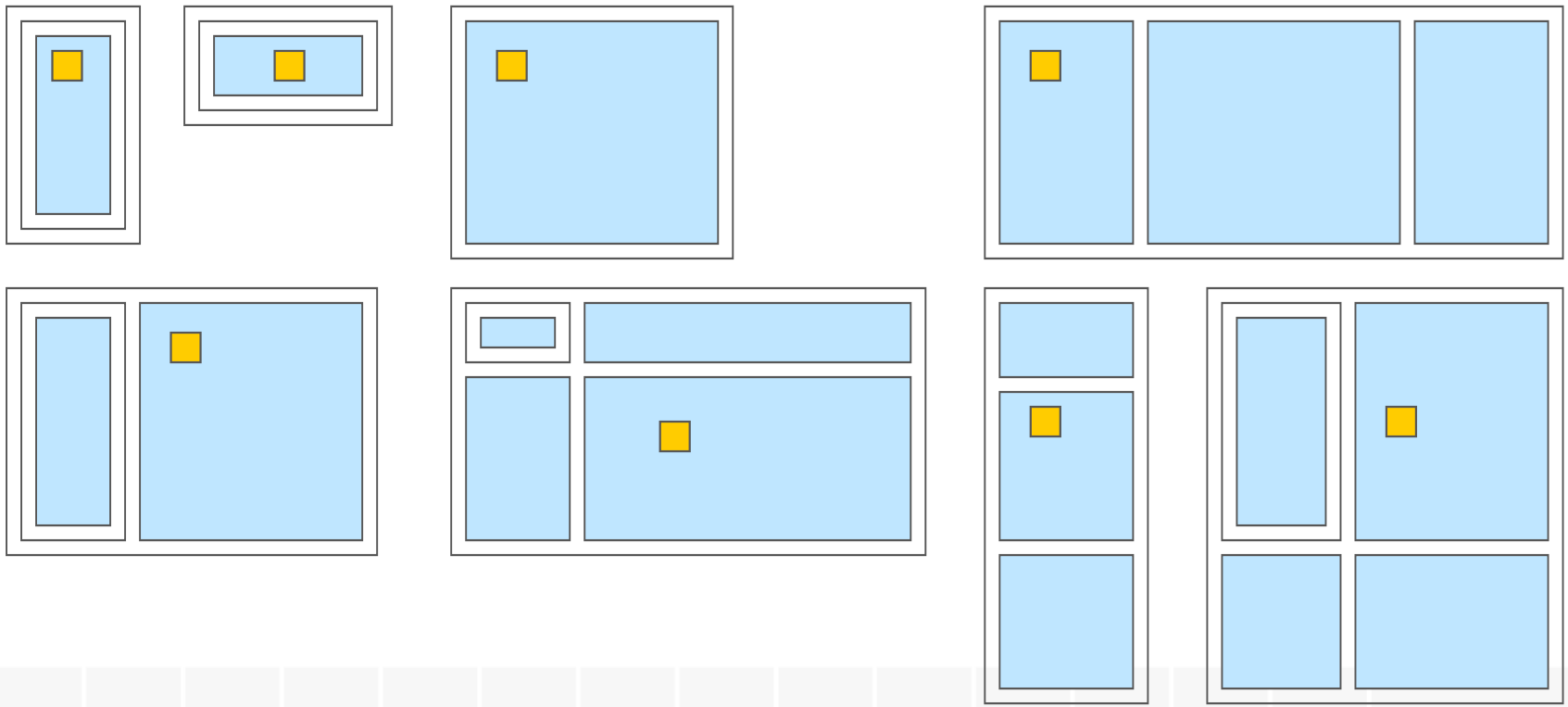


Typical untested products



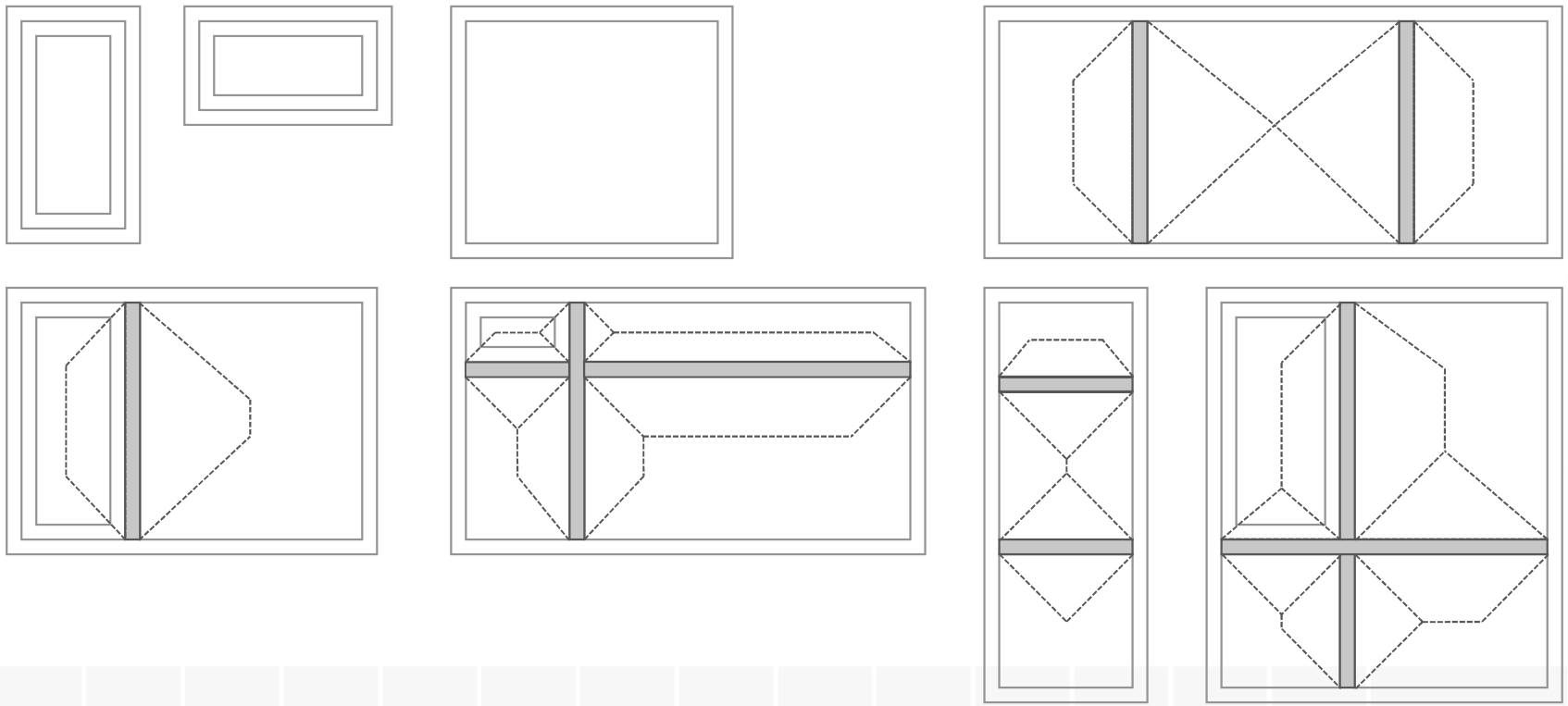
NAFS-08 vs. CSA A440-00

- NAFS explicitly requires all configurations with mullions to be tested, and only one valid label per product
- “No member may be longer in any dimension than tested”



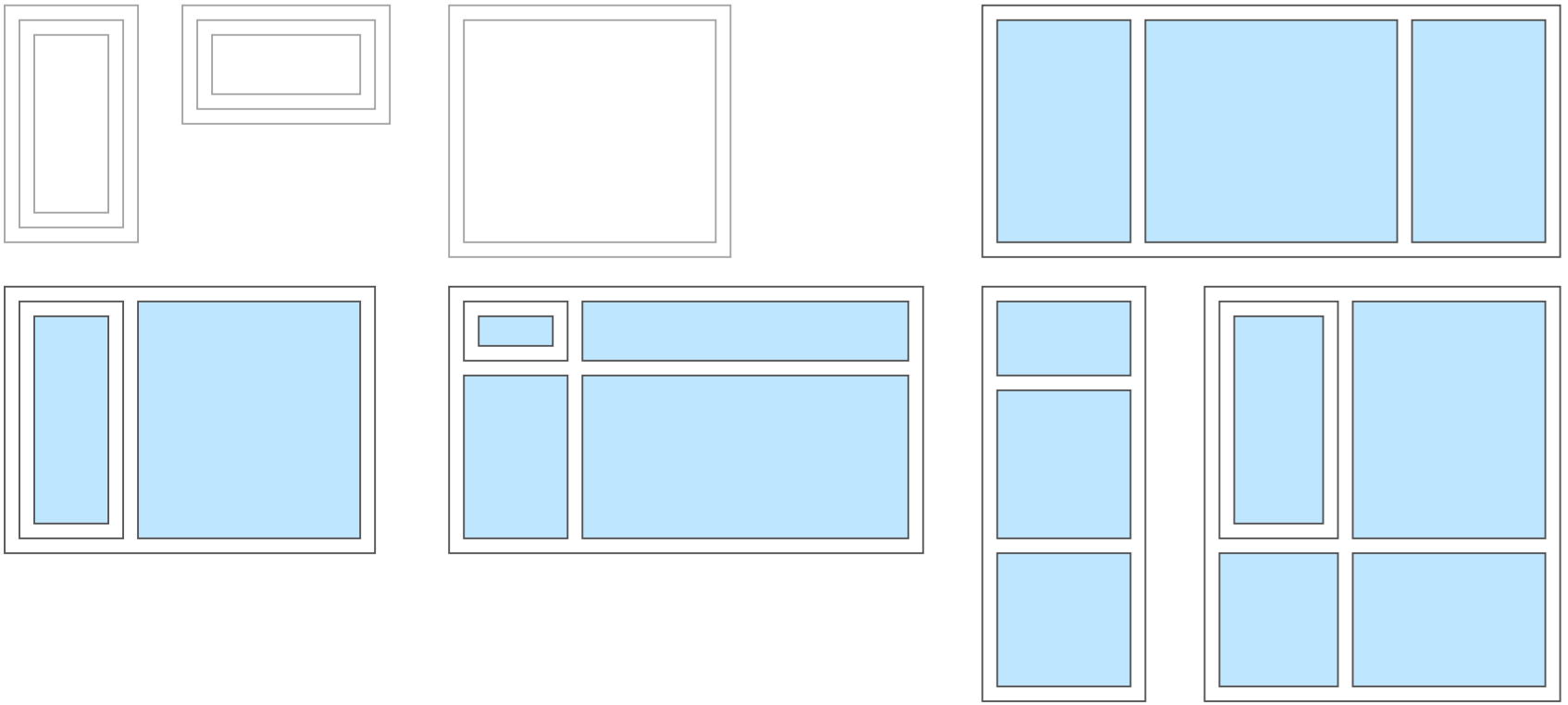
NAFS-08 vs. CSA A440-00

- Mullions are the most heavily loaded structural members
- They increase crack length affecting air and water leakage



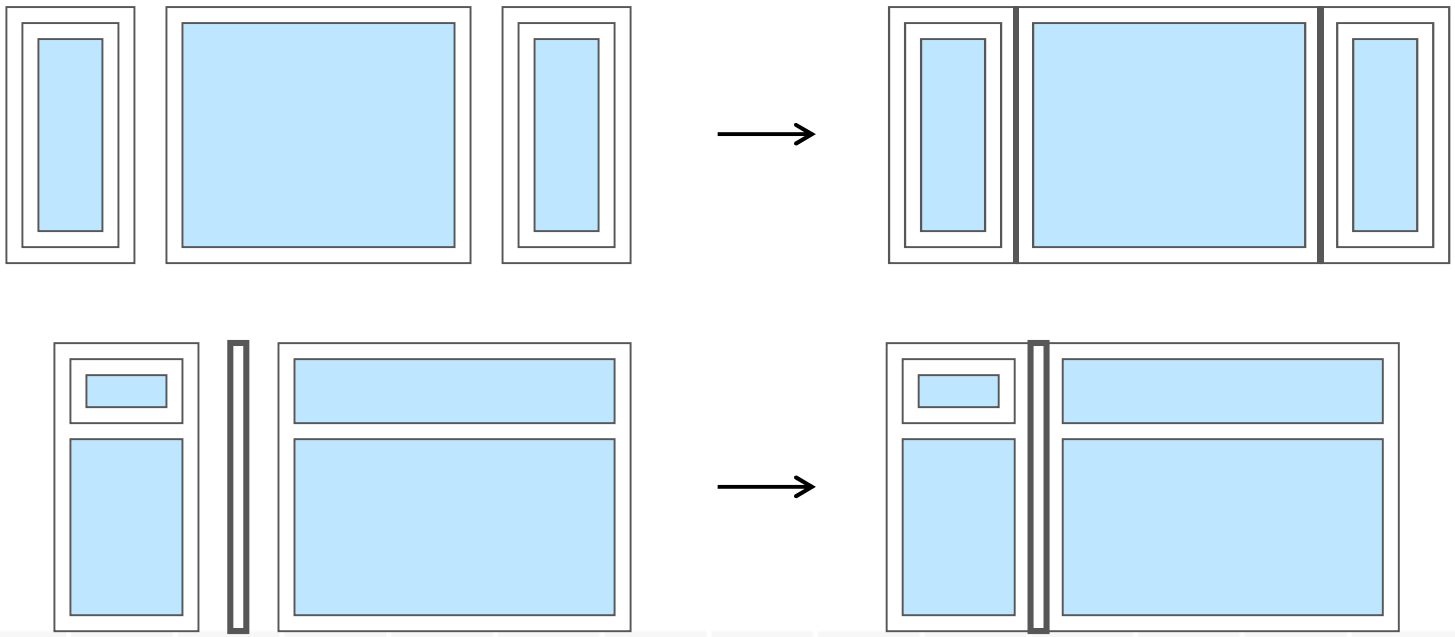
NAFS-08 and mullions—Composite Unit

- **Composite unit:** two or more sashes, leaves, lites, or sliding panels within a single frame and utilizing integral mullions – **must be tested as one unit**



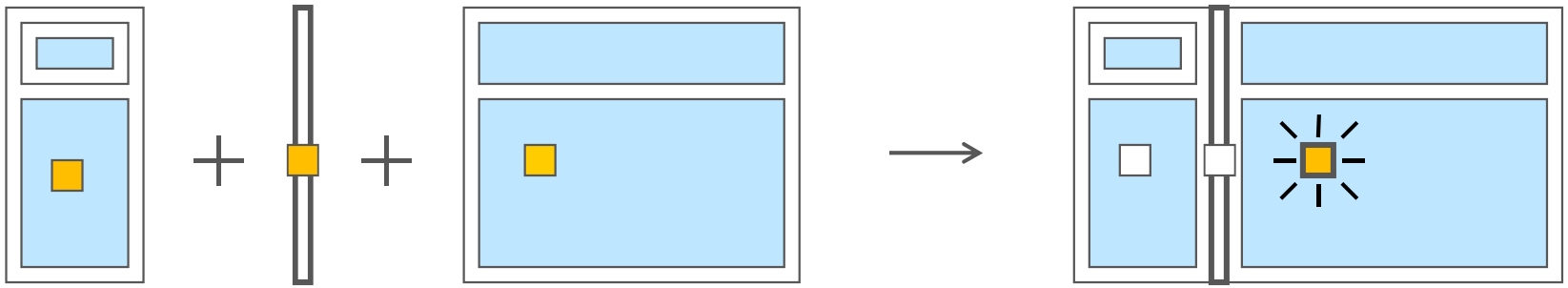
NAFS-08 and mullions—Combination Assembly

- **Combination assembly:** two or more separate fenestration products joined with mullion or clips
- Can test as an assembly, or each test each component separately.
- Mullion PG ratings may be determined by licensed structural engineer using AAMA 450



Combination Assembly allows mullion ratings

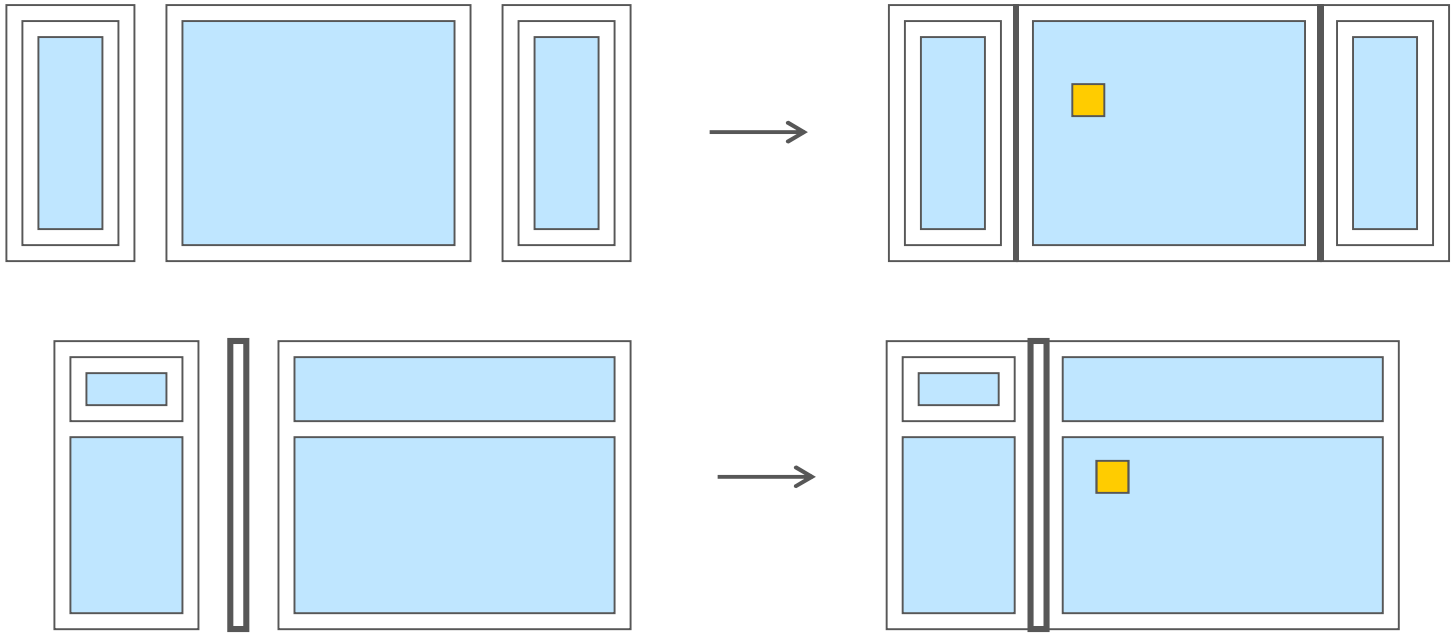
- **When tested as separate components,** can have separate labels for each of the mulled components, including the mullion connector.
- The **Performance Grade of the weakest element is the Performance Grade of the assembly** for code compliance.



Labels must show air, water and structural performance!

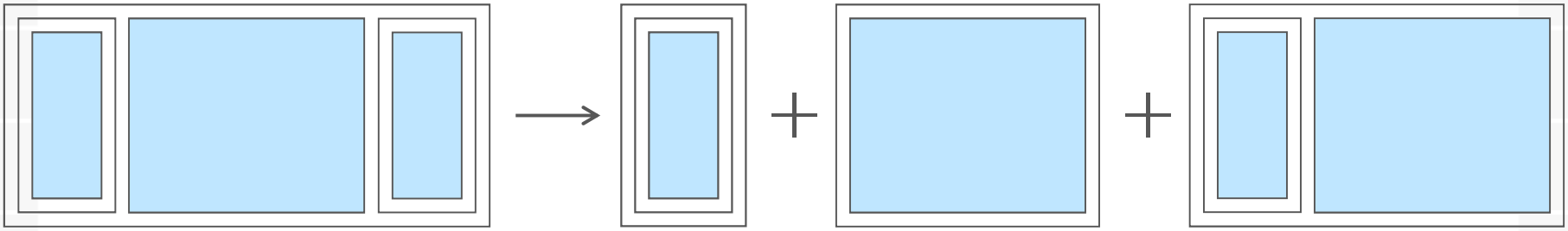
NAFS-08 Combination Assembly – in BC

- Local test labs / certification agencies Intertek and QAI do not do AAMA 450 mullion ratings
- Test Combination products same as Composite products
- Label products to NAFS-11, using Mullion Assembly (MA) designation



NAFS-08 vs. CSA A440-00

- NAFS rules allow testing of complex combinations to qualify simpler combinations
- NAFS ratings and labels apply ONLY if no member – in any direction – is longer than the tested configuration



NAFS in building codes – review

- NAFS harmonizes Canadian and American fenestration standards, covers “most” factory built products
- NAFS applies to both Part 9 and Part 5
- NAFS contains Canadian-only requirements and must be used with the Canadian Supplement
- NAFS applies to side hinged doors, and requires they have same water resistance as windows if not protected
- NAFS establishes performance by testing only, and requires much more testing
- NAFS has new and more precise labeling requirements

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2. New concepts in NAFS

- Performance CLASS
- Performance GRADE
- GATEWAY Requirements
- Optional Performance Grades
- Rating system—Primary and Secondary designators
- NAFS labeling for Canada

New concept in NAFS: Performance Class

- Four categories for rating product “durability”

Table 1
Gateway requirements

(See Clauses 0.2.1, 0.2.6.1, 4.2.1, 4.4.2.3, 4.4.3.2–4.4.3.4, 5.3.3.1, 5.3.4.2, and 5.3.4.3.)

Product performance class	Minimum performance grade (PG)	Minimum design pressure (DP), Pa (psf)	Minimum structural test pressure (STP), Pa (psf)	Minimum water resistance test pressure, Pa (psf)
Windows and doors				
R	15	720 (15.0)	1080 (22.5)	140 (2.90)
LC	25	1200 (25.0)	1800 (37.5)	180 (3.75)
CW	30	1440 (30.0)	2160 (45.0)	220 (4.50)
AW	40	1920 (40.0)	2880 (60.0)	390 (8.00)
Unit skylights, tubular daylighting devices, and roof windows				
R	15	720 (15.0)	1440 (30.0)	140 (2.90)
CW	30	1440 (30.0)	2880 (60.0)	220 (4.5)

New concept in NAFS: Performance Class

Designation	Connotation	Suggested Application	BC Application?
R	"Light Duty"	One and Two family	Part 9 buildings
LC	"Moderate Duty"	Low-rise and multifamily dwellings	Part 9 buildings
CW	"Heavy Duty"	Low-rise and multifamily dwellings with higher loading and larger sizes	Part 5 buildings
AW	"Severe Duty"	Mid and high rise buildings, high exposure conditions, or severe usage requirements (institutional)	Part 5 buildings

No deflection limit

L/175 deflection limit

- Code minimum is Class R, but specifiers may choose any class

New concept in NAFS: Performance Class

- Products MUST be classified by Performance Class
- Performance Class defined by Gateway requirements:
  - Minimum test specimen size
  - Minimum Performance Grade
  - Successful completion of auxiliary tests
- Products are compared within a Performance Class, not across performance classes
- **Gives architects ability to specify a new property, independently of “air, water, structural” performance**

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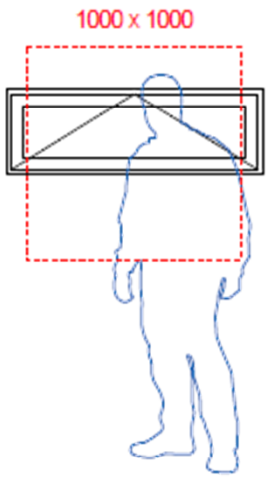
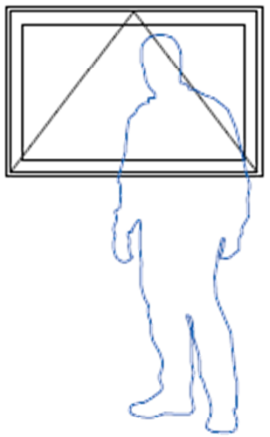
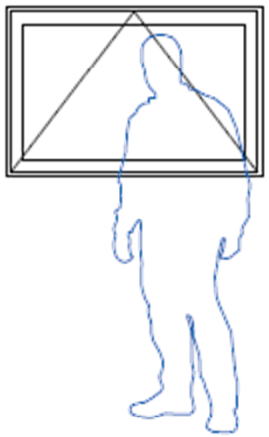
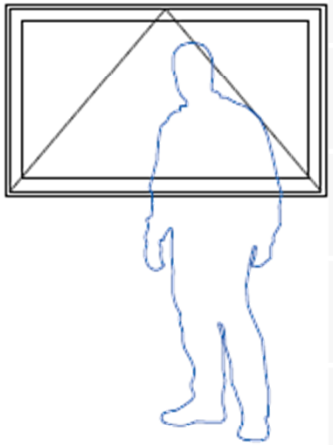
A closer look at Performance Class

AP Awning/Hopper/Projected classes

R	LC	CW	AW
PG 15	**PG 25**	**PG30**	**PG40**
1200 x 400	1200 x 800	1200 x 800	1500 x 900
			
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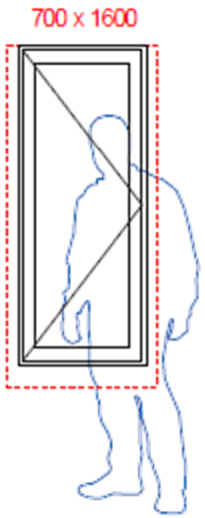
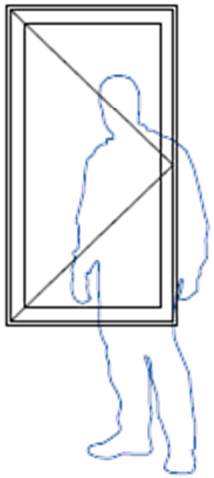
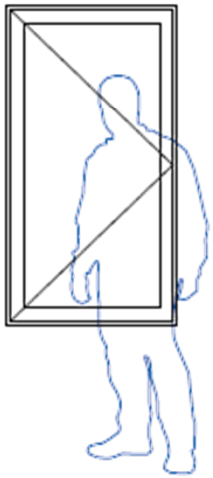
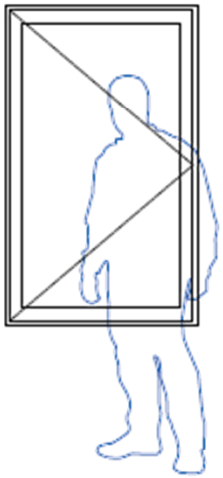
Defl: Report Only	Defl: Report Only	Defl: L/175	Defl: L/175
Min Struct: 1080 Pa	Min Struct: 1800 Pa	Min Struct: 2160 Pa	Min Struct: 2880 Pa
Min Water Test: 140 Pa (15% DP)	Min Water Test: 180 Pa (15% DP)	Min Water Test: 220 Pa (15% DP)	Min Water Test: 390 Pa (20% DP)
Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 0.5 L/s*m2 @ 300 Pa

C Casement Window classes

R	LC	CW	AW
PG 15	PG 25	PG30	PG40
600 x 1500	800 x 1500	800 x 1500	900 x 1500
			
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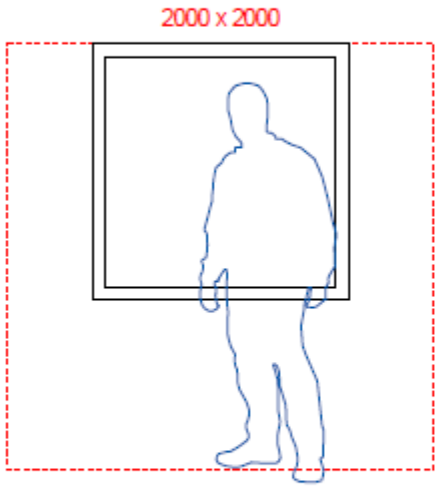
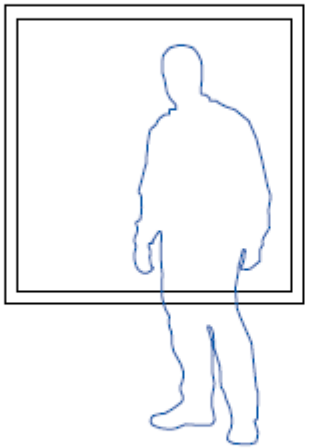
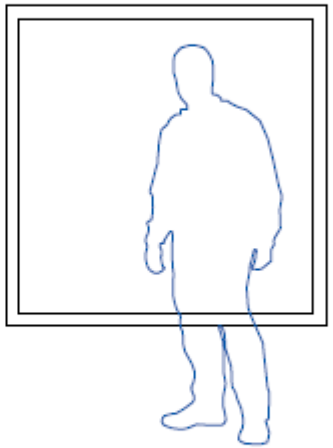
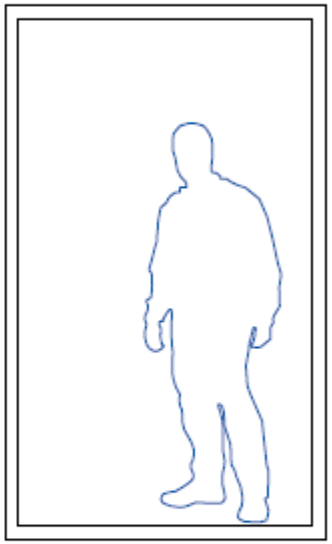
Defl: Report Only	Defl: Report Only	Defl: L/175	Defl: L/175
Min Struct: 1080 Pa	Min Struct: 1800 Pa	Min Struct: 2160 Pa	Min Struct: 2880 Pa
Min Water Test: 140 Pa (15% DP)	Min Water Test: 180 Pa (15% DP)	Min Water Test: 220 Pa (15% DP)	Min Water Test: 390 Pa (20% DP)
Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 0.5 L/s*m2 @ 300 Pa

FW Fixed Window classes

R	LC	CW	AW
PG 15	PG 25	PG30	PG40
1200 x 1200	1400 x 1400	1500 x 1500	1500 x 2500
			
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Defl: Report Only	Defl: Report Only	Defl: L/175	Defl: L/175
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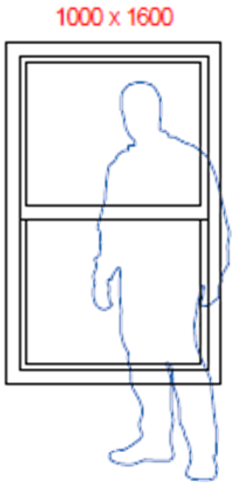
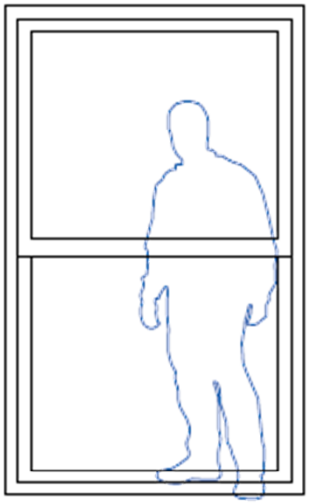
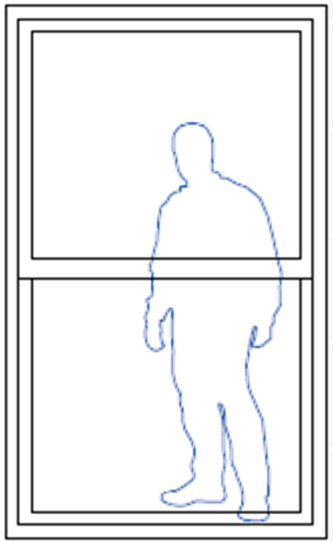
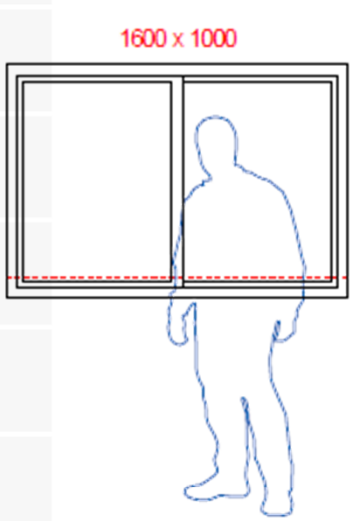
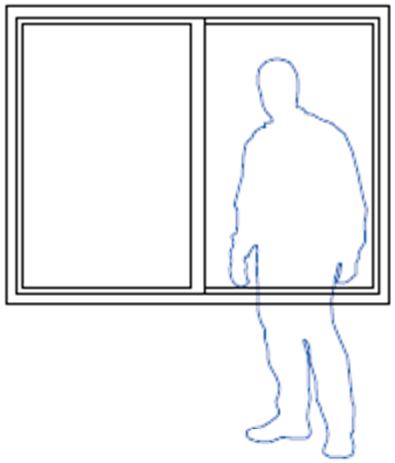
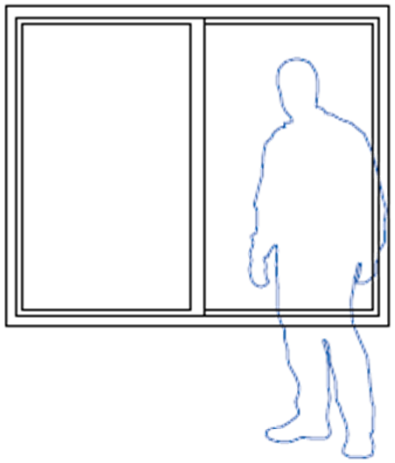
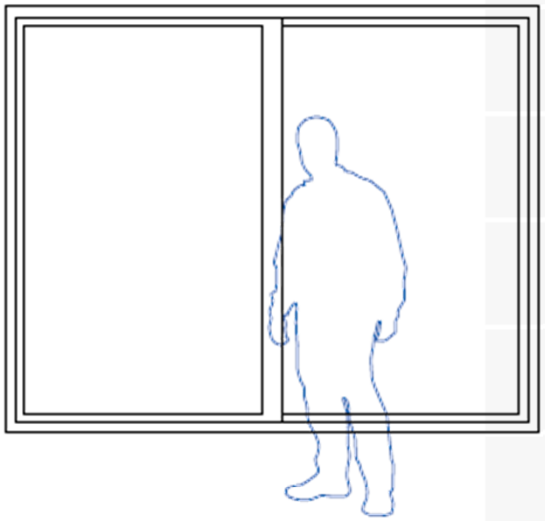
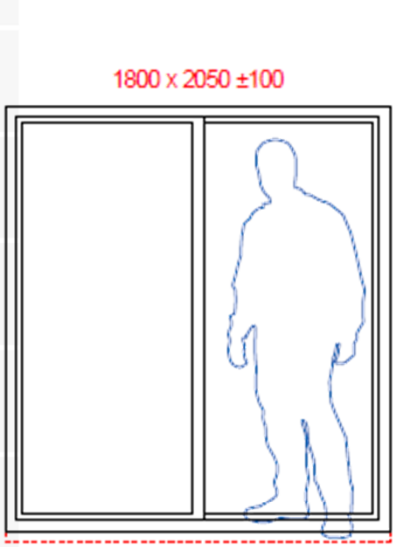
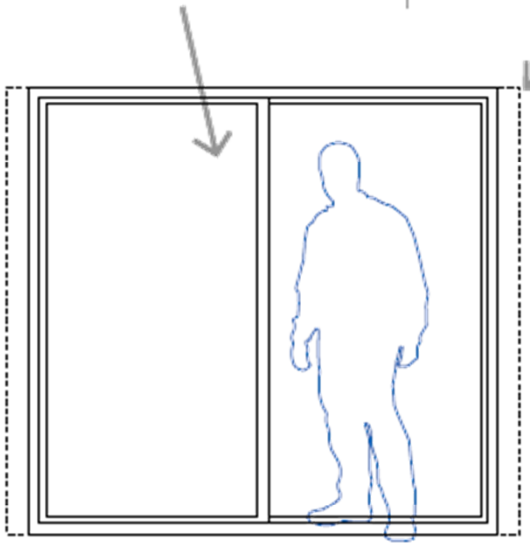
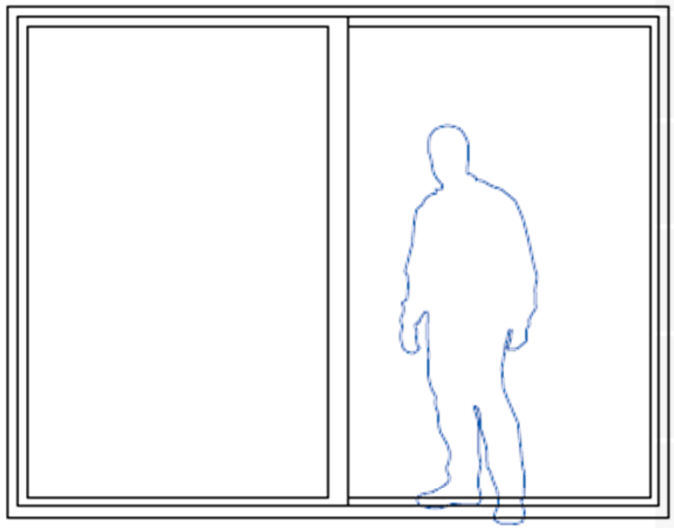
H Hung/Vertical Sliding Window classes

R	LC	CW	AW
PG 15	PG 25	PG30	PG40
1000 x 1600	1100 x 1900	1400 x 2300	1500 x 2500
			
Min DP: 720 Pa	Min DP: 1200 Pa	Min DP: 1440 Pa	Min DP: 1920 Pa
Defl: Report Only	Defl: Report Only	Defl: L/175	Defl: L/175
Min Struct: 1080 Pa	Min Struct: 1800 Pa	Min Struct: 2160 Pa	Min Struct: 2880 Pa
Min Water Test: 140 Pa (15% DP)	Min Water Test: 180 Pa (15% DP)	Min Water Test: 220 Pa (15% DP)	Min Water Test: 390 Pa (20% DP)
Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 300 Pa

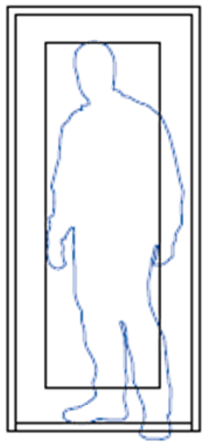
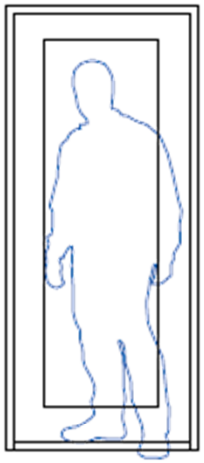
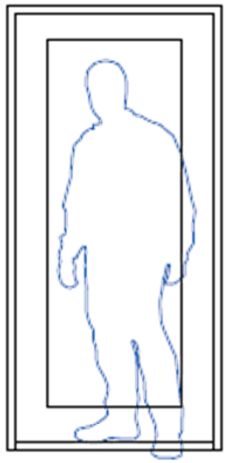
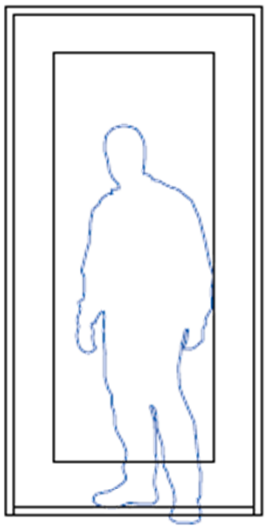
HS Horizontal Sliding Window classes

R	LC	CW	AW
PG 15	**PG 25**	**PG30**	**PG40**
1600 x 1100	1800 x 1400	1800 x 1500	2500 x 2000
			
Min DP: 720 Pa	Min DP: 1200 Pa	Min DP: 1440 Pa	Min DP: 1920 Pa
Defl: Report Only	Defl: Report Only	Defl: L/175	Defl: L/175
Min Struct: 1080 Pa	Min Struct: 1800 Pa	Min Struct: 2160 Pa	Min Struct: 2880 Pa
Min Water Test: 140 Pa (15% DP)	Min Water Test: 180 Pa (15% DP)	Min Water Test: 220 Pa (15% DP)	Min Water Test: 390 Pa (20% DP)
Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 300 Pa

SD Sliding Door classes

R	LC	CW	AW
PG 15	**PG 25**	**PG30**	**PG40**
1800 x 2000	2200 x 2100	2400 x 2100	3100 x 2400
			
Min DP: 720 Pa	Min DP: 1200 Pa	Min DP: 1440 Pa	Min DP: 1920 Pa
Defl: Report Only	Defl: Report Only	Defl: L/175	Defl: L/175
Min Struct: 1080 Pa	Min Struct: 1800 Pa	Min Struct: 2160 Pa	Min Struct: 2880 Pa
Min Water Test: 140 Pa (15% DP)	Min Water Test: 180 Pa (15% DP)	Min Water Test: 220 Pa (15% DP)	Min Water Test: 390 Pa (20% DP)
Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 300 Pa

SHD Side Hinged Door classes

R	LC	CW	AW
PG 15	PG 25	PG30	PG40
900 x 2000	900 x 2100	1000 x 2100	1200 x 2400
			
Min DP: 720 Pa	Min DP: 1200 Pa	Min DP: 1440 Pa	Min DP: 1920 Pa
Defl: Report Only	Defl: Report Only	Defl: L/175	Defl: L/175
Min Struct: 1080 Pa	Min Struct: 1800 Pa	Min Struct: 2160 Pa	Min Struct: 2880 Pa
Min Water Test: 140 Pa (15% DP)	Min Water Test: 180 Pa (15% DP)	Min Water Test: 220 Pa (15% DP)	Min Water Test: 390 Pa (20% DP)
Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 1.5 L/s*m2 @ 75Pa	Air Leakage: 0.5 L/s*m2 @ 300 Pa

Performance Class – more than size and pressure

- Product Class also defined by 21 auxiliary tests applied to specific products:
  - 3 Ease of operation tests
  - Forced entry resistance tests
  - Fabrication quality tests
  - 9 Frame and sash stiffness and stress tests
  - 4 Hardware load tests
  - Operation / cycling and durability tests

Performance Class – auxiliary/durability tests

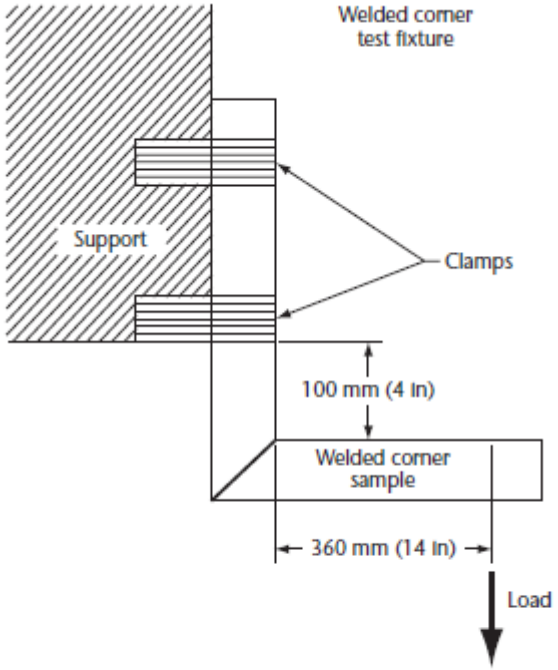


Figure 12
Set-up for thermoplastic corner weld test
(See Clause 5.3.6.2.)

5.3.6.4.2 Sash/leaf torsion test

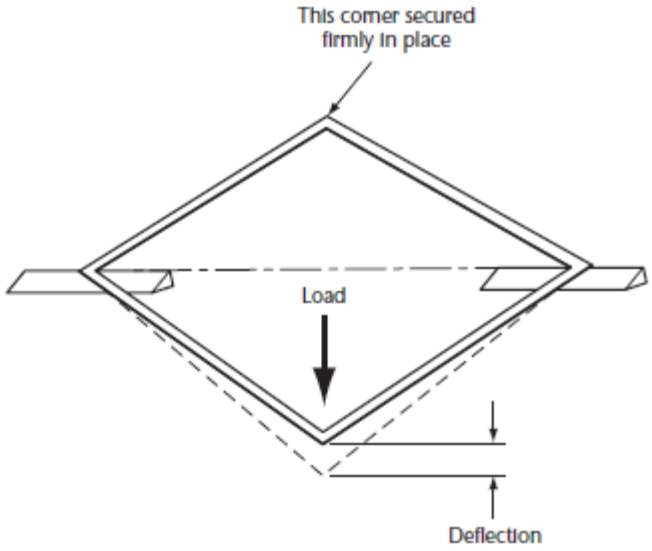


Figure 13
Set-up for sash/leaf torsion test
(See Clause 5.3.6.4.2.)

Performance Class – auxiliary/durability tests

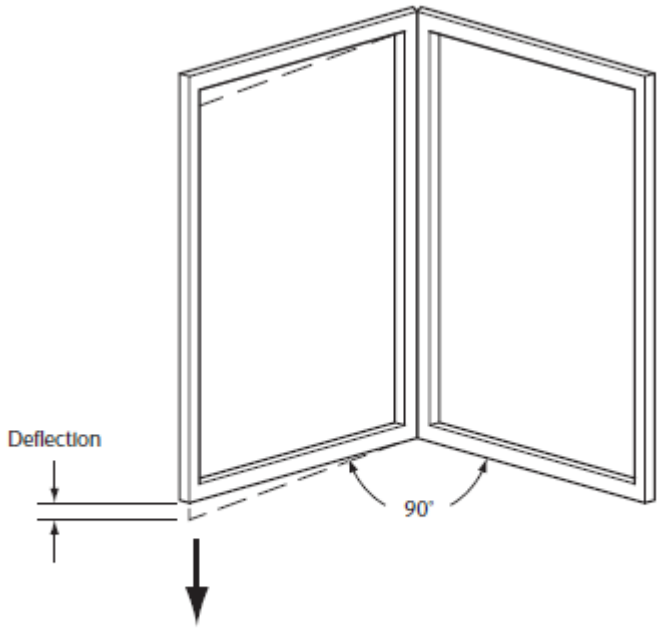


Figure 14
Set-up for sash vertical deflection test
(See Clause 5.3.6.4.3.)

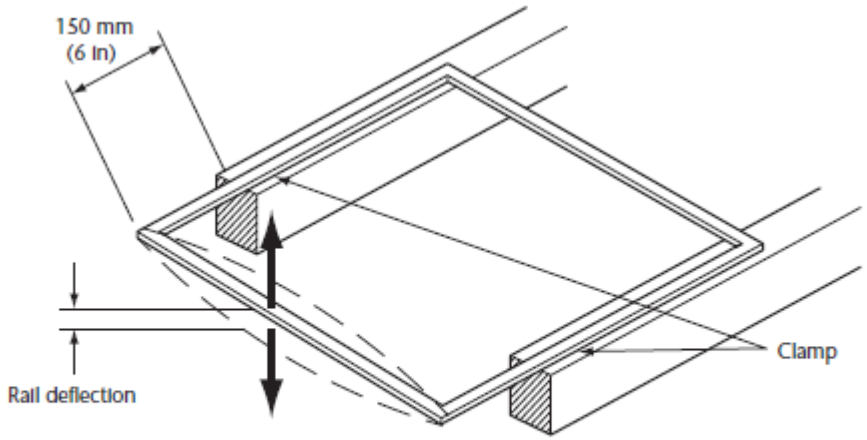


Figure 15
Perpendicular load for sash/leaf concentrated load test on latch rail
(See Clause 5.3.6.4.4.)

Performance Class – auxiliary/durability tests

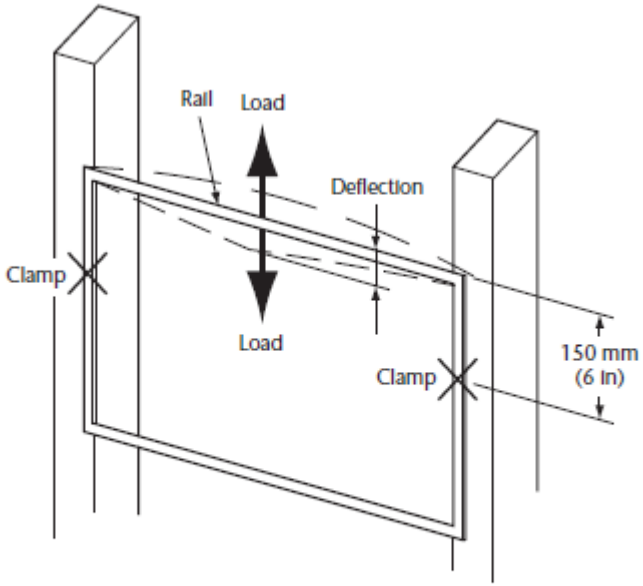


Figure 16
Parallel load for sash/leaf concentrated load test on latch rail
(See Clause 5.3.6.4.4.)

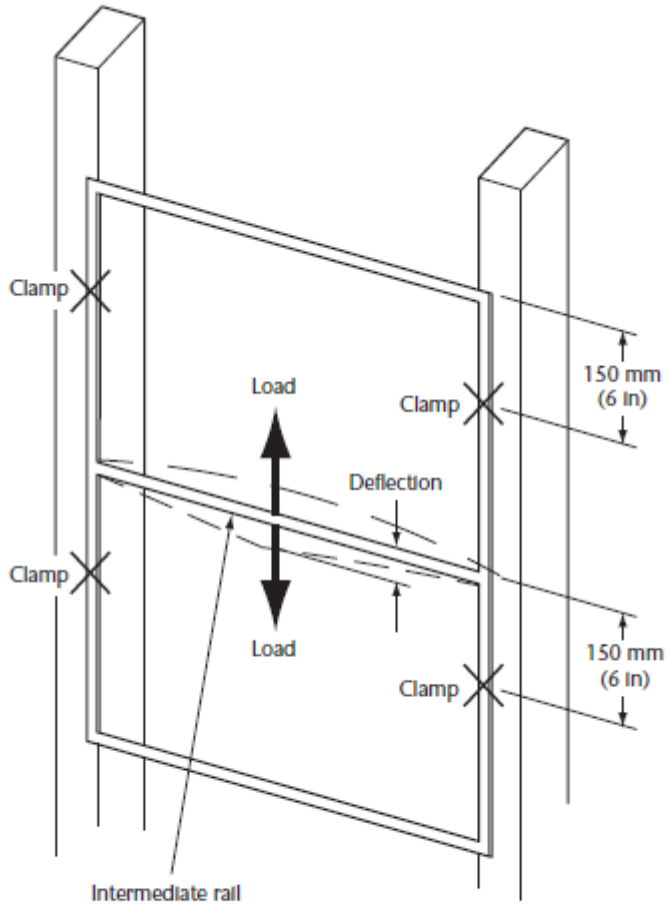


Figure 18
Set-up for vertical concentrated load test on intermediate frame rails
(See Clause 5.3.6.5.)

Performance Class – auxiliary/durability tests

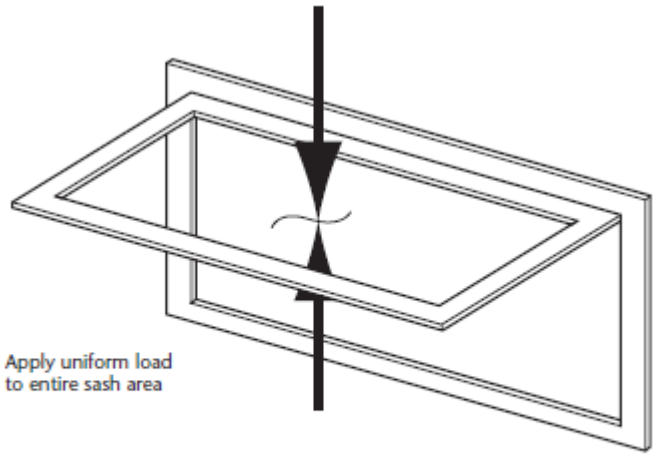


Figure 19
Set-up for distributed load test
(See Clause 5.3.6.6.2.)

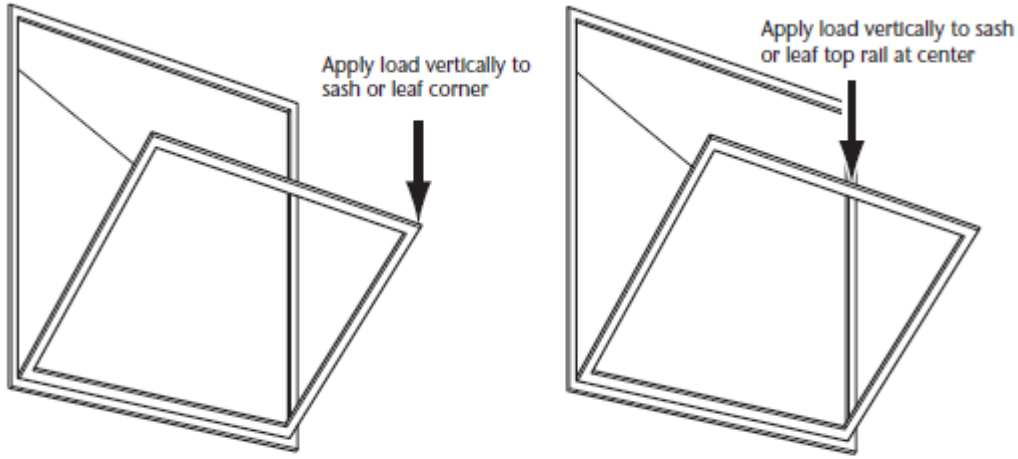


Figure 20
Set-up for stabilizing arm load test
(See Clause 5.3.6.6.3.)

Performance Class – auxiliary/durability tests

Table 19
Operation/cycling performance (side-hinged door systems)
(See Clause 5.3.6.10.)

Performance class	Number of cycles
R	25 000
LC	100 000
CW	250 000
AW (except architectural terrace doors)	500 000
AW (architectural terrace doors)	25 000

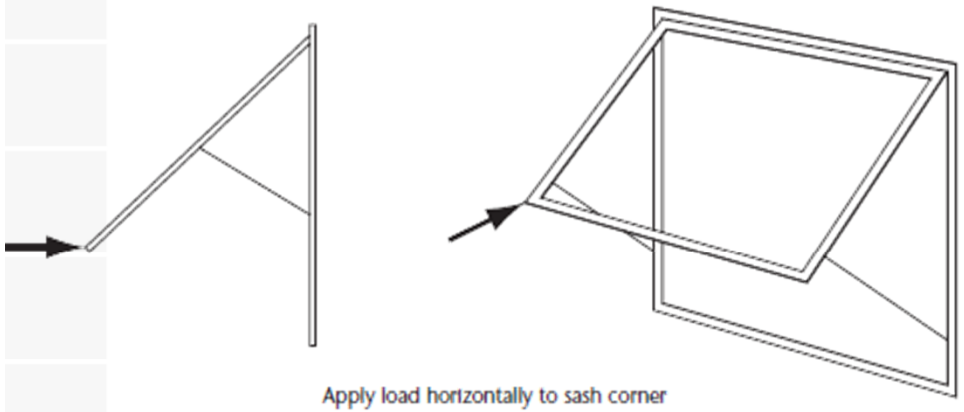


Figure 21
Set-up for hold-open arm/stay bar test
(See Clause 5.3.6.6.4.)

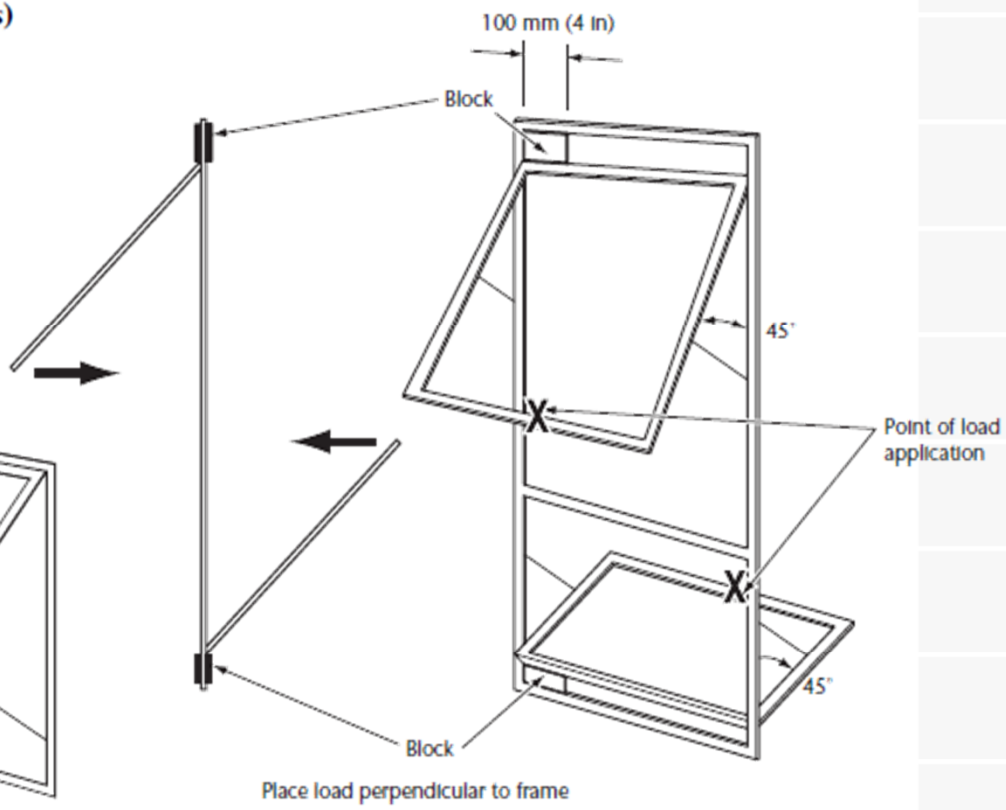


Figure 22
Set-up for awning, hopper, projected hardware load test
(See Clause 5.3.6.6.6.)

Performance Class implications

- **Products sold and labeled as belonging to a Performance Class MUST be identical in every respect (but glass) to the test specimen that achieved the Class designation,** regardless of whether those features are “needed” to meet code design loads!
- Products may therefore have more reinforcing, hardware than needed for project wind loads

Performance Class – conclusion and implications

- Performance Classes define categories of products that did not exist before in Canada
- They differentiate products according to suitability for particular applications
- Performance Class influences frame material
  - AW product lines are, for all practical purposes, aluminum only
- Performance Class influences cost
  - Expect significant cost increases from class to class, especially from LC to CW and AW
  - Over-specifying can be costly!

New concept in NAFS: Performance Grade

- A **single numeric designation** combining structural and water penetration resistance properties

- Performance Grades are based on design pressure as determined by
  - Architect
  - Municipal building department
  - Using Canadian Supplement

- Grades range from 720-4800 Pa (15-100 psf in US)
- Grades reported in increments of 240 Pa (5 psf US)

New concept in NAFS: Performance Grade

Table 1
Gateway requirements

(See Clauses 0.2.1, 0.2.6.1, 4.2.1, 4.4.2.3, 4.4.3.2–4.4.3.4, 5.3.3.1, 5.3.4.2, and 5.3.4.3.)

Product performance class	Minimum performance grade (PG)	Minimum design pressure (DP), Pa (psf)	Minimum structural test pressure (STP), Pa (psf)	Minimum water resistance test pressure, Pa (psf)
Windows and doors				
R	15	720 (15.0)	1080 (22.5)	140 (2.90)
LC	25	1200 (25.0)	1800 (37.5)	180 (3.75)
CW	30	1440 (30.0)	2160 (45.0)	220 (4.50)
AW	40	1920 (40.0)	2880 (60.0)	390 (8.00)
Unit skylights, tubular daylighting devices, and roof windows				
R	15	720 (15.0)	1440 (30.0)	140 (2.90)
CW	30	1440 (30.0)	2880 (60.0)	220 (4.5)

New concept in NAFS: optional Performance Grades

Table 3
Canada (only) optional performance grades (PG)
(See Clauses 0.2.6.1, 4.3.2.2, 4.4.3.2–4.4.3.4, 5.3.3.1, 5.3.4.2, and 5.3.4.3.)

Performance class and optional performance grade (PG)				Design pressure (DP)		Structural test pressure (STP)		Water penetration resistance test pressure			
								R, LC, CW		AW	
R	LC	CW	AW	Pa	(psf)	Pa	(psf)	Pa	(psf)	Pa	(psf)
20	—	—	—	960	(20.00)	1 440	(30.00)	150	(3.00)	—	—
25	—	—	—	1 200	(25.00)	1 800	(37.50)	180	(3.75)	—	—
30	30	—	—	1 440	(30.00)	2 160	(45.00)	220	(4.50)	—	—
35	35	35	—	1 680	(35.00)	2 520	(52.50)	260	(5.25)	—	—
40	40	40	—	1 920	(40.00)	2 880	(60.00)	290	(6.00)	—	—
45	45	45	45	2 160	(45.00)	3 240	(67.50)	330	(6.75)	440	(9.00)
50	50	50	50	2 400	(50.00)	3 600	(75.00)	360	(7.50)	480	(10.00)
55	55	55	55	2 640	(55.00)	3 960	(82.50)	400	(8.25)	530	(11.00)
60	60	60	60	2 880	(60.00)	4 320	(90.00)	440	(9.00)	580	(12.00)

Assigned in 240 Pa (5 psf) increments ONLY

New concept in NAFS: optional Performance Grades

- Gateway requirements qualify a product to enter a Product Class
- Can test bigger than the gateway size, not smaller*
- Can test to higher pressures than gateway—but can rate products using Optional Performance Grades only
- Once qualified for a Class, can test smaller size of same product to get a higher Performance Grade at the smaller size

* Exception: R Class Alternative Minimum Sizes

NAFS vs. A440 optional Performance Grades

NAFS-08 vs. A440-00 – Water Penetration Resistance

PERFORMANCE GRADE (PG)				Design Pressure (DP)		Water Test Pressure 15% x DP		Comparison A-440-00 (Canada)
R	LC	CW	AW	psf	Pa	psf	Pa	
15				**15**	720	**2.80**	140	
20				**20**	960	3.00	**150**	**B1**
25	25			**25**	1200	**3.75**	180	
							200	**B2**
30	30	30		**30**	1440	**4.50**	220	
35	35	35		**35**	**1680**	**5.25**	260	
40	40	40	40	**40**	1920	**6.00**	290	
							300	**B3**
45	45	45	45	**45**	2150	**6.75**	330	
50	50	50	50	**50**	2400	**7.50**	360	
55	55	55	55	**55**	2640	**8.25**	**400**	**B4**
60	60	60	60	**60**	2880	**9.00**	440	
65	65	65	65	**65**	3120	**9.75**	470	
							500	**B5**
70	70	70	70	**70**	3360	**10.50**	510	
75	75	75	75	**75**	3600	**11.25**	540	
80	80	80	80	**80**	3840	**12.00**	580	
							600	**B6**
85	85	85	85	**85**	4080	**12.75**	620	
90	90	90	90	**90**	4320	**13.50**	650	
95	95	95	95	**95**	4560	**14.25**	690	
							700	**B7**
100	100	100	100	**100**	4800	**15.00**	730	

NAFS vs. A440 optional Performance Grades

NAFS-08 vs. A440-00 – Wind Load Resistance

PERFORMANCE GRADE (PG)				Design Pressure (DP)		Structural Test (150% x DP)		Comparison A-440-00 (Canada)
R	LC	CW	AW	psf	Pa	psf	Pa	
15				**15**	720	**22.50**	1080	
20				**20**	960	**30.00**	1440	
							1500	**C1**
25	25			**25**	1200	**37.50**	1800	
							2000	**C2**
30	30	30		**30**	1440	**45.00**	2160	
35	35	35		**35**	1680	**52.50**	2520	
40	40	40	40	**40**	1920	**60.00**	2880	
							3000	**C3**
45	45	45	45	**45**	2150	**67.50**	3240	
50	50	50	50	**50**	2400	**75.00**	**3600**	
55	55	55	55	**55**	2640	**82.50**	3960	
							4000	**C4**
60	60	60	60	**60**	2880	**90.00**	4320	
65	65	65	65	**65**	3120	**97.50**	4680	
							5000	**C5**
70	70	70	70	**70**	3360	**105.00**	5040	
75	75	75	75	**75**	3600	**112.50**	5400	
80	80	80	80	**80**	3840	**120.00**	5760	
85	85	85	85	**85**	4080	**127.50**	6120	
90	90	90	90	**90**	4320	**135.00**	6480	
95	95	95	95	**95**	4560	**142.50**	6840	
100	100	100	100	**100**	4800	**150.00**	7200	
			No-limit	No-limit	No-limit	1.5 x DP	1.5 x DP	

New concept in NAFS: product-specific ratings

- NAFS-08 lists 30 different product types for which there are performance ratings (Table 5)
- Covers all major product types (except folding doors*)
- Abbreviated product type codes may be used on NAFS labels in place of longer descriptions
- Each Product Type is rated by Performance Class, and Performance Grade

New concept in NAFS: product-specific ratings

Table 5
Product types
(See Clauses 4.4.2.1, 4.4.2.2, 8.1, and 8.3.2.)

AP	=	Awning, hopper, projected window	LW SHD	=	Limited water side-hinged door
ATD	=	Architectural terrace door	RW	=	Roof window
BW	=	Basement window	SD	=	Sliding door
C	=	Casement window	SHD	=	Side-hinged door
DASHD	=	Dual-action side-hinged door	SHW	=	Side-hinged (inswinging) window
DAW	=	Dual-action window	SKG	=	Unit skylight — glass glazed
FD	=	Fixed door	SKP	=	Unit skylight — plastic glazed
FW	=	Fixed window	SLT	=	Side lite
GH	=	Greenhouse window	SP	=	Specialty product
H	=	Hung window	TA	=	Tropical awning window
HE	=	Hinged rescue window	TDD	=	Tubular daylighting device
HP	=	Horizontally pivoted window	TH	=	Top-hinged window
HS	=	Horizontal sliding window	TR	=	Transom
J	=	Jalousie window	VP	=	Vertically pivoted window
JA	=	Jal-awning window	VS	=	Vertical sliding window
LW DASHD	=	Limited water dual-action side-hinged door			

New concept in NAFS: product-specific ratings

- Each product type has one or more Performance Classes
- Each Performance Class has a set of Gateway Requirements
- Exception: Specialty Product type (SP) used for products not in Table 5, or products of non-standard geometric shape
  - SP products are rated by Performance Grade but do not have a Performance Class or minimum Gateway requirements
  - Folding doors can report their performance as Specialty Products

New concept in NAFS: Gateway requirements

- Table 1 introduces Gateway Requirements

Table 1
Gateway requirements

(See Clauses 0.2.1, 0.2.6.1, 4.2.1, 4.4.2.3, 4.4.3.2–4.4.3.4, 5.3.3.1, 5.3.4.2, and 5.3.4.3.)

Product performance class	Minimum performance grade (PG)	Minimum design pressure (DP), Pa (psf)	Minimum structural test pressure (STP), Pa (psf)	Minimum water resistance test pressure, Pa (psf)
Windows and doors				
R	15	720 (15.0)	1080 (22.5)	140 (2.90)
LC	25	1200 (25.0)	1800 (37.5)	180 (3.75)
CW	30	1440 (30.0)	2160 (45.0)	220 (4.50)
AW	40	1920 (40.0)	2880 (60.0)	390 (8.00)
Unit skylights, tubular daylighting devices, and roof windows				
R	15	720 (15.0)	1440 (30.0)	140 (2.90)
CW	30	1440 (30.0)	2880 (60.0)	220 (4.5)

New concept in NAFS: Gateway requirements

- **Gateway requirements**
  - Each Performance Class has:
    - A minimum Performance Grade
    - A minimum test specimen size
    - May be subject to additional auxiliary requirements
  - Products may be tested to sizes and performance grades greater than the minimum!
  - Table 27 has detailed gateway requirements for all products

Table 27—detailed Gateway requirements

- 6 pages of tables for 30 product types
- Lists all applicable classes and grades for each product type

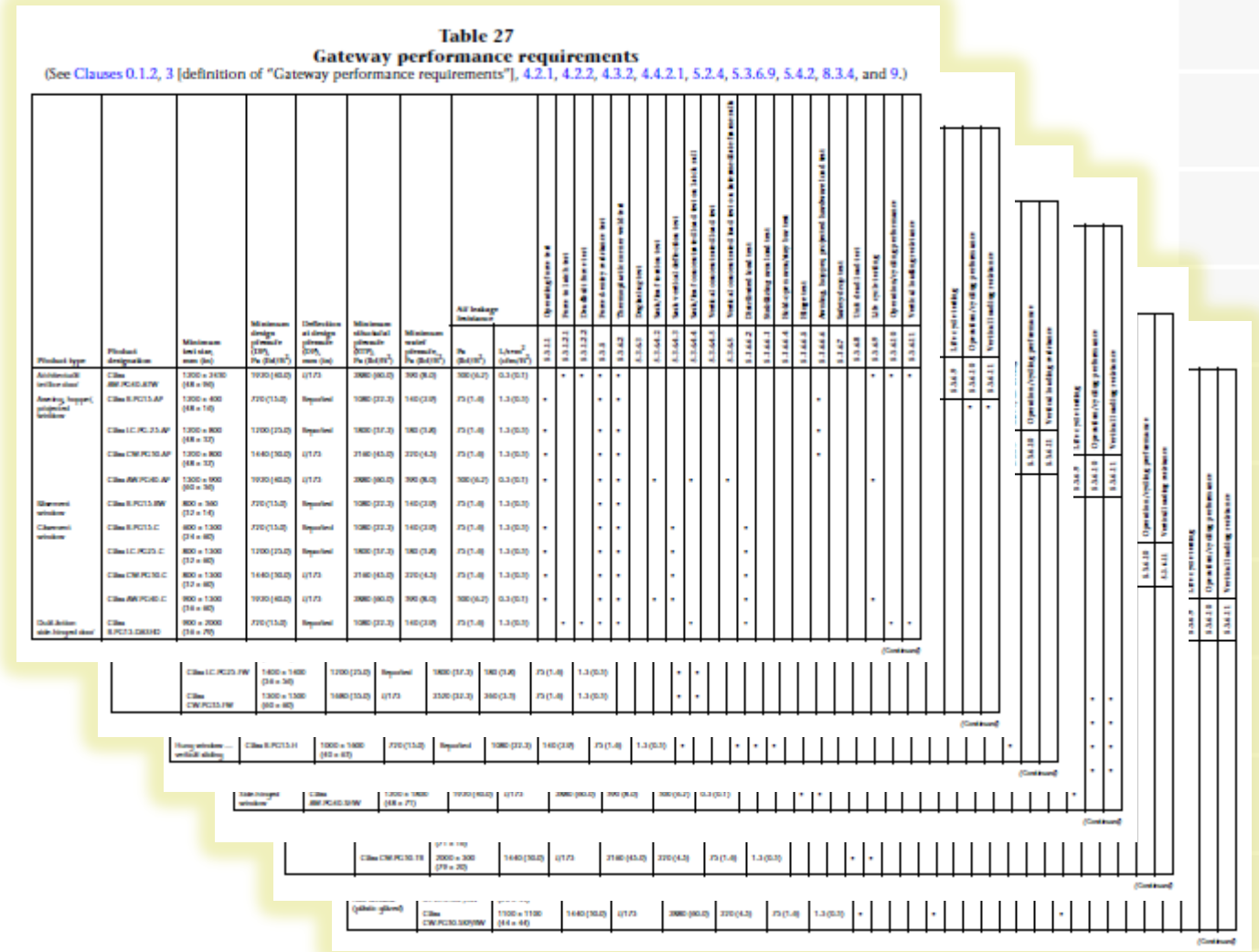


Table 27
Gateway performance requirements
(See Clauses 0.1.2, 3 [definition of "Gateway performance requirements"], 4.2.1, 4.2.2, 4.3.2, 4.4.2.1, 5.2.4, 5.3.6.9, 5.4.2, 8.3.4, and 9.)

NAFS Canadian air leakage ratings

- US measures air infiltration only at Gateway level, equal to Canada's A2. Canadian products must be tested for both infiltration and exfiltration
- Canadian ratings are: A2, A3 and Fixed

Table 9
Canadian (only) air infiltration/exfiltration levels
(See Clause 5.3.2.2.)

Performance class	Pressure difference, Pa (psf)	Infiltration/exfiltration					
		A2 level		A3 level		Fixed level	
		L/s•m^2	(cfm/ft^2)	L/s•m^2	(cfm/ft^2)	L/s•m^2	(cfm/ft^2)
R, LC, and CW	75 (1.6)	1.5	(0.3)	0.5	(0.1)	0.2	(0.04)
AW (sliding seal products)	300 (6.2)	1.5	(0.3)	0.5	(0.1)	0.2	(0.04)
AW (compression seal products)	300 (6.2)	0.5	(0.1)	0.5	(0.1)	0.2	(0.04)

New concept in NAFS: rating system (IP and metric)

- **Primary Designator:** Performance Class, Performance Grade and size tested
- Example—Fixed Window (**IP**):
  - Class R – PG 15: Size tested 48 x 48 in
  - Class LC – PG 25: Size tested 56 x 56 in – FW*
  - Class CW – PG 30: Size tested 60 x 60 in – Type FW*
  - Class AW – PG 40: Size tested 60 x 99 in – Fixed*

A primary designator is sufficient to describe product performance in the U.S.

** Addition of product type to primary designator is optional*

New concept in NAFS: rating system (IP and metric)

- **Primary Designator**: single line indicating Performance Class, Performance Grade and size tested
- Example—Fixed Window (**metric**):

  Class R – PG 720(metric): Size tested 1200 x 1200 mm

  Class LC – PG 1200(metric): Size tested 1400 x 1400 mm – FW*

  Class CW – PG 1680(metric): Size tested 1500 x 1500 mm – Type FW*

  Class AW – PG 1920(metric): Size tested 1500 x 2500 mm – Fixed*

** Addition of product type to primary designator is optional*

New concepts in NAFS: rating system

Secondary Designator: a multiline listing of additional performance attributes

Positive Design Pressure	1200 Pa
Negative Design Pressure	1440 Pa
Water Penetration Resistance Test Pressure	220 Pa
Canadian Air Infiltration/Exfiltration	A3

- A secondary designator is mandatory in Canada, but is optional in the US
- Secondary designator must be used in conjunction with a primary designator

Canadian labeling requirements

Canadian Supplement section 6.4

- A permanent label identifying manufacturer
- A temporary label declaring the product's:
  - conformance to NAFS-08 and the Canadian Supplement
  - the primary designator
  - the secondary designator

Canadian temporary label elements

Manufacturer name – series/model of product

Primary — Class CW – PG30: Size Tested 800 x 1500 mm – Type C

Secondary

Positive Design Pressure (DP)	2400 Pa
Negative Design Pressure (DP)	2400 Pa
Water Penetration Resistance Test Pressure	360 Pa
Canadian Air Infiltration/Exfiltration	A3 Level

Tested to AAMA/WDMA/CSA 101/I.S.2/A440-08 and CSA A440S1-09

Both primary and secondary designators must appear on Canadian NAFS performance labels

Example Canadian temporary label

Manufacturer name – series/model of product

Class CW – PG30: Size Tested 800 x 1500 mm – Type C

Positive Design Pressure (DP)	2400 Pa
Negative Design Pressure (DP)	2400 Pa
Water Penetration Resistance Test Pressure	360 Pa
Canadian Air Infiltration/Exfiltration	A3 Level

Tested to AAMA/WDMA/CSA 101/I.S.2/A440-08 and CSA A440S1-09

No CSA, AAMA or other certification marks permitted unless products are CERTIFIED by those bodies!

Example temporary labels

Product Manufacturer – Series/Model identifier

Class R – PG1200 (metric): Size Tested 800 x 1500 mm

Positive Design Pressure: 1200 Pa

Negative Design Pressure: 1200 Pa

Water Penetration Resistance Test Pressure: 220 Pa

Canadian Air Infiltration/Exfiltration: A3 Level

Tested to AAMA/WDMA/CSA 101/I.S.2/A440-08 and CSA A440S1-09

Product Manufacturer – Series/Model identifier

Class R – PG25: Size Tested 31.5 x 59 in. (800 x 1500 mm) – Casement

DP: +1200 / -1200 Pa

Water Penetration Resistance Test Pressure: 220 Pa

Canadian Air Infiltration/Exfiltration: A3 Level

Tested to AAMA/WDMA/CSA 101/I.S.2/A440-08 and CSA A440S1-09

Product Manufacturer – Series/Model identifier

Class LC – PG2400 (metric) – Size tested 900 x 2100 mm – Limited Water Side-Hinged Door

Design Pressure: +2400 Pa / -2640 Pa

Water Penetration Resistance Test Pressure: 0 Pa

Canadian Air Infiltration/Exfiltration: A3 Level

Tested to AAMA/WDMA/CSA 101/I.S.2/A440-08 and CSA A440S1-09

Example US manufacturer's Canadian label

Indicates performance certified by 3rd Party (AAMA)

Tested to NAFS-08 and Canadian Supplement

New concept in NAFS: optional tests

- NAFS has four optional tests, three of which are unlikely to be used in Canada:
  - Condensation resistance (x)
  - Thermal transmittance (x)
  - **Acoustical performance**
  - Impact performance (x)
- Acoustical performance addresses the lack of standard sized for STC/OITC testing
- Provides a test method based on using NAFS gateway sizes for the test specimens, to better allow comparison of test results

NAFS – more than lab testing

Material and component specifications in Clauses 6 and 7:

- Glass used in test specimens
- Material requirements for wood, vinyl, aluminum, fiberglass, steel, cellulosic composite materials, plastics used for door lite insert frames, etc.
- Performance and testing requirements for hardware, fasteners, reinforcing, weather stripping, insect screens, sealants, PAINT COATINGS, and MULLION RATINGS

- Material and component compliance with these specifications are not addressed in lab test reports!

New concepts in NAFS – review

- Performance Class: R, LC, CW, AW (~ Durability)
- Performance GRADE: 18 levels of Classification
  - In Canada water test pressure separate from Performance Grade
- GATEWAY Requirements for each product, each Class
  - Min. size, test pressures, auxiliary tests
  - Can test larger than minimum
  - Can test to higher pressures than minimum
- Optional Performance Grades
  - Performance must be specified using optional grades only
- Rating system—Primary and Secondary designators
  - Canadian NAFS label examples

New concepts in NAFS – review

- Performance Classes define categories of products that did not exist before in Canada
- Architects will likely welcome this capability
- Performance Class influences frame material
  - AW product lines are, for all practical purposes, aluminum only
- Performance Class influences cost
  - Expect significant cost increases from class to class, especially from LC to CW and AW

3. Using the Canadian Supplement to determine NAFS-08 performance requirements

Objectives

Using A440S1-09, the Canadian Supplement to NAFS-08, determine the fenestration performance requirements for Code compliance:

1. Determine the Performance Grade
2. Determine the water test pressure
3. Choose air leakage level

How NOT to specify performance under NAFS-08

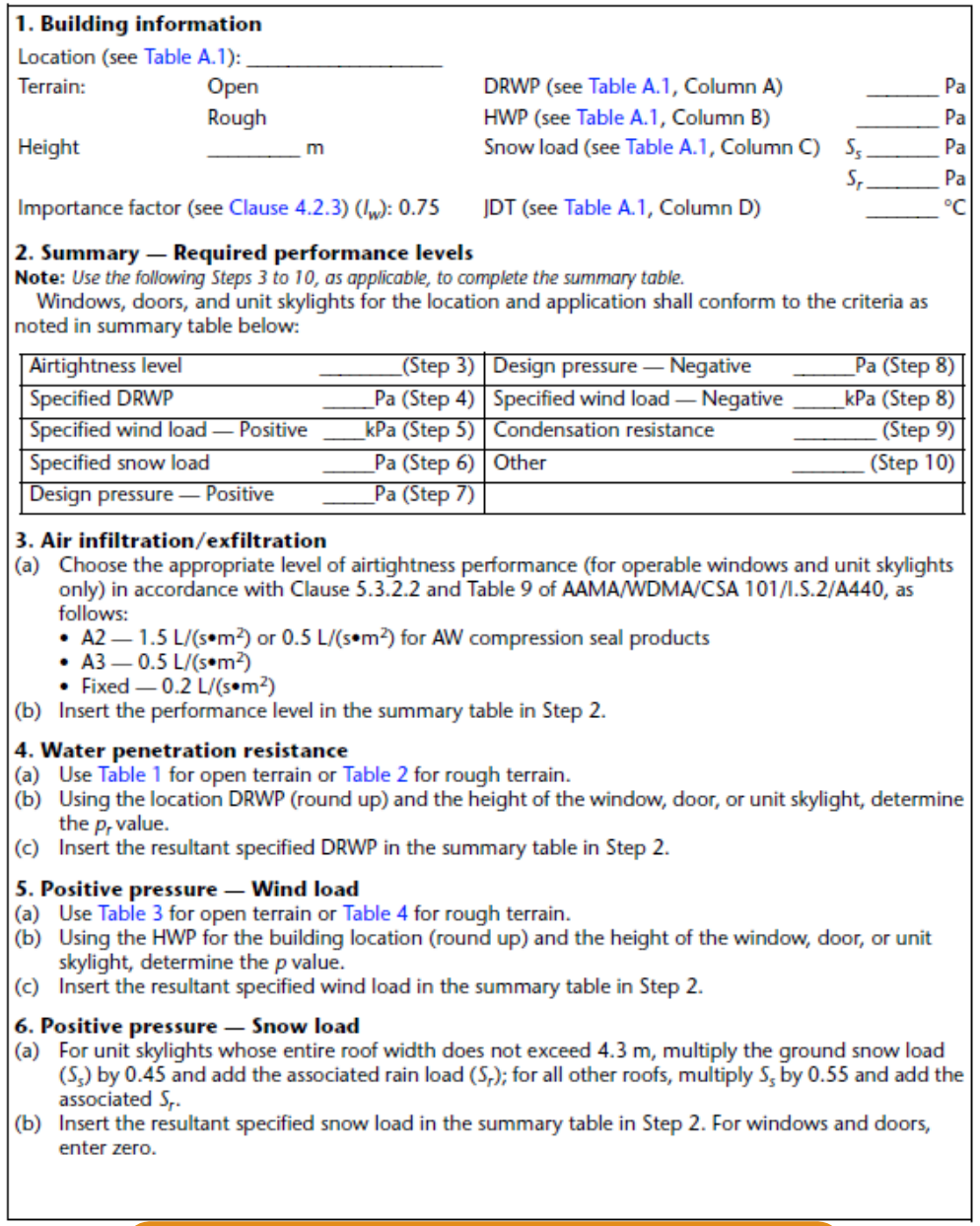
- Guess at the Performance Class
  - (or ask your favorite supplier for help)
- Try to convert ABC ratings to NAFS Performance Grades
  - Use your “usual” A-rating (even if A1 no longer exists)
  - B5 = 500 Pa (but there is no such rating, either 470 or 510)
  - C4 . . . ? (no corresponding design pressures)
- Typical mistake:
  - Specify a PG 60 “Design Pressure” (in place of C4 rating) and
  - a PG 70 “Water Pressure” (in place of B5 rating)
- **There is a better way . . .**

How to properly specify performance under NAFS-08

- Use the **Canadian Supplement (A440S1-09)** to determine Performance Grade (PG) and water penetration resistance test pressures for the building location/exposure/height
- Specifiers must also choose a preferred air infiltration/exfiltration level
  - Code minimum:
    - A2 for operable products
    - Fixed for non-operable windows
- All of these properties must appear on Canadian “non-permanent” (temporary) labels

CSA A440S1-09

- Canadian Supplement inputs:
  - Geographic location
  - Terrain
  - Building height
- Supplement has environmental data, simplified methods to determine:
  - Design pressure
  - Driving Rain Wind Pressure (DRWP)



1. Building information

Location (see Table A.1): _____

Terrain:	Open	DRWP (see Table A.1, Column A)	_____ Pa
	Rough	HWP (see Table A.1, Column B)	_____ Pa
Height	_____ m	Snow load (see Table A.1, Column C)	S_s _____ Pa
			S_r _____ Pa
Importance factor (see Clause 4.2.3) (I_w): 0.75		JDT (see Table A.1, Column D)	_____ °C

2. Summary — Required performance levels

Note: *Use the following Steps 3 to 10, as applicable, to complete the summary table.*

Windows, doors, and unit skylights for the location and application shall conform to the criteria as noted in summary table below:

Airtightness level	_____(Step 3)	Design pressure — Negative	_____Pa (Step 8)
Specified DRWP	_____Pa (Step 4)	Specified wind load — Negative	_____kPa (Step 8)
Specified wind load — Positive	_____kPa (Step 5)	Condensation resistance	_____ (Step 9)
Specified snow load	_____Pa (Step 6)	Other	_____ (Step 10)
Design pressure — Positive	_____Pa (Step 7)		

3. Air infiltration/exfiltration

(a) Choose the appropriate level of airtightness performance (for operable windows and unit skylights only) in accordance with Clause 5.3.2.2 and Table 9 of AAMA/WDMA/CSA 101/I.S.2/A440, as follows:
- A2 — 1.5 L/(s•m^2) or 0.5 L/(s•m^2) for AW compression seal products
- A3 — 0.5 L/(s•m^2)
- Fixed — 0.2 L/(s•m^2)

(b) Insert the performance level in the summary table in Step 2.

4. Water penetration resistance

(a) Use Table 1 for open terrain or Table 2 for rough terrain.
(b) Using the location DRWP (round up) and the height of the window, door, or unit skylight, determine the p_r value.
(c) Insert the resultant specified DRWP in the summary table in Step 2.

5. Positive pressure — Wind load

(a) Use Table 3 for open terrain or Table 4 for rough terrain.
(b) Using the HWP for the building location (round up) and the height of the window, door, or unit skylight, determine the p value.
(c) Insert the resultant specified wind load in the summary table in Step 2.

6. Positive pressure — Snow load

(a) For unit skylights whose entire roof width does not exceed 4.3 m, multiply the ground snow load (S_s) by 0.45 and add the associated rain load (S_r); for all other roofs, multiply S_s by 0.55 and add the associated S_r.
(b) Insert the resultant specified snow load in the summary table in Step 2. For windows and doors, enter zero.

Figure A.1
Checklist for selecting performance levels for windows, doors, and unit skylights
(See Clause A.4.4.)

See page 21 of Supplement →

Example step 1

Objective

- Determine the performance requirements for a **30m** high commercial building in **Abbotsford** located in **open terrain** with large casement windows
- Objective:
  - Performance Grade
  - Water resistance test pressure

Example step 1

- Step 1: fill in building information

1. Building information

Location (see Table A.1): Abbotsford

Terrain: Open / Rough

Height 30 m

Importance factor (see Clause 4.2.3) (I_w): 0.75

DRWP (see Table A.1, Column A) 200 Pa

HWP (see Table A.1, Column B) 620 Pa

Snow load (see Table A.1, Column C) S_s 2000 Pa

S_r 300 Pa

JDT (see Table A.1, Column D) ____ °C

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Table A.1
Climate design data for selected locations in Canada
(See Clauses 4.1, A.4.1, A.4.2.1, A.4.2.2, and A.4.2.4 and Figure A.1.)

Location	Column A: Driving rain wind pressure (DRWP), Pa, 1/10	Column B: Hourly wind pressure (HWP), kPa, 1/50	Column C: Snow load, kPa, 1/50 — Ground snow load, S_s	Column C: Snow load, kPa, 1/50 — Associated rain load, S_r	Column D: January design temp. (JDT), °C, 2.5%
British Columbia					
Abbotsford	200	0.62	2.0	0.3	–10

Example step 2

- Step 2 is actually the summary, completed after the other steps

2. Summary — Required performance levels

Note: *Use the following Steps 3 to 10, as applicable, to complete the summary table.*

Windows, doors, and unit skylights for the location and application shall conform to the criteria as noted in summary table below:

Airtightness level	_____(Step 3)	Design pressure — Negative	_____Pa (Step 8)
Specified DRWP	_____Pa (Step 4)	Specified wind load — Negative	_____kPa (Step 8)
Specified wind load — Positive	____kPa (Step 5)	Condensation resistance	_____ (Step 9)
Specified snow load	_____Pa (Step 6)	Other	_____ (Step 10)
Design pressure — Positive	_____Pa (Step 7)		

Example step 3

- Choose air infiltration/exfiltration level
  - At specifier's discretion
  - Keep available product performance in mind
  - Fixed level applies to non-operable windows only

3. Air infiltration/exfiltration

(a) Choose the appropriate level of airtightness performance (for operable windows and unit skylights only) in accordance with Clause 5.3.2.2 and Table 9 of AAMA/WDMA/CSA 101/I.S.2/A440, as follows:

- A2 — 1.5 L/(s•m^2) or 0.5 L/(s•m^2) for AW compression seal products
- A3 — 0.5 L/(s•m^2)
- Fixed — 0.2 L/(s•m^2)

(b) Insert the performance level in the summary table in Step 2.

Example step 3

- Add air tightness level to Summary

2. Summary — Required performance levels

Note: *Use the following Steps 3 to 10, as applicable, to complete the summary table.*

Windows, doors, and unit skylights for the location and application shall conform to the criteria as noted in summary table below:

Airtightness level	A2 (Step 3)	Design pressure — Negative	_____Pa (Step 8)
Specified DRWP	_____Pa (Step 4)	Specified wind load — Negative	_____kPa (Step 8)
Specified wind load — Positive	____kPa (Step 5)	Condensation resistance	_____ (Step 9)
Specified snow load	_____Pa (Step 6)	Other	_____ (Step 10)
Design pressure — Positive	_____Pa (Step 7)		

Example step 4

Determine Driving Rain Wind Pressure (DRWP)

4. Water penetration resistance

(a) Use Table 1 for open terrain or Table 2 for rough terrain.

(b) Using the location DRWP (round up) and the height of the window, door, or unit skylight, determine the p_r value.

(c) Insert the resultant specified DRWP in the summary table in Step 2.

Example step 4

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Table A.1
Climate design data for selected locations in Canada

(See Clauses 4.1, A.4.1, A.4.2.1, A.4.2.2, and A.4.2.4 and Figure A.1.)

Location	Column A	Column B	Column C		Column D
	Driving rain wind pressure (DRWP), Pa, 1/10	Hourly wind pressure (HWP), kPa, 1/50	Snow load, kPa, 1/50		January design temp. (JDT), °C, 2.5%
			Ground snow load, S_s	Associated rain load, S_r	
British Columbia					
Abbotsford	200	0.62	2.0	0.3	–10

Table 1
Specified DRWP (p_r) for open terrain

(See Clauses 4.2.1 and A.4.2.1 and Figure A.1.)

Height, m	p_r, Pa 1/10 DRWP, Pa																				
	40	60	80	100	120	140	160	180	200	220	240	260	280	300	350	400	450	500	550	600	650
10	49	73	98	122	146	171	195	220	244	268	293	317	342	366	427	488	549	610	671	732	793
15	53	79	106	132	159	185	212	238	265	291	318	344	370	397	463	529	595	662	728	794	860
20	56	84	112	140	168	196	224	252	280	308	336	364	392	420	490	561	631	701	771	841	911
25	59	88	117	147	176	205	234	264	293	322	352	381	410	440	513	586	659	733	806	879	952
30	61	91	122	152	182	213	243	274	304	334	365	395	426	456	532	608	684	760	836	912	988

Example step 4

- Add *Specified* Driving Rain Wind Pressure to Summary

2. Summary — Required performance levels

Note: *Use the following Steps 3 to 10, as applicable, to complete the summary table.*

Windows, doors, and unit skylights for the location and application shall conform to the criteria as noted in summary table below:

Airtightness level	A2 (Step 3)	Design pressure — Negative	_____Pa (Step 8)
Specified DRWP	304 Pa (Step 4)	Specified wind load — Negative	_____kPa (Step 8)
Specified wind load — Positive	____kPa (Step 5)	Condensation resistance	_____ (Step 9)
Specified snow load	_____Pa (Step 6)	Other	_____ (Step 10)
Design pressure — Positive	_____Pa (Step 7)		

Example step 5

Determine positive pressure

5. Positive pressure — Wind load

(a) Use Table 3 for open terrain or Table 4 for rough terrain.

(b) Using the HWP for the building location (round up) and the height of the window, door, or unit skylight, determine the *p* value.

(c) Insert the resultant specified wind load in the summary table in Step 2.

Example step 5

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Table A.1
Climate design data for selected locations in Canada
(See Clauses 4.1, A.4.1, A.4.2.1, A.4.2.2, and A.4.2.4 and Figure A.1.)

Location	Column A Driving rain wind pressure (DRWP), Pa, 1/10	Column B Hourly wind pressure (HWP), kPa, 1/50	Column C Snow load, kPa, 1/50 Ground snow load, S_s	 Associated rain load, S_r	Column D January design temp. (JDT), °C, 2.5%
British Columbia					
Abbotsford	~~200~~	0.62	2.0	0.3	–10

Table 3
Specified wind load (p) for windows, doors, and positive loads on unit skylights — Open terrain
(See Clauses 4.2.2 and A.4.2.2 and Figure A.1.)

Height, m	p, kPa 1/50 Hourly wind pressure, kPa 0.20	0.25	0.30	0.35	0.40	0.45	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.05	1.10	1.15	1.20	1.25
10	0.56	0.70	0.84	0.98	1.13	1.27	1.41	1.55	1.69	1.83	1.97	2.11	2.25	2.39	2.53	2.67	2.81	2.95	3.09	3.23	3.38	3.52
15	0.61	0.76	0.92	1.07	1.22	1.37	1.53	1.68	1.83	1.98	2.14	2.29	2.44	2.59	2.75	2.90	3.05	3.20	3.36	3.51	3.66	3.81
20	0.65	0.81	0.97	1.13	1.29	1.45	1.62	1.78	1.94	2.10	2.26	2.42	2.58	2.75	2.91	3.07	3.23	3.39	3.55	3.72	3.88	4.04
25	0.68	0.84	1.01	1.18	1.35	1.52	1.69	1.86	2.03	2.20	2.36	2.53	2.70	2.87	3.04	3.21	3.38	3.55	3.72	3.88	4.05	4.22
30	~~0.70~~	~~0.88~~	~~1.05~~	~~1.23~~	~~1.40~~	~~1.58~~	~~1.75~~	~~1.93~~	~~2.10~~	2.28	2.45	2.63	2.80	2.98	3.15	3.33	3.50	3.68	3.85	4.03	4.20	4.38

Example step 5

- Add *Specified* wind load to Summary

2. Summary — Required performance levels

Note: *Use the following Steps 3 to 10, as applicable, to complete the summary table.*

Windows, doors, and unit skylights for the location and application shall conform to the criteria as noted in summary table below:

Airtightness level	A2 (Step 3)	Design pressure — Negative	Pa (Step 8)
Specified DRWP	304 Pa (Step 4)	Specified wind load — Negative	kPa (Step 8)
Specified wind load — Positive	2.28 kPa (Step 5)	Condensation resistance	(Step 9)
Specified snow load	Pa (Step 6)	Other	PVC, natural beige (Step 10)
Design pressure — Positive	Pa (Step 7)		

- Snow load and negative pressure apply only to skylights
- Condensation resistance outside scope of example
- Other: frame material, finish, etc.

Determine PG and water test pressure

Specified Wind Load = 2·28 kPa

Specified DRWP = 304 Pa

Performance class and optional performance grade (PG)				Design pressure (DP)		Structural test pressure (STP)		Water penetration resistance test pressure			
								R, LC, CW		AW	
R	LC	CW	AW	Pa	(psf)	Pa	(psf)	Pa	(psf)	Pa	(psf)
20	—	—	—	960	(20.00)	1 440	(30.00)	150	(3.00)	—	—
25	—	—	—	1 200	(25.00)	1 800	(37.50)	180	(3.75)	—	—
30	30	—	—	1 440	(30.00)	2 160	(45.00)	220	(4.50)	—	—
35	35	35	—	1 680	(35.00)	2 520	(52.50)	260	(5.25)	—	—
40	40	40	—	1 920	(40.00)	2 880	(60.00)	290	(6.00)	—	—
45	45	45	45	2 160	(45.00)	3 240	(67.50)	330	(6.75)	440	(9.00)
50	50	50	50	2 400	(50.00)	3 600	(75.00)	360	(7.50)	480	(10.00)
55	55	55	55	2 640	(55.00)	3 960	(82.50)	400	(8.25)	530	(11.00)
60	60	60	60	2 880	(60.00)	4 320	(90.00)	440	(9.00)	580	(12.00)
65	65	65	65	3 120	(65.00)	4 680	(97.50)	470	(9.75)	630	(13.00)
70	70	70	70	3 360	(70.00)	5 040	(105.00)	510	(10.50)	680	(14.00)

But . . . water penetration test pressure cannot be lower than required for PG
(it CAN however be higher, which is why it is specified separately from PG!)

Determine PG and water test pressure

Specified Wind Load = 2·28 kPa

Specified DRWP = 304 Pa

Performance class and optional performance grade (PG)				Design pressure (DP)		Structural test pressure (STP)		Water penetration resistance test pressure			
								R, LC, CW		AW	
R	LC	CW	AW	Pa	(psf)	Pa	(psf)	Pa	(psf)	Pa	(psf)
20	—	—	—	960	(20.00)	1 440	(30.00)	150	(3.00)	—	—
25	—	—	—	1 200	(25.00)	1 800	(37.50)	180	(3.75)	—	—
30	30	—	—	1 440	(30.00)	2 160	(45.00)	220	(4.50)	—	—
35	35	35	—	1 680	(35.00)	2 520	(52.50)	260	(5.25)	—	—
40	40	40	—	1 920	(40.00)	2 880	(60.00)	290	(6.00)	—	—
45	45	45	45	2 160	(45.00)	3 240	(67.50)	330	(6.75)	440	(9.00)
50	50	50	50	2 400	(50.00)	3 600	(75.00)	360	(7.50)	480	(10.00)
55	55	55	55	2 640	(55.00)	3 960	(82.50)	400	(8.25)	530	(11.00)
60	60	60	60	2 880	(60.00)	4 320	(90.00)	440	(9.00)	580	(12.00)
65	65	65	65	3 120	(65.00)	4 680	(97.50)	470	(9.75)	630	(13.00)
70	70	70	70	3 360	(70.00)	5 040	(105.00)	510	(10.50)	680	(14.00)

Minimum Performance Grade PG50 (PG2400 metric), water test pressure 360 Pa

Example step 6

- Add *Performance Grade* and *water test pressure to* Summary

2. Summary — Required performance levels

Note: *Use the following Steps 3 to 10, as applicable, to complete the summary table.*

Windows, doors, and unit skylights for the location and application shall conform to the criteria as noted in summary table below:

Airtightness level	A2 (Step 3)	Design pressure — Negative	/ Pa (Step 8)
Specified DRWP	304 Pa (Step 4)	Specified wind load — Negative	/ kPa (Step 8)
Specified wind load — Positive	2·28 kPa (Step 5)	Condensation resistance	/ (Step 9)
Specified snow load	/ Pa (Step 6)	Other PVC, natural beige	(Step 10)
Design pressure — Positive	/ Pa (Step 7)	PG50 (PG2400 metric), water 360 Pa	

- Snow load and negative pressure apply only to skylights
- Condensation resistance outside scope of example
- Other: optional information specifier may use

Conclusion: using the Canadian Supplement

- **Recap objective**
- Determine the performance requirements for a **30m** high commercial building in **Abbotsford** located in **open terrain** with large casement windows
- **Result**
  - Class R — PG50 or Class R — PG 2400(metric)
  - Canadian water penetration resistance test pressure: 360 Pa
  - Canadian air infiltration/ exfiltration level = A2

Temporary label example →

Manufacturer name – series/model of product

Class R – PG50: Size Tested 800 x 1500 mm – Type C
Positive Design Pressure (DP) 2400
Negative Design Pressure (DP) 2400 Pa
Water Penetration Resistance Test Pressure 360 Pa
Canadian Air Infiltration/Exfiltration A2 Level

Tested to AAMA/WDMA/CSA 101/I.S.2/A440-08 and CSA A440S1-09

RDH

4. NAFS challenges to resolve

- Challenges for architects/specifiers
- Challenges for manufacturers
- Challenges for glazing contractors
- Conclusions

Challenges for architects/specifiers

- NAFS requires all performance attributes to be determined by testing only
  - All configurations
  - Air, water and structural
  - Doesn’t test anchorage
- Part 9 compliance will require strict reliance on testing
- Part 5 allows professionals to determine best way to comply with code intent
- BC’s letters of assurance practices already address:
  - Structural adequacy (wind, seismic, guard and human impact loads)
  - Anchorage

Challenges for architects/specifiers

- How much NAFS testing will you require of suppliers?
  - Literal NAFS testing for everything on window schedule?
  - Limited testing for general conformance to AWS requirements, supplemented by engineering review?
- Will Part 5 designers see value in NAFS test reports?
  - Engineers will not support use of products with no deflection limit, may not accept use of R or LC products in these buildings
  - Engineers may not be willing to rely on lab test reports and may evaluate a manufacturer's structural performance differently
  - Engineering review could also affect engineering validation of R and LC windows in Part 9 buildings

Performance Class – implications for BC

CW, AW classes will likely be favored for Part 5 buildings because they will be tested to L/175 deflection limit

Designation	Connotation	NAFS Application	BC Application
R	“Light Duty”	One and Two family dwellings	Part 9 buildings
LC	“Moderate Duty”	Low-rise and multifamily dwellings	Part 9 buildings
CW	“Heavy Duty”	Low-rise and multifamily dwellings with higher loading and larger sizes	Part 5 buildings
AW	“Severe Duty”	Mid and high rise buildings, high exposure conditions, or severe usage requirements (institutional)	Part 5 buildings

Challenges for architects/specifiers

- Desired Class may exceed budget and gateway performance grades may exceed code design loads
  - Product Class designation only permitted if labeled products comply fully with Class requirements
  - Do you insist on properly rated specified Class to obtain desired product attributes?
  - Do you accept a properly rated lower Class product to reduce cost?
  - Do you accept products from an R or LC product line, with additional reinforcing to meet L/175 deflection requirements for code design loads, without configuration specific testing or labeling?

Challenges for manufacturers

- Testing and rating products to NAFS requirements is costly and time consuming
- Individual products within a product line may need to be modified to qualify for a desired Class or Grade
- What will the market be for fully qualified CW and AW products?
- How much testing do you do to qualify a product line?
- How do you reconcile the code requirement to fully test what you sell when no two window schedules are alike, each with a dozen or more untested configurations?

Challenges for glazing contractors

How do you bid a job when . . .

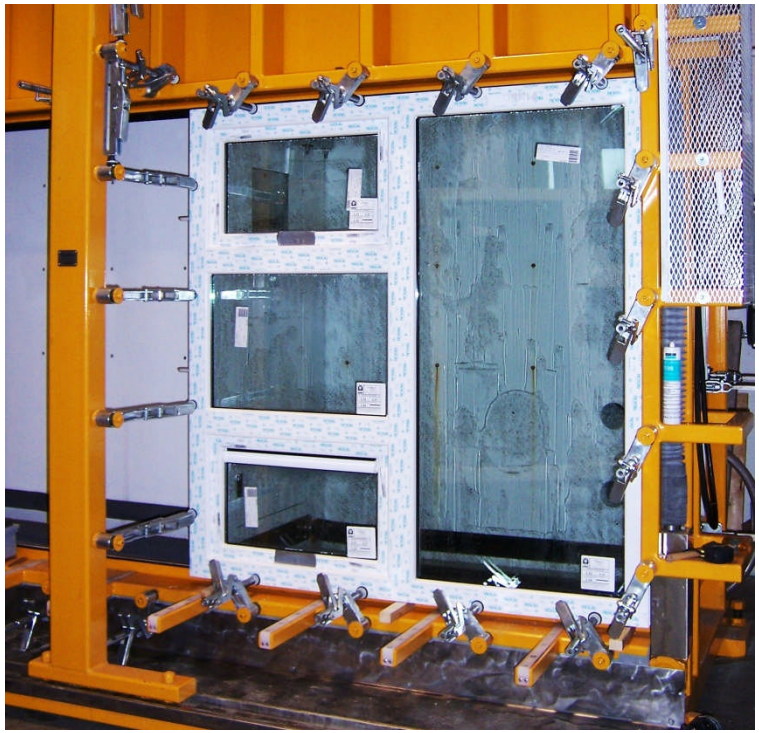
- The specified Performance Class exceeds code design load?
  - Do you bid plans and specs when you know others will be pricing less expensive alternates?
  - Do you qualify your price?
  - Do you seek clarification of the designer's intent?
- The specified manufacturer does not have products with the specified Performance Class?
- The manufacturer's tested product line doesn't cover many of the configurations on the drawings?

RDH

5. Industry readiness for NAFS

Is the window industry ready for NAFS?

- Larger window manufacturers are testing and will be ready
- Medium and smaller manufacturers in various states of readiness
- Delays to building code didn't help
- Labs report moderate testing activity

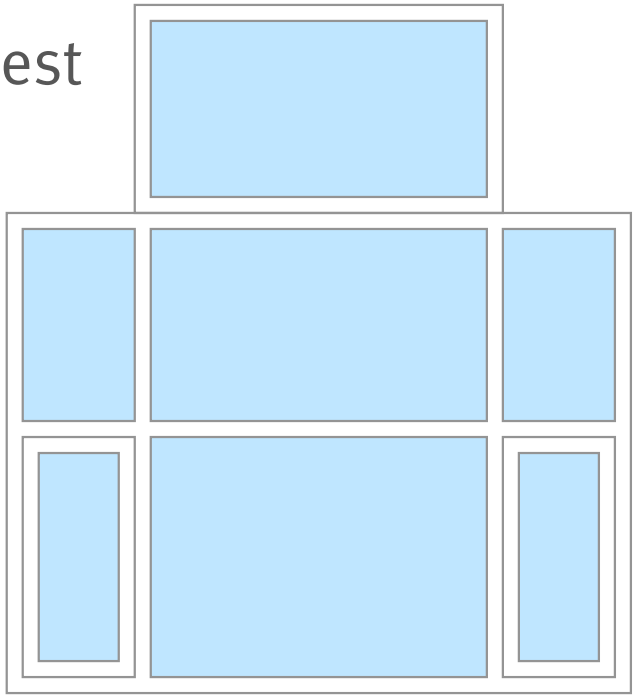


Is the window industry ready for NAFS?

- The challenge for manufacturers is to retest their product lines to new test sizes and pressures
- NAFS explicitly requires significantly more testing to qualify the various configurations offered
- Compliance a matter of time and cost

What about BIG, “one-off” windows?

- Unusual configurations may not be testable
- Manufacturers still need to comply with code . . . So if it can’t be tested, should at least be engineered
- Building officials may request test reports or proof of engineering



Is the door industry ready for NAFS?

- Prehangers — no previous experience with performance testing
- US door industry lobbied to exempt exterior side hinged doors from NAFS water testing requirements
- Only Canada requires NAFS rated doors with water penetration resistance
- US-based component suppliers have little to offer to meet the challenge

Is the door industry ready for NAFS?

- It is possible to build NAFS-compliant doors, but requires R&D, learning from testing
- Several BC manufacturers/prehangers have NAFS tested products
- Component suppliers now working with industry to increase supply of tested products
- Most prehangers are very small operators for whom testing will be a costly challenge

RDH

5. Conclusion

Conclusion

- NAFS and the 2012 BCBC are already in effect

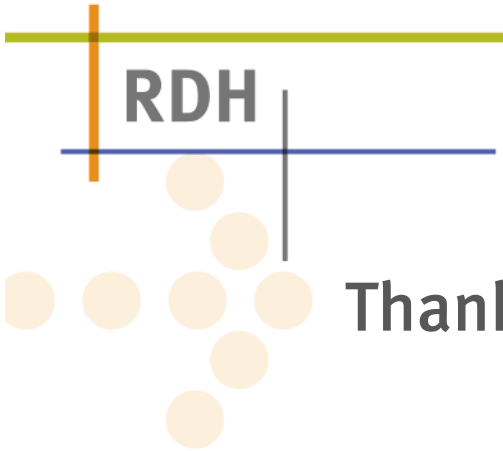
~~NAFS enforcement on Part 9 buildings delayed to July 2, 2013, according to BSSB announcement Mar. 11!~~

NAFS enforcement on Part 9 buildings delayed to Dec. 20, 2013, confirmed by BSSB on April 22!

- NAFS is coming to the VBBL soon
- All parties need to learn about the new standard

Conclusion

- If you are a designer/specifier:
  MUST buy the Canadian Supplement
- If you want to intelligently specify Performance Classes:
  MUST buy a copy of NAFS-08
- Need industry-design community dialogue to sort out the issues
- Let's write better specs than "windows and doors shall conform to NAFS-08" or "conform to Building Code"



Thank you!