

Part 1 General**1.1 Summary**

- .1 Unless otherwise indicated, follow the standards below when specifying new windows. These standards are not intended to restrict or replace professional judgment.
- .2 The current section applies to the specification of windows separating environmentally dissimilar spaces, within vertical interior or interior/exterior wall assemblies.

1.2 Design Requirements

- .1 All modifications (including change of finish or color) or replacement of windows must be reviewed by McGill's Architectural Advisory Committee (AAC).
- .2 Except otherwise indicated, all replacement windows should be specified to match the existing.
- .3 Integrated Design Strategy:
 - .1 To maximize energy efficiency, occupants' comfort and long-term performance of assemblies separating environmentally dissimilar spaces, window selection shall be part of an Integrated Design Strategy incorporating building envelope, lighting and HVAC performance analysis;
 - .2 To maximise natural lighting, interior spaces shape and finishes shall be considered in window type and location selection.
- .4 Condensation Management:
 - .1 Particular attention has to be given to condensation management, especially in existing buildings;
 - .2 For exterior wall assemblies, the impact of changing interior internal air pressure is of particular concern;
 - .3 Determine if the window performance has to be supplemented by a heating source, or ventilation, to assure sufficient air movement on the window, or if the condensation factor (I factor) should be higher than this Standard's minima.
 - .4 Assess window positioning within the wall assembly for providing continuity of insulation and vapor barriers of the wall it is inserted in;
 - .5 To prevent deterioration of the wall's components, assess window positioning within the wall assembly taking into account the environmental conditions on either side of the vertical barrier and the resulting projected plan where condensation within the wall assembly can be safely managed (saturated vapor pressure/dew-point analysis).

1.3 Applicable Codes and Standards

- .1 At a minimum, and unless indicated otherwise, specify compliance to the latest version of the following Codes and Standards. In case of conflicting requirements, specify the most stringent.
- .2 Specify that testing shall be from an independent third party accredited by the Certification Agency.

- .3 Windows and windows installation must comply with the requirements of Part 5 - Environmental Separation, of the Quebec Construction Code, Chapter I – Building, and National Building Code of Canada, amended (QCC- latest version in effect) and of CSA Group’s standard CAN/CSA-A440.4-07 (latest version in effect) – Window, Door, and Skylight Installation (CSA-A440.4).
- .4 Window products must be fabricated and tested as per the requirements of AAMA/WDMA/CSA 101/I.S.2/A440, NAFS – North American Fenestration Standard/Specification for windows, doors, and skylights (NAFS) and, the Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS – North American Fenestration Standard/Specification for windows, doors, and skylights (CSA A440S1).
- .5 Window systems must meet, and, if possible, exceed requirements of climate zone 6 of the Energy Standard for Buildings Except Low-Rise Residential Building issued by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ANSI/ ASHRAE Standard 90.1- latest version in effect and its supplement). See also Section 01 83 16 – Exterior Enclosure Performance Requirements for additional criteria.
- .6 In situ testing shall be performed according to ASTM International Standards:
 - .1 ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference;
 - .2 ASTM E783 - Standard Test Method for Field Measurement of Air Leakage through Installed Exterior Windows and Doors;
 - .3 ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference;
 - .4 ASTM E1186 - Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems.
- .7 Life-Cycle Testing
 - .1 American Architectural Manufacturers Association, AAMA 910-16 Voluntary "Life Cycle" Specifications and Test Methods for AW Class Architectural Windows and Doors (AAMA 910-16).
- .8 Acoustical Performance shall be specified according to ASTM International Standards:
 - .1 ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements;
 - .2 ASTM E413 - Classification for Rating Sound Insulation;
 - .3 ASTM E1425 - Standard Practice for Determining the Acoustical Performance of Windows, Doors, Skylight, and Glazed Wall Systems;
 - .4 ASTM E1332 - Standard Classification for Rating Outdoor-Indoor Sound Attenuation.
- .9 Forced-Entry Resistance shall be specified according to ASTM International Standards F588- Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact (ASTM F588).
- .10 Specify that when a Code or Standard refers to an Engineer, this Engineer has to be qualified for the specified type of works and registered in the Province of Quebec (Canada).

1.4 Window selection criteria

- .1 Whenever possible, sliding windows shall not be specified.
- .2 Thermoplastic products shall not be specified.
- .3 The need for the following window selection criteria shall be confirmed with the Project Manager early in the Design stage:
 - .1 Operable windows are to be installed in buildings that do not have mechanical ventilation. Operable windows are not to be considered in air-conditioned buildings with mechanical ventilation systems, unless required for building occupant safety or security. In buildings with mechanical ventilation systems that do not include air-conditioning, operable windows are to be considered on a case-by-case basis;
 - .2 If a window is operable, determine the necessary size of operable sash and the type of operability. Type of operable window shall take the room layout into account so that the window can indeed be opened (e.g. a vertical sliding sash (hung window) might be difficult to open if located above a counter). Determine if barrier-free design is a consideration;
 - .3 For operable windows, validate types of hardware and necessity for stoppers, keylocks and other accessories. Determine the necessity of integrating insects' screens;
 - .4 Operation type and maintenance of windows - inclusive of window washing method - shall be coordinated with the Building Director, the Director of Building Operations and Director Buildings and grounds, through the Project Manager;
 - .5 Where large window ledges exist, the windows might be subjected to lateral loads from people seated on the ledge and leaning against the window, determine if additional safety features should be integrated in the window design or wall assemblies;
 - .6 For windows susceptible to impacts beyond Codes' design criteria, determine if additional features should be integrated in the window design or wall assemblies;
 - .7 Determine if excessive or disruptive sound attenuation is needed.
- .4 Windows shall be selected for a minimum 30 years' service life.
- .5 Field mulling (i.e. combining window units into assemblies on site) shall not be specified unless combination assemblies have been tested as per NAFS and CSA A440S1 and their design confirmed by the manufacturer and an Engineer registered in the province of Quebec.
- .6 Whenever possible, specify products for which the installation performance - as per the manufacturer's written instructions for application similar as those of the project - has been tested in laboratory.
- .7 Foreign products shall only be specified as per the instructions of the *Conditions générales* and with the approval of the Project Manager. Request report of compliance to NAFS and CSA A440S1.
- .8 Energy Star rated products cannot be specified based on this criteria only, a written report of compliance to NAFS and CSA A440S1 shall be provided for all windows.

1.5 Guarantee

- .1 The products specified under this section shall be guaranteed for a period of at least ten (10) years from the date of substantial completion of the work.
- .2 Factory applied finishes shall be guaranteed for a period of at least twenty (20) years against chalking, fading, chipping, peeling, blistering and cracking.
- .3 Anodized finishes shall be guaranteed for a period of at least ten (10) years.

1.6 Quality Assurance

- .1 In situ testing:
 - .1 Unless instructed otherwise by the Project Manager, specify at least two (2) in situ testing during construction for projects comprising 15 windows or more; For projects comprising less than 15 windows, confirm the necessity for in situ testing with the Project Manager.
 - .2 Field Test Specimen (Real size mock-ups)
 - .1 Unless instructed otherwise by the Project Manager, specify Field Test Specimen for window projects comprising 15 windows or more;
 - .2 For projects comprising less than 15 windows, confirm the necessity for Field Test Specimen with the Project Manager;
 - .3 Field Test Specimen shall be representative of product and installation specifications (field anchoring, perimeter sealant, intersection with building structure, etc.).
- .3 Shop drawings:
 - .1 Specify that manufacturer must confirm on each of the shop drawings that the window dimensions are within the acceptable range of the standard it has been tested against;
 - .2 Specify that shop drawings must be accompanied by the relevant testing reports;
 - .3 Specify that if a product comprises modifications from manufacturer's standard product, these modifications shall be clearly indicated on the drawing and be accompanied by a confirmation that the modified assembly has been tested.
 - .4 Shop drawings shall be sealed by an Engineer, member in good standing with his/her Professional order, which entails that glazing underwent analysis and that calculations were validated in accordance with the Quebec Construction Code.
- .4 Qualification
 - .1 Specify windows with at least five (5) years' field service history. For windows with less than five (5) years' field service history, or foreign products, specify that the test apparatus for testing compliance to NAFS and CSA A440S1 shall also be representative of the installation specifics of the project;
 - .2 Specify that installer must be approved by Manufacturer.

1.7 Project Manual

- .1 Specify that at the end of the project, approved shop drawings of windows shall be included in the Project Manual as per the instructions of the *Conditions générales*.
- .2 Specify that shop drawings, in the Project Manual, shall be accompanied by the corresponding NAFS/CSA A440S1 temporary label(s).

1.8 Performance Requirements

- .1 Windows shall be specified as per NAFS and CSA A440S1 Primary and designators and optional tests below.
- .2 Before specifying a window, the consultant shall get a written confirmation from the manufacturer that the selected product is qualified for the specified performances (i.e. the product exists and its compliance has been tested).
- .3 Request that the manufacturer issue an expert engineering notice in accordance with AAMA 2502 standards specifying that the products of the project answer NAFS requirements and, more specifically, the requirements of the specifications. This notice will have to demonstrate the results.
- .4 Performance Class : AW
 - .1 Performance class AW shall be selected only.
- .5 Performance Grade (PG)
 - .1 Performance Grade (PG) shall be no less than:
 - .1 30 for class CW windows (CW-PG35);
<http://www.fenestrationcanada.ca/calculator/>
 - .2 40 for class AW windows (AW-PG45).
- .6 Gateway requirements:
 - .1 Performance Grade design loads should consider accepted good practices, historical demonstrated performance and specific conditions to which a specific window will be exposed. Depending on these factors and on the exposure, height and shape of the building, it may be desirable to consider design loads greater than the average Driving Rain Wind Pressure (DRWP) and Hourly Wind Pressure (HWP) provided by the climate design data tables for Canada (QCC-'10 and CSA A-440S1).
- .7 Canadian Air Infiltration/Exfiltration Level:
 - .1 Specify level A3 (for operable windows) or fixed level (fixed windows).
- .8 Water Penetration Resistance test pressure (WPR)
 - .1 Water Penetration Resistance Pressure shall not be less than the aforementioned Gateway minimums.
 - .2 To assure that the effective field testing results for Water Penetration Resistance (WPR) will be equivalent to the design WPR, or better, it is suggested to use a

- Driving Rain Wind Pressure (DRWP) one (1) or two (2) levels above the DRWP provided in the design data for the Montreal region (QCC'10 and CSA A440S1).
- .3 For operable windows, specify products for which water penetration through the specified locking/latching mechanism has been tested.
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- .9 Acoustical Performance
 - .1 Specify and rate sound attenuation as Sound Transmission Class (STC) for interior windows, and as Outdoor-Indoor Transmission Class (OITC) for exterior sounds;
 - .2 The following Acoustical Performances are minima and shall be confirmed with the Project manager:
 - .1 STC-40 for interior windows;
 - .2 OITC-32 for exterior windows.
 - .3 STC and OITC to be validated in accordance with ASTM E90.

 - .10 Condensation Resistance
 - .1 Tests results of Condensation Resistance evaluation under the procedures of CAN/CSA-A440.2 Energy Performance of Windows and Other Fenestration Systems shall be requested for all windows.
 - .2 The CSA temperature index (I) shall be I = 60 or better.

 - .11 Thermal Performance
 - .1 Tests results of Thermal Performance evaluation under the procedures of CAN/CSA-A440.2 Energy Performance of Windows and Other Fenestration Systems shall be requested for all windows;
 - .2 Specify thermally improved (thermal-break) construction for all windows.

 - .12 Solar Heat Gain Coefficient (SHGC)
 - .1 Solar Heat Gain Coefficients (SHGC) shall be determined in accordance with climate zone 6 of ANSI/ ASHRAE Standard 90.1-2010 and its supplement (see also Section 01 83 16 – Exterior Enclosure Performance Requirements for additional criteria);
 - .2 SHGC shall be 0,40 or better. Refer to section 08 80 50 – Glazing for specific SHGC requirements.

 - .13 U-Value (Thermal transmittance W/M²K)
 - .1 U-Value (Thermal transmittance) of assembly shall be determined in accordance with climate zone 6 of ANSI/ ASHRAE Standard 90.1-2010 and its supplement (see also Section 01 83 16 – Exterior Enclosure Performance Requirements for additional criteria).
 - .2 U-Value shall be 0,33 or better.

 - .14 Visible Light Transmission (VLT)
 - .1 VLT of building envelope glazing must be greater than 40%.

- .15 Load deflection test
 - .1 Deflection limit for glass supporting members shall comply with Part 5 of QCC'10 and not exceed 1/175th of the span (max.3 mm).

- .16 Operating Force

If allowed by pressure delta from either side of the window, the force required to open or close any latch for normal opening/closing shall be no more than 38N wherever an operable window is accessible to people with disabilities.

- .17 Forced-Entry Resistance test
 - .1 Confirm with the Project Manager if Campus Public Safety, the Building Director, Building Operations or any other stakeholder requires a Forced-Entry Resistance level beyond the minimum requirements of NAFS. Any superior requirement shall be specified as per ASTM F588 (for fixed and operable windows);
 - .2 Determine with the Project Manager if the windows must be protected with additional means such as window films or integrated security grills. If this is the case, these additions must be confirmed with the manufacturer to assure complete warranty.

Part 2 Products**2.1 Preferred Products**

- .1 All products must adhere to the requirements listed in Division 01 – Product Requirements 01 60 00.
- .2 Specify aluminum windows unless otherwise indicated by the Director of Design Services. Aluminum must adhere to the requirements listed in section 2.1 of Division 05 - Metals 05 00 00.
- .3 Specify that any mandatory manufacturer's identification permanent marking, requested by NAFS or others, shall be installed in an inconspicuous location.
- .4 Specify windows be supplied by the same (one) manufacturer.
- .5 Specify factory applied finishes.

2.2 Additional requirements for aluminum windows

- .1 Prefer 6063-T5 alloy anodized aluminum extrusions;
- .2 Prefer a four (4) coats Duranar XL factory oven baked finish;
- .3 Prefer windows with shop fitted installation flanges. Specify water-tightness attributes of connection to the wall assembly and detail field anchoring;

- .4 To prevent corrosion, specify isolation of aluminium from dissimilar materials (metals, concrete, mortar, masonry, wood, etc).

2.3 Wood windows

- .1 Specify wood windows only if:
 - .1 It involves replacing a few already existing wood windows
 - .2 Project Manager specifically requests wood windows
- .2 DMA Douglas Hall kiln dried 6-8% vs NAFS 12%

2.4 Glazing

- .1 Sealed Unit comprising at least two (2) windowpanes shall always be specified for exterior windows; Specify that setting blocks for glazing shall not obstruct venting or draining of glazing cavity;
- .2 Whenever possible, for windows part of Environmental Separations that are also Fire Separations assemblies, specify that glass assemblies comprising security or wired glazing shall provide the same airtightness and water tightness performances as non-security glazing for the same Performance Class;
- .3 Sun exposed muntins can create a differential in temperature in the glass and make it break. Glazing size, type and attributes selection shall take this possibility into account;
- .4 Window selection should never include glazing which exceeds the heaviest glazing configuration tested for that window;
- .5 The safety of people and practicality of handling glazing shall be taken into account when selecting windows (size and weight of glazing, transport, installation);
- .6 Plastic glazing
 - .1 Plastic glazing shall never be used for exterior windowpane,
 - .2 If permitted by Building and Fire-Safety Codes, plastic glazing shall only be used for interior application if accepted by the Director of Design Services.

2.5 Weatherstrip

- .1 Prefer extruded one piece (welded corners) and easily replaceable compression seals. The weatherstrip shall provide Canadian Air Infiltration/Exfiltration level A3 or better.

2.6 Secondary Storm Products (SSP)

- .1 If applicable, prefer external SSP and specify forced-entry requirements.
- .2 Design Pressures for SSP shall be at least as per NAFS' minimum gateway requirements for class CW windows.

2.7 Hardware

- .1 Operable window shall never be specified to open beyond 100mm without a key or special tool;

- .2 Friction hinges as limit devices for operable sashes shall not be specified;
- .3 For location susceptible to abuse, but nevertheless requiring operable windows, consider continuous hinges (eg. if people could dangle themselves from an open sash);
- .4 Specify locking/latching mechanisms that have been tested within the Water Penetration Resistance testing.

2.8 Sealant

- .1 Refer to Section 07 92 10 – Joint Sealing;
- .2 Sealant shall remain permanently elastic, non-shrinking, and non-migrating.

2.9 Insects Screen

- .1 When insects' screens are required, specify windows for which insect screens are offered by the manufacturer of the window;
- .2 Windows to be fitted with insect screens shall have been tested to NAFS and A440S1 both, with and without their insect screens;
- .3 The insects' screens mesh shall be made of plastic-coated glass-fibre and have a mesh count of 18 x 16 per square inch. The thread shall be woven and fused to form a fabric mesh resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration, compliant with requirements of ASTM D 3656- Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns;
- .4 If security insects' screens are required, they shall be made of stainless steel type 316 and resist to a minimum impact load of 1220J when tested according to ASTM F 2006 - Standard Safety Specification for Window Fall Prevention Devices for Non-Emergency Escape (Egress) and Rescue (Ingress) Windows.

2.10 Related Technical Sections

The technical sections of the McGill Building Design and Technical Standards should be consulted with the current document, most notably (but not limited to) the following:

Section Number	Title of Section
08 11 16	Aluminum Doors and Frames
08 41 00	Entrances and Storefront
08 44 00	Curtain Walls
08 52 00	Wood Windows Restoration
08 80 50	Glazing

Part 3 Execution**3.1 Installation**

- .1 Specify installation as per QCC'10 and CSA-A440.4. Window installation detailing shall assure the continuity of thermal, vapor and water barrier of the wall assembly. To assure warranty from the manufacturer, installation detailing shall at least be in full accordance with manufacturer's documented instructions;
- .2 Specify that both, window and window glazing, shall, each, be delivered on site with the proper temporary (removable) label confirming compliance to its specifications and standards;
- .3 Specify that weep holes and condensation channels shall not be blocked upon installation of window.

3.2 Testing

- .1 In situ testing:
 - .1 Temporary product's compliance label shall remain in place at least until in situ testing is completed;
 - .2 To facilitate confirming proper water drainage of the window on the window flashing, specify in situ water infiltration testing be performed with colored water. Coloring product shall be compatible with the assembly materials and completely washable (not staining material);
 - .3 The first in situ test shall be performed on a window randomly selected by the testing agency within the first 15 installed windows;
 - .4 Specify that the interior finishes around windows shall not be installed before in situ testing having confirmed compliance of window installation;
 - .5 Specify in situ testing of operating and functioning of operable windows as per NAFS and CSA A440S1;
 - .6 Specify in situ testing of concentrated load deflection of sill ("charge au nez/rigidité du châssis");
 - .7 Specify the course of action if window installation is found defective by the in situ testing.

3.3 Cleaning

- .1 Specify removal of all non-permanent labels and protective coatings.
- .2 Specify that temporary product's compliance label to NAFS and CAN A440S1 shall remain in place until removal is approved by the Architect.
- .3 Specify removal of all surplus material, grease, dust, dirt, etc and proper cleaning of windows, including removal of fingerprints, as a prerequisite to the substantial completion visit.

END OF SECTION