

How to Get the Window Performance You Want On Site

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Outline of Presentation

- What performance do you want ?
- Pre-construction
- Installation issues
- In-situ testing
- Post-construction
- Project specifications

What do you want? (defining “performance”)

- U-factor
- SHGC
- ★ air leakage
- ★ water tightness
- wind loading
- condensation
- ★ ease of operation
- colour/aesthetics
- visible light
- sound transmission
- durability
- impact resistance
- ★ security/forced entry
- fire resistance

What do you want? (determining performance levels)

Climatic

- U-factor
- SHGC
- ★ air leakage
- ★ water tightness
- wind loading
- condensation

Regulatory

- durability
- impact resistance
- ★ security/forced entry
- fire resistance
- structural

- colour/aesthetics
- visible light
- sound transmission
- ease of operation

User concerns

What do you want? (determining performance levels)

- U-factor
- SHGC
- ★ air leakage
- ★ water tightness

What do you want? (determining performance levels)

- U-factor (NFRC 100 or CSA A440.2)*
- SHGC (NFRC 300 or CSA A440.2)*
- ★ air leakage (AAMA, NFRC 400 or CSA A440)*
- ★ water tightness (AAMA or CSA A440)*

("AAMA" = AAMA/NWWDA-101/I.S.2-97)

*** your mileage may vary**

What do you want? (determining performance levels)

- U-factor (CSA A440.2 or A453)*
 - SHGC (CSA A440.2 or A453)*
 - ★ air leakage (CSA A440 or A453)*
- } Energy Rating (ER)

ER = solar gains (SHGC) – transmission losses (U-factor)
– air-leakage losses (L75)

*** your mileage may vary**

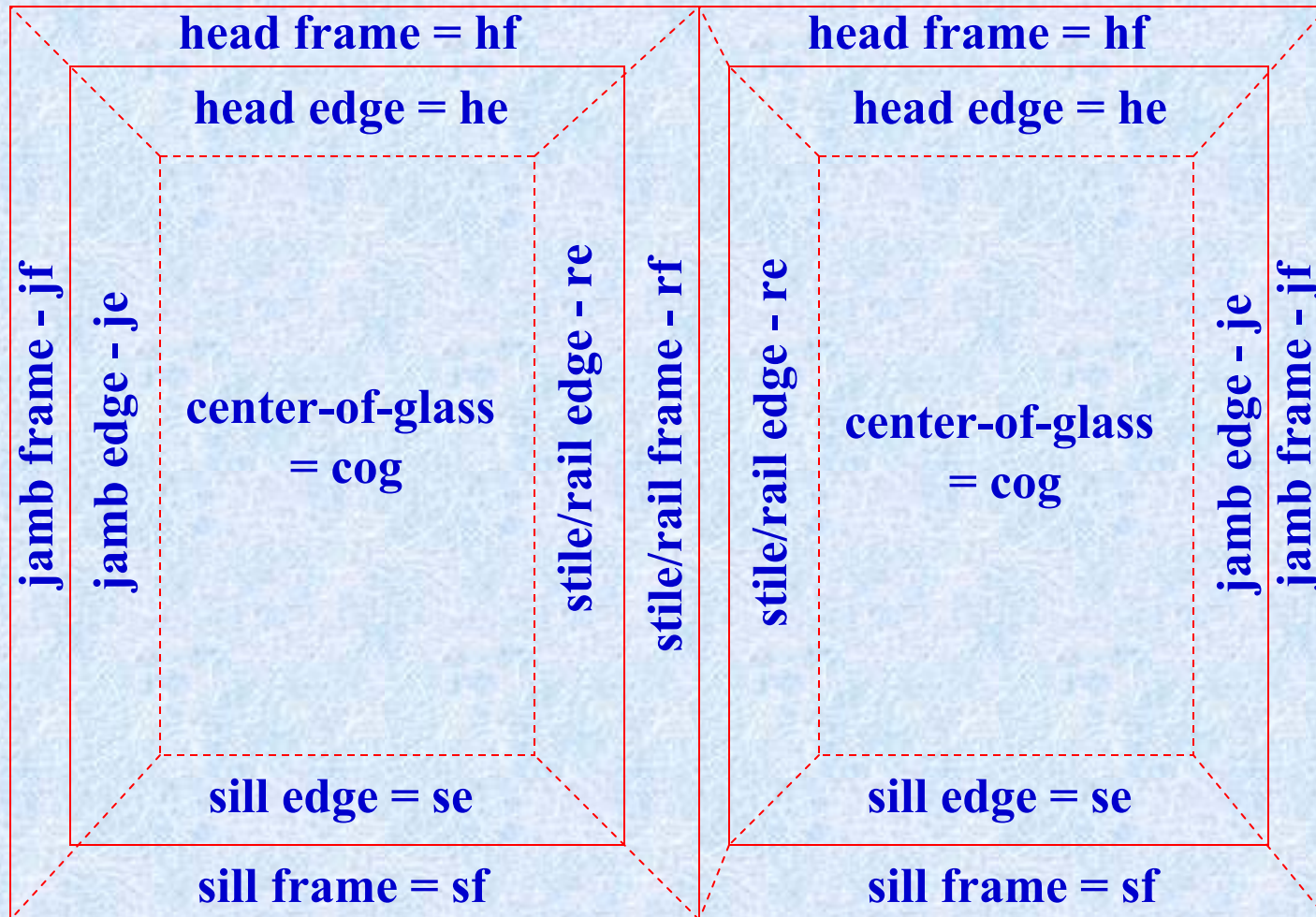
The CSA “family” of window standards

- A440 and A440.1
 - Defines test sizes, A B C ratings and suggested levels
 - Defines minimum material and dimensional criteria
 - Defines a condensation rating protocol (test only!)
- A440.2 and A440.3
 - Defines U-factor, SHGC and ER at standard sizes
 - ER = solar gains (SHGC) – transmission losses (U-factor)
 - air-leakage losses (L75)
 - Also defined ERS and ERC (not used)
 - New ER pending
- A440.4 (new version pending)
 - Describes window installation methods for various designs
- A440.5 (also AAMA 101 / WDMA I.S.2)
 - Standardized spec for windows, doors and unit skylights
 - R LC C HC AW designations (LW for entrance doors)

The A B C's of window rating, per CSA A440

- A = air leakage
 - Storm A1 A2 A3 Fixed
 - Tested per ASTM E283 at 75 Pa at a given test size
 - Rated value is the average of infiltration and exfiltration
 - A1 = 2.79 m³/hr/m (0.5 cfm/ft) is NBCC minimum
- B = water tightness
 - Storm B1 B2 B3 B4 B5 B6 B7
 - Tested per ASTM E547 for four cycles (5 on / 1 off)
 - A440.1 selection guide for location and building height
 - B1 = no “leakage” at 150 Pa is NBCC minimum
- C = wind load resistance
 - Storm C1 C2 C3 C4 C5
 - Tested per ASTM E330 for standard sizes
 - Maximum deflection of sash and mullions (+/-) and blowout
 - A440.1 selection guide for location and building height
 - C1 (< L/125 @ 500 Pa (sash), < L/175 at 1000 Pa (frame), and no blowout at 1500 Pa) is NBCC minimum

Area-weighted performance index (U-factor)



$$U_{tw} = \frac{U_{sf} \cdot A_{sf} + U_{hf} \cdot A_{hf} + U_{jf} \cdot A_{jf} + U_{rf} \cdot A_{rf} + A_{se} \cdot A_{se} + U_{he} \cdot A_{he} + \dots}{A_{sf} + A_{hf} + A_{jf} + A_{rf} + A_{se} + A_{he} + \dots}$$

Pre-construction

- What performance do you want ?
- What can you get ?
- Pre-qualify products (performance criteria)
- Ask for test lab reports
(the whole report, and nothing but the report)
- Design details vs. Shop drawings
- Project specifications



TEKTTI
IR COATING DETECTOR
ESSENTIAL 70 PANNE
MANUFACTURED BY
TEKTTI

CONTROL KNOB

NO LOW-E DETECTED
LOW-E ON OTHER SIDE OF NEAR GLASS
LOW-E ON ONE SIDE OF FAR GLASS
ALL LIT = LOW-E ON CONTACT SURFACE

no low-e detected
low-e on other side of near glass
low-e on one side of far glass
all lit = low-e on contact surface



Installation Issues

■ Did you get what you wanted ?

■ Is the product intact ?

■ Too big ?  Too small ?  Just right ?



■ Is the installer qualified ?

■ The Mock-Up

- attendance by all involved
- photographic record
- in-situ test

In-situ testing per ASTM E1105 (field version of E547 or E331) provides confirmation of actual performance of the window assembly as installed in the building



In-situ testing

- What performance do you want ? (pass / fail)
- Who does the testing ?
- Follow the protocol
 - calibration
 - pre-condition the sample
 - check pressures
 - monitor cycle times
- What happens if it “fails” ?
- Testing frequency and sampling

Post-construction

- What performance do you want ? (service life)
- Durability of Materials
- Warranties and Guarantees
- Cleaning and Contract Deficiencies
- When is the job done ?
- Maintenance: is it important ? Who does it ?

Project Specifications (1 of 5)

1 GENERAL

1.1 SECTION INCLUDES

- .1 Operable and fixed aluminum window units
- .2 Glass and Glazing

1.2 RELATED WORK

Section 06100	Rough Carpentry
Section 07600	Metal Flashing and Waterproof Membrane
Section 07920	Sealants

...

1.3 REFERENCE STANDARDS

- .1 ...
- .2 ...

1.4 SITE MEASUREMENTS

- .1 The contractor shall measure all existing rough opening sizes and confirm type of window at each location prior to ordering the new windows.

1.5 DESIGN AND PERFORMANCE REQUIREMENTS

- .1 Air Tightness: ...
- .2 Water Tightness: ...
- .3 Wind Load Resistance: ...
- .4 Operable windows to meet or exceed the requirements for sash strength and stiffness, ease of operation and sash pull-off, when tested in accordance with
- .5 **Window units shall be thermally broken**

Project Specifications (2 of 5)

1.6 SHOP DRAWINGS

- .1 Submit shop drawings for review by the Consultant.
- .2 Windows to have been tested in Provide such test reports and indicate the location of each applicable window.
- .3 Clearly indicate, by large scale details, perimeter conditions of construction, mullion details, components of the assembly, elevations, materials, sealants, hardware and finishes, vapour retarder / air barrier connection, and anchors and fasteners.
- .4 Indicate design assumptions and parameters such as temperature ranges, wind and deadloads etc. used for calculations.

1.7 MAINTENANCE DATA

- .1 Provide operation and maintenance data for windows for incorporation into building maintenance manual

1.8 LABORATORY TEST REPORTS

- .1 Submit manufacturer's Testing Laboratory Certificate, certifying window type being supplied is in compliance with specification requirements for:
 - .1 all windows as scheduled.
 - .2 finish
 - .3 infiltration / exfiltration rates
 - .4 thermal transfer resistance of frames
 - .5 condensation resistance
 - .6 wind load resistance
 - .7 mullion deflection - combination and composite windows
 - .8 Building Code structural requirements

1.9 FIELD TESTING

- .1 Advise Consultant when windows are ready for testing. Prior to installation of finish cladding Consultant will perform random testing of windows, fully installed in openings complete with self adhering membrane. Testing will be performed in accordance with ASTM E 1105 to determine if water resistance for window unit and for window installation, meet CAN/CSA A440, as specified.
- .2 Non-conforming work shall be removed, cleaned and reinstalled at no cost to the Owner. Further testing as a result of failure at or below 400 Pa air pressure difference shall be paid for by the Contractor.

1.10 GUARANTEE/WARRANTY

- .1 Finish: Against non-uniform fading during warranty period to extent that adjacent members have a colour range greater than originally accepted colour range samples approved by the Consultant; pitting or other type of corrosion resulting from natural elements in local atmosphere; discoloration, staining or streaking of the surface for a period of 10 years.
- .2 Failure of hardware for 10 years.
- .3 Failure of sealed unit for 10 years.

Project Specifications (3 of 5)

2 PRODUCTS

2.1 METALS

- .1 Aluminum Window Assemblies: to comply with the provisions outlined in Acceptable products:
 - .1
 - .2 **...or equivalent**
- .2 Aluminum Sheet: To comply with the provisions of ...
- .3 CAN/CSA-G40.21-M Structural Quality Steels-for reinforcement where required.
- .4 Sill angle clips: extruded aluminum, mill finish, thickness to match frame extrusion.

2.2 HARDWARE

- .1 Hardware: ...
- .2 Fasteners: Fasteners of cadmium coated or galvanized steel to ...

2.2 SEALANT

- .1 Sealants within window assembly as recommended by window manufacturer.

2.4 WEATHERING SEALANT

- .1 In accordance with Section 07920.

2.5 GLAZING MATERIALS

- .1 Exterior and Interior Glazing Gaskets: Dense, EPDM Durometer 50 (Shore A) to ASTM C509, keyed into stops and frame.
- .2 Glazing Tape **...or approved substitution**
- .3 Glass Setting Blocks: To comply with ...
- .4 Glazing bead: extruded aluminum type.

2.6 GLASS AND GLAZING

- .1 Glass Thickness: In accordance with ...
- .2 Standards: As listed under Clause 1.3.
- .3 Glass Schedule:
 - .1 Windows: Sealed units with clear float lites, ½" air space.
- .4 Manufacture, handle and install sealed units in accordance with ...

...

Project Specifications (4 of 5)

3 EXECUTION

3.1 INSPECTION

- .1 Inspect the work of other sections upon which the work of this section depends. Proceed only after the deficiencies, if any, in the work of other sections have been corrected.
- .2 Ensure that all anchor and setting or installing assemblies or components supplied by this trade for installation by others are properly located and correctly set in place.

3.2 PREPARATION

- .1 Obtain all dimensions affecting the work of this section from the job site.
- .2 Provide data, dimensions and components, anchors and assemblies to be installed by others in proper time for installation.

3.3 ERECTION

- .1 Erect and secure assemblies aligned plumb and square, free from warp, twist or superimposed loads, installed to achieve watertight installation with air/thermal barrier seal to full system.
- .2 **Erect in strict accordance with the manufacturer's written instructions and reviewed shop drawings**
- .3 All anchors and fittings shall be concealed. Exposed heads or fasteners not permitted unless otherwise specified. All joints in exposed work to be flush butt joints.
- .4 **Use anchors that will permit sufficient adjustment for accurate alignment.**
- .5 Build-in and provide any supplementary reinforcing and bracing required for assembly loads and deflections.
- .6 Secure work adequately to structure in **not restricting thermal and wind movement** repair any damaged finish to match surrounding finish.
- .7 Correctly locate and install flashing, deflectors and weep holes to ensure proper drainage of moisture to exterior.
- .8 Ensure that all stops, gaskets, splines and seals are perfectly aligned and ready to receive glazing as specified herein.

Project Specifications (5 of 5)

3.3 SEALANTS

- .1 Install in accordance with Section 07920.

3.4 GLASS AND GLAZING

- .1 All glazing shall meet design and performance requirements specified and suit the particular location and conditions for the job. Glazing shall be permanently air and watertight under all conditions, including weather and glass movement.
- .2 Face clearance, edge bite and edge clearance of glass shall be as recommended by the glass manufacturer as minimum necessary to meet design and performance requirements specified.
- .3 All sealed units to be installed and handled in accordance with ...
- .4 Install glass in frames without bending or twisting, with uniform contact on all thickness or bedding even and regular all around. **Do not block condensation channels, weep holes or other similar items**
- .5 All glass shall be left clean without cracks, scratches or other defects detrimental to appearance or performance.
- .6 Replace all damaged or broken glass.

3.5 CLEANING

- .1 At completion and continuously as work proceeds, remove surplus materials, debris and scrap.
- .2 At completion of work, remove protective surface covering film and wrappings. Clean glass, panels and frames (on both the interior and exterior) with tools and methods that will not damage the window.
- .3 **Adjust all hardware for proper function**

END OF SECTION

Questions | Comments | Concerns

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