

Builder Insight

TECHNICAL BULLETIN

Fenestration Energy Performance: Requirements for Residential Buildings in British Columbia

OVERVIEW

Energy performance requirements for windows, doors and skylights (collectively referred to as fenestration) continue to become more stringent.

In British Columbia, the fenestration energy performance is regulated through building codes as well as the *Energy Efficiency Standards Regulation (EESR)*. The 2012 BC Building Code (BCBC) and the 2014 Vancouver Building Bylaw (VBBL) introduced significant new fenestration energy performance requirements. For the first time, both codes have fenestration energy performance requirements for smaller buildings.

This bulletin summarizes the fenestration energy performance requirements of the 2012 BCBC, the 2014 VBBL, and the BC EESR as of January 1, 2015.



Builder Insight is a series of bulletins and companion videos designed to provide practical information on new technologies, research results, good building practices and emerging technical issues in residential construction to Licensed Residential Builders and others in the industry.

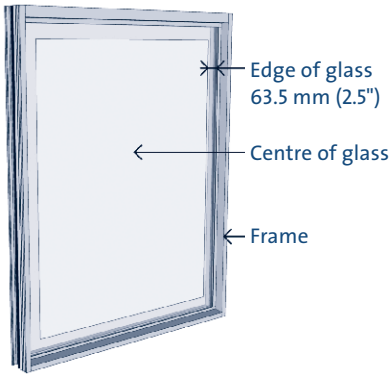
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Table of Contents

Energy Performance Properties	2
Energy Performance and Climate Zones	2
Energy Performance Regulation in BC	3
British Columbia Building Code (BCBC)	3
Vancouver Building Bylaw (VBBL)	5
BC Energy Efficiency Standards Regulation	6
Design for Energy Performance of Part 3 Buildings.....	8
ASHRAE 90.1-2010 Fenestration Requirements.....	8
2011 NECB Fenestration Requirements	10
Accountability for Energy Performance Design of Part 3 Buildings	11
Key Points	12
For More Information	13



Overall Window U-factor Calculation



Overall window U-factor =
Frame U-factor x % frame area
+ Centre of glass U-factor x
% glass area + Edge of glass
U-factor x % edge of glass area
Overall window R-value = 1/ U-factor

Energy Performance Properties

Three properties describe the energy performance of windows, doors and skylights: U-value (also called U-factor), Solar Heat Gain Coefficient (SHGC), and air leakage.

U-value is a measure of the overall heat transfer rate through the entire fenestration product under standardized winter conditions. The heat transfer rate varies through the frame, the glass edge and the centre of glass. The U-value represents the overall heat transfer rate through all of these components. It is expressed in metric units ($W/m^2\cdot K$) or imperial units ($Btu/h\cdot ft^2\cdot F$).

Lower U-values are always desirable as they represent less heat transfer (primarily winter heat loss) and, therefore, less energy needed for heating and cooling.

Solar Heat Gain Coefficient (SHGC) is the proportion of incident solar radiation transferred through the product, and is a decimal fraction between 0.0 (totally opaque) and 1.0 (a hole in the wall).

The merits of increasing or reducing the SHGC depend on building-specific design parameters. Fenestration with high solar heat gain can reduce the need for heating in winter. However, in many buildings it is also beneficial to reduce solar heat gain in summer for comfort and to reduce the need for cooling. Balancing summer and winter priorities requires consideration of the entire building design, including building orientation, exterior shading, window area, and glazing properties.

Air leakage is a measure of the air flow rate through a fenestration system. It is considered an energy performance property as higher air flow rates correlate with greater energy use for conditioning replacement air. In the ASHRAE 90.1 standard and in American test standards in general, air leakage is measured under positive pressure only, representing infiltration into the building. In Canadian standards, specified air leakage rates must be achieved under both infiltration and exfiltration conditions, and requirements are generally more stringent.

Energy Performance and Climate Zones

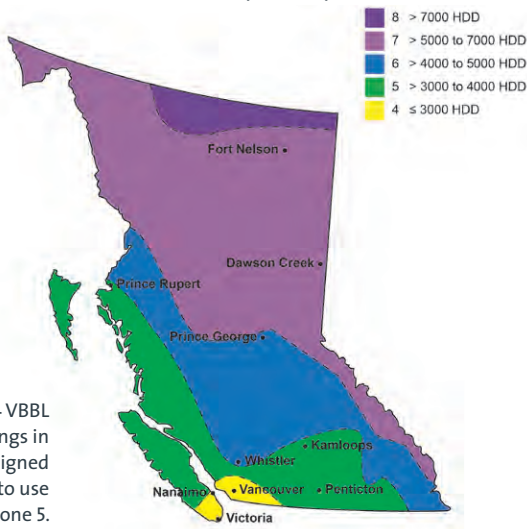
Building Codes specify the required fenestration energy performance levels according to the climate zone the building is in.

The NECB and BCBC 9.36 share climate zone definitions that are very similar to those of ASHRAE 90.1 (see *Figure 1*). The BC Building Safety and Standards Branch bulletin B14-01 provides guidance on the need to use Canadian climate data to determine ASHRAE 90.1 climate zone boundaries. Designers are reminded that authorities having jurisdiction may require the use of climate data that differs from the data published in a standard or in a Building Code.

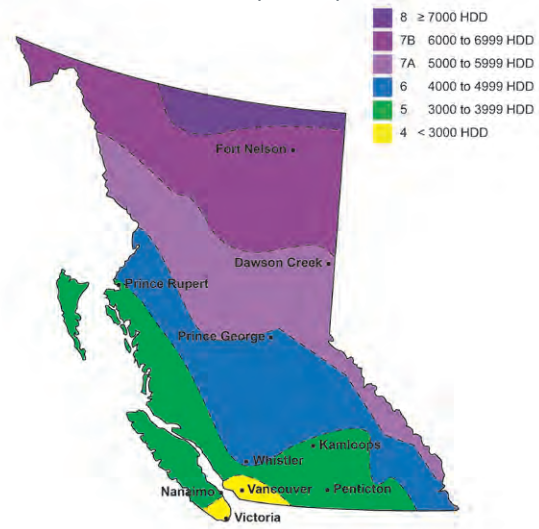
For 2014 VBBL compliance, the City of Vancouver has indicated that designers using ASHRAE 90.1-2010 are to use ASHRAE 90.1 climate zone 5, while designers following the 2011 NECB are to use NECB climate zone 4.

Figure 1: ASHRAE 90.1 Climate Zones Based on BCBC Data Compared to NECB Climate Zones

ASHRAE 90.1 Climate Zones (SI units)*



2011 NECB Climate Zones (SI units)



* The 2014 VBBL requires buildings in Vancouver designed to ASHRAE 90.1 to use climate zone 5.

Energy Performance Regulation in BC

Energy performance is regulated under building codes, and also by the Energy Efficiency Standards Regulation (EESR) of the *Energy Efficiency Act* (EEA).

British Columbia Building Code (BCBC)

The BC Building Code is a provincial regulation enforced by local governments. The BCBC applies to the entire province except for within the City of Vancouver.

Part 3 Buildings

The 2012 BCBC requires the fenestration energy performance in Part 3 buildings to conform to the ASHRAE 90.1-2010 standard or the 2011 NECB, as do the VBBL and the EESR. These whole building energy performance design documents are discussed under separate headings later in this bulletin.

Part 9 Buildings

The BCBC requires the fenestration energy performance in Part 9 buildings to conform to Section 9.36, which has comprehensive building envelope requirements. Section 9.36 provides prescriptive, trade-off and performance path options, depending on the building type.

Fenestration to Wall Ratios

The fenestration and door to wall area ratio (FDWR) is not regulated directly, although FDWR limits do apply to several permitted building envelope trade-offs and to the simulated reference house under the performance path.

Prescriptive Path

The prescriptive path addresses both manufactured factory glazed products as well as “site-built” products that are typically site-glazed. The maximum fenestration U-values permitted under the prescriptive path are summarized in *Table 1*.

Table 1: 2012 BCBC 9.36. Prescriptive Maximum U-values for Fenestration, Doors and Skylights

Thermal Characteristics	Component	Heating Degree-Days at Building Location in Celsius Degree-Days					
		Zone 4 < 3000	Zone 5 3000 – 3999	Zone 6 4000 – 4999	Zone 7 5000 – 5999	Zone 7B 6000 – 6999	Zone 8 ≥ 7000
Max. U-Value W/m ² ·K (Btu/h·ft ² ·F)	Fenestration and Doors	1.80 (0.32)		1.60 (0.28)			1.40 (0.25)
	Skylights	2.90 (0.51)		2.70 (0.48)			2.40 (0.42)

U-values of manufactured (factory glazed) fenestration products may be determined using either the CSA A440.2 or NFRC 100 standards. Factory labeling of U-values for manufactured products is required by the EESR. In Part 9, site-glazed products are considered to be products outside the scope of AAMA/WDMA/CSA 101/I.S.2/A440-08, NAFS—North American Fenestration Standard/Specification for windows, doors and skylights. Site-glazed products therefore include curtain wall, storefront framing, commercial entrance systems, and commercial steel doors. Site-glazed products do not need to comply with prescriptive U-values. Instead, they can comply with Section 9.36 when they meet a set of compliance options outlined in article 9.36.2.7.

The prescriptive requirements also address fenestration product air leakage, which must comply with the minimum requirements of CSA A440S1-09, Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440-08, NAFS—North American Fenestration Standard/Specification for windows, doors and skylights. Operable fenestration products must have an air infiltration/exfiltration rating of A2 or better, and non-operable products must have a Fixed rating.

Trade-off Path

Subsection 9.36.2 allows limited U-value trade-offs, but only between opaque wall areas, and between fenestration areas labeled with U-values. Site-built products cannot be used for trade-offs. Trade-offs between fenestration and opaque wall areas are not permitted.

Performance Path

Subsection 9.36.5 allows whole building energy modeling to be used to demonstrate that a proposed design has energy consumption no greater than that of a reference building constructed to the prescriptive requirements. Both the proposed and reference buildings must be modeled under identical environmental and operating conditions.

Vancouver Building Bylaw (VBBL)

The VBBL is administered and enforced by the City of Vancouver, whose charter permits it to have its own building code. Apart from one and two family dwellings, including laneway houses, there are no energy performance requirements for fenestration in other Part 9 buildings. Fenestration in those buildings would therefore be subject to the EESR.

One and Two Family Dwellings, Including Dwellings with Secondary Suites or Laneway Houses

Article 10.2.2.2 requires windows and sliding glass doors to have a maximum U-value of 1.4 W/m²·K (0.25 Btu/h·ft²·F), and skylights to have a maximum U-value of 2.4 W/m²·K (0.42 Btu/h·ft²·F).

The City allows some variation from these U-value requirements as outlined in a windows and doors FAQ document posted on the new home energy requirements web page¹. The Appendix also addresses mandatory labeling requirements as well as a U-value averaging provision that may be used.

The VBBL requires regulated products to be labeled with certified U-values determined according to NFRC 100-2010 or CSA A440.2-09, as required by the EESR.

The Vancouver Building Bylaw is administered and enforced by the City of Vancouver, whose charter permits it to have its own building code.



All Other Buildings

Article 10.2.1.1 addresses all other buildings. Detailed compliance requirements are provided on the City of Vancouver's Energy Requirements web page, for large and retail commercial buildings.² The energy performance of all the other buildings, except residential buildings of three storeys or less, are to be designed and constructed to ASHRAE 90.1-2010 or 2011 NECB. It restricts the use of the 2011 NECB to new Part 3 buildings, but allows ASHRAE 90.1-2010 to be used for new construction or renovations. The City of Vancouver has specific compliance checklists and data submission requirements that may not be required by other jurisdictions.

¹ <http://vancouver.ca/home-property-development/energy-efficiency-requirements-and-resources-for-new-homes.aspx>

² <http://vancouver.ca/home-property-development/large-building-energy-requirements-forms-checklists.aspx>

BC Energy Efficiency Standards Regulation

The BC Energy Efficiency Standards Regulation (EESR), a regulation separate from the building code, applies to all replacement windows, and all new Part 9 buildings. It regulates product manufacturers, not builders, though it is an offence to procure and install non-compliant products in British Columbia.

The current energy performance requirements of BCBC 9.36 and VBBL 10.2.2 are more stringent than those of the EESR, so products that comply with these code requirements also comply with the EESR.

EESR does not apply to buildings designed to ASHRAE 90.1 (2010 or 2013), ASHRAE 189.1 (2011), and NECB (2011), and NECB (2011), nor to buildings with a heritage designation. It also does not apply to decorative windows that have stained glass panels, iron inserts or blinds contained in a sealed insulating glass unit. The EESR requirements are summarized in *Table 2*.

The regulation also has a “flexibility provision” that allows licensed architects and engineers to use area-weighted averaging of actual size fenestration products at a particular building to demonstrate compliance with the U-value requirements. The product U-value calculations must be performed using the specified NFRC and CSA A440.2 simulation methods.

EESR and Manufactured Product Labeling Requirements in British Columbia

The EESR requires fenestration energy properties of all manufactured fenestration products within its scope to be labeled and verified by responsible third parties named in the regulation. Buildings designed to ASHRAE 90.1 or NECB are not subject to these requirements. As this legislation applies to all products intended for use in BC, it has important implications not only for manufacturers, but for all parties engaged with code compliance.

Factory glazed fenestration products *that are within the scope of existing certification programs* must have labels showing U-values verified by recognized entities and bearing the verifying certifier’s mark. These entities include certification agencies accredited by the Standards Council of Canada (CSA, Intertek and QAI) and independent NFRC inspection agencies. Products that must be labeled in this way include factory glazed windows, side hinged and sliding doors, and unit skylights.

In the case of pre-hung side hinged doors not tested for U-value, third party verification labels are required to demonstrate that prescriptive door slab insulation and insulating glass requirements have been met.

In the case of site-glazed products and products *that are outside the scope of existing certification programs*, the regulation allows qualified professional engineers and architects, to verify that reported product U-values are determined using the approved CSA or NFRC methods.

While the regulation spells out the details, the *Energy Efficiency Act* makes it an offence to manufacture, offer for sale, sell, lease, or install fenestration products that are not labeled or otherwise do not comply with the *Act*.

The current energy performance requirements of BCBC 9.36 and VBBL 10.2.2 are more stringent than those of the EESR, so products that comply with these code requirements also comply with the EESR.

Table 2: Summary of BC Energy Efficiency Standards Regulation Fenestration Requirements

Application	Max. U-Value W/m ² ·K (Btu/h-ft ² ·F)	Regulation Item
Manufactured Fenestration Products in Smaller Buildings (residential buildings with less than 5 storeys, or non-residential buildings with ≤ 600 m ² floor space) *		
Non-metal, non-wood framed windows and sliding glass doors	2.0 (0.35)	Section 27 Item 3
Wood framed windows and sliding glass doors	2.0 (0.35)	Section 27 Item 4
Skylights	3.1 (0.55)	Section 27 Item 5
Metal framed windows, sliding glass doors, curtain walls, window walls and storefront windows	2.0 (0.35)	Section 27 Item 7
Hinged or bi-folding doors in aluminum, fibreglass, or steel frames	2.0 (0.35)	Section 27 Item 8
Manufactured Fenestration Products in Larger Buildings (residential buildings with 5 storeys or more, or non-residential buildings with > 600 m ² floor space) *		
Metal framed windows, sliding glass doors, curtain walls, window walls and storefront windows	2.57 (0.45)	Section 27 Item 9
Non-metal framed windows, sliding glass doors, curtain walls, window walls and store front windows	2.0 (0.35)	Section 27 Item 10
Prehung Door Assemblies—All Buildings*		
Pre-hung door assemblies, including sidelites and transoms, with certified U-value ratings	U-value ≤ 2.0 (0.35)	Section 17
Pre-hung door assemblies, including sidelites and transoms, <u>without</u> certified U-value ratings must comply with the prescriptive requirements below		
Solid wood door slab	No requirement	Section 17
Insulated door slabs: door panels must be insulated with products rated to a thermal resistance of RSI ≥ 0.875 m ² ·K/W		Section 16(2) and Section 27 Item 1
Glazing for installation in manufactured door slabs, side lites and transoms to be multiple glazed with at least one low-e coating between panes, a 90% argon gas fill level, and have spacer bars other than non-thermally broken aluminum box spacer bars		Section 16(3) and Section 27 Item 2
Excluded Products		
<ul style="list-style-type: none"> • Products installed in a building designed to ASHRAE 90.1-2010/2014, ASHRAE 189.1-2011, or NECB 2011 • Decorative windows that have stained glass panels, iron inserts or blinds contained in a sealed insulating glass unit • Glazing products installed in a designated heritage building • Glass replacement in an existing frame whose U-value is not higher than the original glass 		

* The regulation applies only to fenestration products that separate heated space from non-heated space

The EESR applies to all replacement windows, and all new Part 9 buildings. It regulates product manufacturers, not builders in British Columbia.





Design for Energy Performance of Part 3 Buildings

Both the BCBC and VBBL require large buildings to be designed to either ASHRAE 90.1-2010 or the 2011 NECB. While there are similarities between these two approaches, there are also important differences. Depending on the type of building, designing to one of these design guides may be more advantageous than the other.

ASHRAE 90.1-2010 Fenestration Requirements

ASHRAE 90.1 has three compliance paths for the building envelope: the Prescriptive, the Building Envelope Trade-Off (BET), and the Energy Cost Budget (ECB) method, which is based on whole building energy modeling. The ASHRAE 90.1 BET and ECB paths differ significantly from the trade-off and performance paths in the 2011 NECB.

The Prescriptive Path for the building envelope limits both the maximum area of fenestration and the maximum U-values for different product types.

Fenestration to Wall Ratios

Fenestration to wall area limits apply to the prescriptive path only:

- Vertical fenestration may not exceed 40% of gross wall area for each space-conditioning category
- Skylight fenestration may not exceed 5% of the gross roof area for each space-conditioning category

Designs following the BET or ECB paths may vary from these prescriptive limits.

Prescriptive Maximum U-value and SHGC

The maximum fenestration U-values permitted under the prescriptive path are summarized in *Table 3*.

Regardless of which compliance path is followed, all fenestration U-values must be determined according to NFRC 100 and Solar Heat Gain Coefficients (as well as Visible Transmittance when required) according to NFRC 200. The NFRC ratings are determined for specified standard sizes defined in NFRC 100, with adiabatic boundaries at the outside edges of the framing. NFRC 100 and 200 allow these properties to be determined by simulation, but also require U-values to be verified through physical testing of production line product specimens.

There is no requirement in ASHRAE 90.1 for reporting actual size U-values or the inclusion of installation related thermal bridges in fenestration U-values as these effects are not within the scope of the referenced NFRC 100 standard.

Air Leakage

ASHRAE 90.1 specifies the maximum allowable air leakage with reference to air infiltration only, as that is the custom in American standards. Testing is permitted to several standards: AAMA/WDMA/CSA 101/I.S.2/A440, NAFS—North American Fenestration Standard/Specification for windows, doors and skylights (NAFS), NFRC 400 or ASTM E 283.

Table 3: ASHRAE 90.1 Prescriptive Fenestration U-value and SHGC Requirements for Residential Buildings

BCBC – ASHRAE 90.1-2010 Window and Door Assembly Maximum U-Value W/m ² ·K(Btu/h·ft ² ·F) and SHGC										
	Zone 4		Zone 5		Zone 6		Zone 7		Zone 8	
	Maximum U-Value	Maximum SHGC	Maximum U-Value	Maximum SHGC	Maximum U-Value	Maximum SHGC	Maximum U-Value	Maximum SHGC	Maximum U-Value	Maximum SHGC
Windows (0%-40% of Wall)										
Non-Metal (all)	U-2.27 (0.40)		U-1.99 (0.35)		U-1.99 (0.35)		U-1.99 (0.35)		U-1.99 (0.35)	
Metal CW/Storefront	U-2.84 (0.50)	0.40	U-2.56 (0.45)	0.40	U-2.56 (0.45)	0.40	U-2.27 (0.40)	NR	U-2.27 (0.40)	NR
Entrance Door	U-4.83 (0.85)		U-4.54 (0.80)		U-4.54 (0.80)		U-4.54 (0.80)		U-4.54 (0.80)	
All Other	U-3.12 (0.55)		U-3.12 (0.55)		U-3.12 (0.55)		U-2.56 (0.45)		U-2.56 (0.45)	
Skylight with curb, Glass										
0%-2.0% of roof area	U-5.56 (0.98)	0.36	U-6.64 (1.17)	0.49	U-5.56 (0.98)	0.46	U-6.64 (1.17)	0.64	U-5.56 (0.98)	NR
2.1%-5.0% of roof area	U-5.56 (0.98)	0.19	U-6.64 (1.17)	0.39	U-5.56 (0.98)	0.36	U-6.64 (1.17)	0.64	U-5.56 (0.98)	NR
Skylight with curb, Plastic										
0%-2.0% of roof area	U-7.38 (1.30)	0.62	U-6.25 (1.10)	0.77	U-4.20 (0.74)	0.65	U-3.46 (0.61)	0.77	U-3.46 (0.61)	NR
2.1%-5.0% of roof area	U-7.38 (1.30)	0.27	U-6.25 (1.10)	0.62	U-4.20 (0.74)	0.55	U-3.46 (0.61)	0.77	U-3.46 (0.61)	NR
Skylight without curb, All¹										
0%-2.0% of roof area	U-3.29 (0.58)	0.36	U-3.92 (0.69)	0.49	U-3.29 (0.58)	0.49	U-3.92 (0.69)	0.64	U-3.29 (0.58)	NR
2.1%-5.0% of roof area	U-3.29 (0.58)	0.19	U-3.92 (0.69)	0.39	U-3.29 (0.58)	0.39	U-3.92 (0.69)	0.64	U-3.29 (0.58)	NR

NR = no requirement

¹ “Skylight without curb” refers to site-built, multiple-lite sloped glazing systems such as “the roof of an atrium.” ASHRAE 90.1-2010 User’s Manual, p. 5-62

Energy Performance Verification and Labeling

Unlike the NECB, ASHRAE 90.1 Section 5.8 provides explicit requirements to facilitate verification of compliance for fenestration energy performance properties.

The ratings for U-value, SHGC, VT and air leakage rate for all manufactured fenestration products shall be determined “by a laboratory accredited by a nationally recognized accreditation organization, such as the National Fenestration Rating Council.” Fenestration products are required to have either a permanent name plate listing these properties, or a “signed and dated certification” from the manufacturer or installer of the fenestration listing the U-value, SHGC, VT and air leakage rate. This language, together with the requirement in NFRC 100 that U-value and SHGC be not only simulated, but tested, describe a compliance regime that validates the simulated performance by physical testing, that documents the construction of the tested product in a report, and that certifies in writing that the performance ratings ascribed to the installed products conform to the simulated and tested performance of the products.



2011 NECB Fenestration Requirements

The NECB has three compliance paths for the building envelope: the prescriptive path, the trade-off path, and the performance path, the latter being based on whole building energy modeling. NECB trade-off and performance paths differ significantly from the similarly-named paths in ASHRAE 90.1. The prescriptive path for the building envelope limits both the maximum area of fenestration and the maximum U-values for different products.

Fenestration to Wall Ratios

The prescriptive path specifies the maximum allowable total vertical fenestration and door area to gross wall area ratio (FDWR) which is 40% for all locations up to 4000 HDD, and is progressively reduced with increasing HDD to a minimum of 20%. In addition, the total skylight area must not be greater than 5% of the gross roof area. Buildings that exceed these limits must follow either the trade-off path or performance path.

Prescriptive Maximum U-value

The maximum allowable U-values for fenestration and doors under the prescriptive path range from 2.4 to 1.60 W/m²·K (0.42 to 0.28 Btu/h·ft²·F). Main entrance doors whose total door area is ≤ 2% of gross wall may have a U-value of up to 4.4 W/m²·K (0.78 Btu/h·ft²·F). The maximum fenestration U-values permitted under the prescriptive path are summarized in *Table 4*.

Fenestration U-values are specified with the term *overall thermal transmittance*. The standards referenced for this purpose, NFRC 100-2010 and CSA A440.2-09, evaluate this property at specified standard sizes and adiabatic boundaries at the outside edges of the framing. Use of the term *overall thermal transmittance* should not be understood to mean something more.

There is no requirement in the NECB for reporting actual size U-values or the inclusion of installation related thermal bridges in fenestration U-values as these effects are not within the scope of the referenced standards.

Air Leakage

The NECB defines air leakage requirements with reference to standards applicable to specific fenestration product types, but always at a pressure differential of 75 Pa.

Table 4: 2011 NECB Prescriptive Maximum Allowable U-values for Fenestration, Doors and Skylights

Thermal Characteristics	Component	Heating Degree-Days at Building Location in Celsius Degree-Days					
		Zone 4 < 3000	Zone 5 3000 – 3999	Zone 6 4000 – 4999	Zone 7A 5000 – 5999	Zone 7B 6000 – 6999	Zone 8 ≥ 7000
Max. U-Value W/m ² ·K (Btu/h·ft ² ·F)	Fenestration and Skylights ¹	2.40 (0.42)	2.20 (0.39)	2.20 (0.39)	2.20 (0.39)	2.20 (0.39)	1.60 (0.28)
	Doors ²	2.40 (0.42)	2.20 (0.39)	2.20 (0.39)	2.20 (0.39)	2.20 (0.39)	1.60 (0.28)

¹ Skylights that represent ≤ 2% of gross roof area and have an overall U-value ≤ 3.4 W/m²·K (0.60 Btu/h·ft²·F) are exempt from complying with this requirement.

² Main entrance doors that represent ≤ 2% of gross wall area and have an overall U-value ≤ 4.4 W/m²·K (0.77 Btu/h·ft²·F) are exempt from complying with this requirement.

Accountability for Energy Performance Design of Part 3 Buildings

For larger new construction projects, registered professionals are responsible for determining the fenestration energy performance requirements. Whole building design documents such as ASHRAE 90.1 and the 2011 NECB give designers a range of approaches, options and design tools to address the energy performance of buildings. Compliance with these documents is the responsibility of design professionals.

Letters of Assurance

The BCBC and VBBL use Letters of Assurance to record the responsibilities of the various registered professionals on a Part 3 construction project. The architect's responsibilities include the design of the energy performance aspects of the building enclosure, including the fenestration. The architect may in turn rely upon other registered professionals in taking responsibility for energy performance. When another registered professional provides such support services, the use of AIBC-APEGBC Schedules S-B and S-C records the accountability of the professional consulted by the architect.

Project Specifications

Project specifications must indicate the fenestration energy performance requirements for a given building: NFRC 100 or CSA A440.2 U-values for each product type, NFRC 200 SHGC if required, and air leakage requirements specified with reference to the appropriate test method, test pressure and flow rate (or Canadian air infiltration/exfiltration rating). Fenestration manufacturers and suppliers have no idea what compliance path building designers are using to design the building and consequently what U-values and SHGC the fenestration products must have. It is therefore not possible for them to comply with the requirements of ASHRAE 90.1 or NECB without this information in the project specifications.



There are no third-party certification programs for the energy performance or air leakage of commercial fenestration systems commonly used in Part 3 buildings. Many fenestration manufacturers and some specialty engineers have the capability to simulate energy



performance to the NFRC 100 or CSA A440.2 standards, but there are no industry standard compliance, verification, or commissioning programs in place to ensure that products have the properties required by specifications, or that the specified products are installed. When third-party verified or certified U-values are not available, specifiers may wish to consider requiring compliance documentation to be submitted under the seal of a registered professional to ensure a comparable third-party level of oversight. The EESR recognizes registered professional architects and engineers as competent to verify U-values.

Thermal bridging related to fenestration product installation and the use of profiles such as deflection channels and corner posts can significantly degrade fenestration/wall performance. These effects are not captured in the NFRC 100 or CSA A440.2 simulation protocols referenced in ASHRAE 90.1 and the NECB.

Construction Stage

It is common to request that shop drawings and possibly samples of window and door products be submitted for projects. As part of these submissions, manufacturers should be requested to provide confirmation of the energy performance attributes of their products. Field review can confirm that the installed window assembly complies with the material specifications and project specific shop drawings.

Key Points

- Fenestration energy performance is now regulated by Code for all Part 3 and Part 9 buildings in British Columbia.
- ASHRAE 90.1-2010 and NECB 2011 include trade-off and performance options. Design professionals determine which compliance path is used, and the coordinating registered professional is responsible for the design of the energy performance aspects of fenestration through Letters of Assurance.
- Fenestration manufacturers rely on project specifications to inform them of the specific performance requirements for fenestration products: U-value, Solar Heat Gain Coefficient, and air leakage requirements.
- Fenestration U-values determined to the standards referenced in ASHRAE 90.1 and 2011 NECB do not include thermal bridging related to fenestration product installation and use of profiles such as deflection channels, corner posts and flashings that can significantly degrade fenestration/wall performance.
- As the BC *Energy Efficiency Act* applies to all fenestration product manufacturers, the methods for determining, verifying and labeling U-values specified in the Energy Efficiency Standards Regulation should be used to demonstrate conformance with Part 9 U-value requirements.

For More Information

1. *BC Energy Efficiency Act, Energy Efficiency Standards Regulation*, available at www.bclaws.ca.
2. *BC Building Codes and Standards*, available at www2.gov.bc.ca/gov/content/industry/construction-industry/building-codes-standards/
3. *ASHRAE 90.1-2010, Energy Standard for Buildings Except Low-Rise Residential Buildings*, available at www.ashrae.org.
4. *National Energy Code of Canada for Buildings 2011*, available at www.nrc-cnrc.gc.ca.
5. *Builder Insight #7 Energy Performance Requirements for the Building Enclosure: Compliance Paths for Multi-Unit Residential Buildings*, Homeowner Protection Office, 2016, available at www.hpo.bc.ca.

Table 5: Synoptic View of Current Prescriptive U-values

	Energy Star 2010		Energy Star 2015		BCBC 9.36		NECB 2012	ASHRAE 90.1-2010				
	Windows Doors	Skylights	Windows Doors	Skylights	Windows Doors	Skylights	All Fenestration	Non-metal Windows	Curt.wall Storefrt	Entrance Doors	All Other Windows	
HDD												
8000	1.20 (0.21)	2.20 (0.39)					1.60 (0.28)					
7100 Smith River			1.20 (0.21)	2.10 (0.37)	1.40 (0.25)	2.40 (0.42)				2.27 (0.40)		2.56 (0.45)
7000	1.40 (0.25)	2.40 (0.42)					2.20 (0.39)					
6710 Fort Nelson												
6000									2.00 (0.35)		4.54 (0.80)	
5900 Dawson Creek												
5000			1.40 (0.25)	2.40 (0.42)	1.60 (0.28)	2.70 (0.48)						
4720 Prince George	1.60 (0.28)	2.60 (0.46)							2.56 (0.45)			
4000												
3450 Kamloops											3.12 (0.55)	
3000					1.80 (0.32)	2.90 (0.51)						
2900 Lower Mainland	1.80 (0.32)	2.80 (0.50)	1.60 (0.28)	2.60 (0.46)			2.40 (0.42)	2.27 (0.40)	2.84 (0.50)	4.83 (0.85)		

The graphic presents a summary of prescriptive U-value requirements in the Energy Star program, building codes, and whole building design standards, based on HDD.

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Technical Research & Education
 1701- 4555 Kingsway
 Burnaby, BC V5H 4V8
 Phone: 778 452 6454
 Toll-free: 1 866 465 6873
www.bchousing.org
 Email: technicalresearch@bchousing.org

