Part 10
Energy and Water Efficiency

Section 10.1. General

10.1.1. Application

10.1.1.1. Scope

1) The scope of this Part shall be as described in Subsection 1.3.3. of Division A.

10.1.1.2. Application

1) The application of this Part shall be as described in Subsection 1.3.3. of Division A.

10.1.2. Definitions

10.1.2.1. Defined Terms

1) Words that appear in italics are defined in Article 1.4.1.2. of Division A.

Section 10.2. Energy Efficiency

10.2.1. Energy Design Building Classification

10.2.1.1. Application

1) Except as permitted by Sentence (2), a *building* shall be designed and constructed in conformance with this Subsection for the purpose of energy efficiency.

2) A structure that cannot be identified by the characteristics of a *building* in this Subsection shall comply with the requirements of 10.2.1.2., or as deemed *acceptable* to the Chief Building Official.

3) To meet the energy efficiency requirements of Articles 10.2.1.2. to 10.2.1.6., the design requirements of Subsection 10.2.2. shall form an integral part of this Subsection.

4) For the purposes of Part 10 and the classification of applicable energy design requirements of a *building*, the application of these requirements are to be applied to a *building* or that portion of a *building*, which for the purposes of energy and emissions performance, is designed to function as an independent entity. (See Note A-10.2.1.1.(4).)

5) Except as permitted by Sentence (6), a balcony, including those that are enclosed, shall be designed and constructed as unconditioned ambient space, exterior to the *building* envelope, without the provision of heating, cooling, or gas connection.

6) A *building* with not more than 2 principle *dwelling units* may be provided with a gas connection serving a balcony that is not enclosed.

10.2.1.2. Buildings Without Residential or Commercial Components

1) All *buildings* except those included in 10.2.1.3 through 10.2.1.6.,

a) shall be designed in compliance with (See Note A-10.2.1.2.(1)(a).)

i) 10.2.2.2. or 10.2.2.3., or

ii) 10.2.2.2. in a *building* required to be designed to Part 9 by Division A, 1.3.3.3.,

b) **[UTV Deleted]**,

c) **[UTV Deleted]**,
d) **[UTV Deleted]**,
e) shall be provided with vestibules in compliance with Article 10.2.2.8.,
f) shall be provided with metering equipment in compliance with Article 10.2.2.9,
g) shall be provided with lighting in conformance with Article 10.2.2.10.,
h) **[UTV Deleted]**,
i) shall comply with Article 10.2.2.15. where gas-fired fireplaces are provided, and
j) may provide exterior heated spaces in compliance with Article 10.2.2.22.

10.2.1.3. Residential Buildings of 4 Storeys or More, and Commercial Buildings (including Hotels and Motels)

1) All *buildings* containing Group C, D, or E *Major Occupancies*, except those included in 10.2.1.4 through 10.2.1.6.,

a) shall be designed in compliance with energy and emissions performance per Article 10.2.2.5,
b) **[UTV Deleted]**,
c) **[UTV Deleted]**,
d) **[UTV Deleted]**,
e) shall be provided with vestibules in compliance with Article 10.2.2.8.,
f) shall be provided with metering equipment in compliance with Article 10.2.2.9,
g) shall be provided with lighting in compliance with Article 10.2.2.10.,
h) **[UTV Deleted]**,
i) shall comply with Article 10.2.2.15., where domestic gas-fired fireplaces are provided,
j) shall provide airtightness testing in compliance with Article 10.2.2.21, and
k) may provide exterior heated spaces in compliance with Article 10.2.2.22.

10.2.1.4. [UTV Deleted]

10.2.1.5. Residential Buildings of 1 to 3 Storeys, and Houses (excluding Hotels/Motels)

1) A *building* shall comply with the requirements of Sentence (2), where it

a) is entirely of Group C *major occupancy* except subsidiary *occupancies,*
   i. less than 4 storeys in building height, or
   ii. containing not more than 2 principle *dwelling units* and their subsidiary structures with conditioned space, and
b) does not include a Hotel or Motel use.

(See Note A-10.2.1.5.(1)(a)(ii))

2) A *building* conforming with the criteria of Sentence (1),

a) shall be designed in compliance with
   i) the energy and emissions performance of Article 10.2.2.5. and Sentences 10.2.2.15.(1) through (4) where domestic gas-fired fireplaces are provided, or
   ii) Article 10.2.2.15. where domestic gas-fired fireplaces are provided.
b) shall be designed with thermal performance in compliance with Article 10.2.2.6.,
c) shall be designed with exterior closures and fenestration with thermal performance in compliance with Article 10.2.2.7.,
d) except for *residential buildings* with not more than 2 principal *dwelling units*, shall be provided with vestibules in compliance with Article 10.2.2.8.,
e) shall be provided with metering equipment in compliance with Article 10.2.2.9.,
f) shall be provided with lighting in compliance with Article 10.2.2.10.,

g) shall comply with Articles 10.2.2.11. through 10.2.2.13. where domestic boilers generate space heating or hot water,

h) shall comply with Article 10.2.2.14. where domestic heat pumps, furnaces, or make-up air units are provided,

i) shall comply with Article 10.2.2.16. where domestic wood fireplaces are provided,

j) shall be provided with and heat recovery ventilators in compliance with Article 10.2.2.17.,

k) **[UTV Deleted]**

l) shall provide documentation in compliance with Article 10.2.2.20.,

m) shall provide airtightness testing in compliance with Article 10.2.2.21.,

n) except for *residential buildings* with not more than 2 principal *dwelling units*, may provide exterior heated spaces in compliance with Article 10.2.2.22..

10.2.1.6 [UTV Deleted]

10.2.2. Design Measures for Energy Efficiency

10.2.2.1. Application

1) This Subsection applies to all *buildings* and parts of the *buildings* that are required to be energy efficient under Subsection 10.2.1.

10.2.2.2. ANSI/ASHRAE/IESNA 90.1

1) A *building* designed in accordance with this Article shall, be designed and constructed in accordance with ANSI/ASHRAE/IESNA 90.1, "Energy Standard for Buildings, except Low-Rise Residential Buildings".

2) A *building* designed in accordance with Sentence (1), shall be designed, as applicable, with

a) a climate zone of 4,

b) no requirement to comply with the Fenestration Orientation provisions of ASHRAE 90.1, Article 5.5.4.5.,

c) ventilation in conformance with ASHRAE 62-2001 (except addendum n), or if applicable, 6.3.1.1.(3)(b) of the Building By-law,

d) no requirement to comply with Automatic Receptacle Control, per ASHRAE 90.1, Article 8.4.2,

e) lighting alterations in conformance with the following provisions, which replace Lighting Alterations, per ASHRAE 90.1, Article 9.1.2:

9.1.2 Lighting Alterations.
For the *alteration* of any *lighting system* in an interior *space* or exterior area, that *space* or area shall comply with the entirety of Chapter 9, as applicable to that *space* or area.

Exceptions to 9.1.2:

1. Interior lighting *alterations* where the total new wattage of all *replaced luminaires* on a project is 2,000 watts or less, the total wattage of *replaced luminaires* of a *lighting system* within a *space* shall be at least 50% below the total wattage of all *removed luminaires* of that *lighting system*, unless the *space* is at or below the LPD allowance of Table 9.6.1 or Section 9.6.2 as applicable.

   Controls shall comply with the requirement of either Section 9.4.1.1(h) or Section 9.4.1.1(i).

2. Exterior lighting *alterations* where the total number of *replaced luminaires* on a project is 10 or less, the total wattage of *replaced luminaires* shall be at least 50% below the

total wattage of all *removed luminaires*, unless each altered area is at or below the LPD allowances of Table 9.4.2-2.

Controls shall comply with the requirement of Section 9.4.1.4(a).

3. The replacement of a failed *lamp* or *ballast/driver* in an individual *luminaire* or the replacement of any failed lighting control.

4. The removal or relocation of interior or exterior *luminaires* as part of, or independent of, exceptions 1, 2, or 3.

f) the 5% in Table 11.5.1.5. Building Envelope, Exception a., being replaced by 2%, if designed in compliance with ASHRAE 90.1, Section 11, and
g) the 5% in Table G3.1.5.a. Building Envelope, Exception 1., being replaced by 2%, if designed in compliance with ASHRAE 90.1, Appendix G.".

10.2.2.3. National Energy Code of Canada for Buildings

1) A *building*, other than a Part 9 *building*, designed in accordance with this Article shall be designed and constructed in accordance with the National Energy Code of Canada for Buildings (NECB), except that the provisions of this By-law shall apply where the NECB refers to the National Building Code of Canada (NBCC), and shall be designed, as applicable, with

a) a climate zone of 4,
b) ventilation in conformance with ASHRAE 62-2001 (except addendum n),
c) no requirement to comply with vestibules provision of NECB Article 3.2.2.1.,
d) window-to-wall and skylight-to-roof area ratios of the reference *building* identical to area ratios of the proposed *building*, to a maximum of 40% for windows and to a maximum of 5% for skylights, identical to area ratios of the proposed *building*,
e) a vertical glazing Solar Heat Gain Coefficient which does not exceed an assembly maximum of 0.36, and
f) a skylight Solar Heat Gain Coefficient for all types, which does not exceed an assembly maximum of 0.40, where the ratio of the aggregate skylight area to roof area is less than or equal to 3.0%.

10.2.2.4. [UTV Deleted],

10.2.2.5. Building Energy and Emissions Performance

1) Except as permitted by Sentence (4), for a *building* required to comply with this Article, any energy modelling shall comply with:

a) the applicable requirements of Part 8 of the NECB, and the City of Vancouver Energy Modelling Guidelines; or
b) for buildings complying with 10.2.1.5.(2)(a)(i), the EnerGuide Rating System, version 15 or newer.

Important Note: The City of Vancouver Energy Modelling Guidelines are under revision for improved application towards homes and Part 9 multi-family dwellings. Anticipated release is summer of 2022.

2) Except as permitted in Sentences (3), (4) or (5), a *building* designed with this Article shall demonstrate the performance values of the proposed *building* comply with the limits in Table 10.2.2.5.A1.

3) Compliance with the GHGI limits in Table 10.2.2.5.A1 is not required where a *building* can demonstrate the performance values of the proposed *building* comply with the TEUI and TEDI limits in Table 10.2.2.5.B.

4) *Buildings* and major occupancies designed and constructed to conform to:

a) the certification criteria for Passive House Standard, with an energy model conforming to:

i) version 9 or newer of the Passive House Planning Package, and

ii) prepared by a Certified Passive House Designer, or Certified Passive House Consultant,

are deemed to comply with this Article. (See Note A-10.2.2.5.(4).)

5) Compliance with the TEUI and TEDI limits in Table 10.2.2.5.A1 is not required where a building is connected to a *Low Carbon Energy System*, and can demonstrate the performance values of the proposed building comply with the limits in Table 10.2.2.5.C.

Table 10.2.2.5.A1
Maximum Energy Use and Emissions Intensities
Forming part of Sentence 10.2.2.5.(2)

Occupancy Classification (1)	**Total Energy Use Intensity (kWh/m^2a)**	**Thermal Energy Demand Intensity (kWh/m^2a)**	**Greenhouse Gas Intensity ($kgCO_{2e}/m^2a$)**
Group C occupancies complying with 10.2.1.5.(2)(a)(i)	See Table 10.2.2.5.A2	20	3
Group C *occupancies* in *buildings* up to 6 *Storeys*, except Hotel and Motel	110	25	5.5
Group C *occupancies* in *buildings* over 6 *Storeys*, except Hotel and Motel	120	30	6
Hotel and Motel *occupancies*	140	20	8
Group D and E *occupancies*, except Office	120	20	3
Office *occupancies*	100	20	3

Notes to Table 10.2.2.5.A1:

(1) For *buildings* containing multiple *occupancies*, refer to the procedures on mixed-use *buildings* in Section 5 of the City of Vancouver Energy Modelling Guidelines.

Table 10.2.2.5.A2
Mechanical Energy Use Intensity in Buildings under 4 storeys for Group C Major Occupancies except Hotel and Motel

Conditioned Floor Area	**Mechanical Energy Use Intensity (MEUI) (kWh/m^2a)**
≤ 50 m^2	125
≤ 75 m^2	108
≤ 120 m^2	78
≤ 165 m^2	58

≤ 210 m^2	48
> 210 m^2	45

Table 10.2.2.5.B
Maximum Energy Use and Emissions Intensities
Forming part of Sentence 10.2.2.5.(3)

Occupancy Classification	Total Energy Use Intensity (kWh/m^2a)	Thermal Energy Demand Intensity (kWh/m^2a)	Greenhouse Gas Intensity ($kgCO_{2e}/m^2a$)
Group C *occupancies*	100	15	N/A

Table 10.2.2.5.C
Maximum Energy Use and Emissions Intensities
Forming part of Sentence 10.2.2.5.(5)

Occupancy Classification	Total Energy Use Intensity (kWh/m^2a)	Thermal Energy Demand Intensity (kWh/m^2a)	Greenhouse Gas Intensity ($kgCO_{2e}/m^2a$)
Group C *occupancies* in *buildings* up to 6 *Storeys*, except Hotel and Motel	110	25	5.5
Group C *occupancies* in *buildings* over 6 *Storeys,* except Hotel and Motel	130	40	6
Hotel and Motel *occupancies*	170	30	8
Business and Personal Services or Mercantile *occupancies*, except Office	170	30	3
Office *occupancies*	130	30	3

10.2.2.6. Building Envelope Opaque Elements

1) Except as otherwise required in this Subsection, a *building* required to comply with this Article shall be comply with the performance values in Table 10.2.2.6., between

a) heated space and unheated space,
b) heated space and exterior air,
c) heated space and exterior *soil*,
d) heating floor assemblies and heated space,
e) heating floor assemblies and unheated space,
f) heating floor assemblies and exterior air, and
g) heating floor assemblies and exterior *soil*.

Table 10.2.2.6.
Minimum Effective Thermal Resistance of Assemblies
Forming part of Sentences 10.2.2.6.(1)

Building Assembly	Assembly Minimum RSI Value (m^2K/W)	
	Complying with Article 10.2.2.5	Not Subject to Article 10.2.2.5
Roof Assemblies – Houses[1] Only		
Houses with total conditioned space ≤ 110 m^2[2]	4.3	5.28
Houses with total conditioned space > 110 m^2[2]	4.3	7.0
Roof Assemblies – Other		
All projects	5.28	7.0
All Buildings		
Attic Space[3]	8.5	
Walls (including frame crawl space walls)[4]	3.85	
Foundation Walls	3.85	
Box and Rim Joists	3.85	
Concrete or Masonry Walls (other than foundation walls)	3.85	
Suspended Floors (framed)	4.2	
Suspended Floors (concrete slab)	4.2	
Concrete Slabs on Ground at, above, or below grade (insulation under all slab area and around edge of slab)	2.5	
Radiant Heating Suspended Floor Assembly Over Heated Area (insulation between heated floor and heated area below)[5]	2.5	
Concrete Balconies, Eyebrows, and Exposed Slab Edge (wrapped or using manufacturer thermal break in structure)	0.42	

Notes to Table 10.2.2.6.:

[1] The term "Houses" shall represent *buildings* containing not more than 2 principle *dwelling units*.

[2] The conditioned area of 110 m^2 pertains to the entire building and not only the suite.

[3] The thermal resistance rating of attic space insulation may be reduced to value required for frame walls for a distance of 1200 mm from the exterior wall. A minimum nominal RSI of 3.52 m^2K/W is required above the top plate in the attic space.

[4] Headers and lintels: cavities between structural members are to be fully insulated, except where a framing plan provided by the builder, architect, designer, or engineer indicates that full-depth solid headers are structurally required.

[5] Not applicable when heating elements or piping are located within a concrete topping on a suspended floor assembly or within an internally heated suspended slab.

2) Insulation and the installation of insulation in a *building* designed to the requirements of Part 9 shall comply with Subsection 9.25.2. or Part 5.

3) The effective total "R" value of the opaque envelope area, the non-opaque envelope area, and the overall envelope area, calculated by a design professional, shall be submitted as part of an application for a *permit.* (See Note A-10.2.2.6.)

10.2.2.7. Building Envelope Windows, Skylights, Doors and Other Glazed Products

1) Except as otherwise required in this Subsection and as permitted by Sentence (2), a *building* required to comply with this Article shall comply with the performance values in Table 10.2.2.7.(1).

Table 10.2.2.7.(1)
Maximum Thermal Transmittance of Exterior Closures and Fenestration
Forming part of Sentence 10.2.2.7.(1)

Type of Closure	Assembly Maximum USI Value ($W/(m^2K)$)	
	Complying with	Not Subject to Article

	Article 10.2.2.5	10.2.2.5
Windows, sliding, and folding doors with glazing		
Window-to-wall ratio ≥ 30%, and One Family Dwelling with conditioned space ≥ 325 m^2	1.44	Average of 1.04 or lower and no individual window can be above U1.2(2)
All Other	1.44	1.22
Curtainwall and Window Wall Assemblies		
Window-to-wall ratio ≥ 30%, and One Family Dwelling with conditioned space ≥ 325 m^2	1.44	Average of 1.04 or lower and no individual window can be above U1.2(2)
All Other	1.44	1.22
Other Types of Closures		
Storefront curtainwall, window, and door assemblies	2.27	
Doors with or without glazing(1)	1.80	
Doors with a required fire resistance rating	Exempt	
Roof access hatches	2.94	
Skylights (not larger than 1220 mm in both directions), roof windows and sloped glazing systems	2.44	
Skylights larger than 1220 mm in both directions	2.95	
Tubular daylight devices	2.64	

Notes to Table 10.2.2.7.(1):

(1) Includes doors swinging on a vertical axis with or without glazing, door transoms, and sidelites.

(2) See note A-10.2.2.7.(3)

2) A maximum of one entry door assembly consisting of one or two leafs installed in the principle entrance of a *building*, together with attached transoms and sidelites all within a single rough opening, need not comply with Table 10.2.2.2.(1), where constructed of thermally broken metal or wood with multiple panes of glass, which may be argon filled, or coated with a low-e coating.

3) The thermal transmittance of factory-assembled fenestration products within the scope of existing certification programs shall be indicated by labels applied to the products at the manufacturing location. The thermal transmittance of fenestration products that are site-assembled, imported, or otherwise outside the scope of existing certification programs shall be suitably documented. (See Note A-10.2.2.7.(3).)

10.2.2.8. Building Envelope Vestibules

(See Note A-10.2.2.8.)

1) Except as permitted in Sentence (2), in a *building* required to comply with this Article there shall be an enclosed vestibule in all *building* entrances separating a conditioned space from the exterior, designed such that

a) all doors opening into and out of the vestibule shall be equipped with self-closing devices,

b) the interior and exterior doors of the vestibule shall be separated by no less than 2.1 m when closed, and the floor area of each vestibule shall not exceed 4.65 m^2 or 2% of the gross conditioned floor areas for that level of the *building*,

c) for spaces having a gross conditioned floor area for that level of the *building* of 3,716.1m^2 and greater, and when the doors opening into and out of the vestibule are equipped with automatic, electrically driven, self-closing devices, the interior and exterior doors shall be separated by no less than 4.87m.

d) the exterior envelope of a conditioned vestibule shall comply with the design requirements for a conditioned space, and

e) the interior and exterior envelope of an unconditioned vestibule shall comply with the design requirements for a semi heated space.

2) An enclosed vestibule is not required for

a) a *building* entrance with revolving doors,

b) a door not intended to be used as the *building* entrance,

c) a door opening directly to the exterior from a *dwelling unit*,

d) a *building* entrance, in a *building* less than 278.7 m^2 in gross floor area,

e) a door that opens directly to the exterior from a space that is less than 278.7 m^2 and is separate from the *building* entrance,

f) semi-heated spaces,

g) an enclosed elevator lobby for *building* entrances directly from parking garages, and

h) a *building* pursuing certification with the Passive House (PHI) standard.

10.2.2.9. Building Services Submetering

1) Every *building* shall be equipped with metering equipment capable of collecting *building* energy performance data for the *building* and for every portion of the *building* which supports a separate use or *occupancy*.

2) Submetering required by this Article shall include the following

a) hot water generated by a central hot water generation system

b) natural gas used for air handling systems in common areas, and

c) natural gas used for domestic hot water in amenity spaces, pools and spas.

10.2.2.10. Lighting in Residential Buildings

(See Note A-10.2.2.10.)

1) Where a portion of a residential *building* or a portion of a multi-use *building* located above a garage or on an adjacent grade contains more than 20 residential *suites*, the *building* shall be designed with

a) *occupancy* based lighting sensor controls, located in all *exit* stair shafts and parking garages, compatible with the requirements of Sentence 3.2.7.3.(1) of Division B, and

b) a switch near the principal entrance of each residential *suite* that

i) controls all lighting fixtures within the *suite*, except lights serving corridors, stairs, washrooms, and rooms with no exterior window.

ii) with an override on each floor, serving that floor, of a multilevel suite

2) Except as permitted by Sentence (3), permanent ancillary exterior lighting of a *building* of *residential* occupancy or the *residential* portion of a multi-use *building,* or those parts of a *building* facing a *lane*, that is required to conform to this Article shall

a) be provided with fixtures that are appropriately shielded that

i) utilize full cut-off optics or are fully shielded fore luminaires that emit over 600 lumens, or any luminaire installed along the side or back yard, and

ii) are partially shielded and utilize a diffusing cover for luminaires that emit 600 lumens or less.

b) be mounted no higher than 4 m above grade or the balcony surface it illuminates along the side yard, back yard, and similar outward facing courtyards or setbacks of the *building*,

c) be provided with dimmer and timer controls,

d) minimize lighting of adjacent exterior properties and properties across a *street*, *lane*, or *public way.*

3) Where exterior lighting is required by this By-law or other regulator enactments to provide illumination along paths of pedestrian or vehicular travel, fire department access, or equipment signage or lighting, it need not comply with the requirements of Sentence (2).

10.2.2.11. Hot Water Tank Piping

1) In a *building* required to comply with this Article, the first 3 m of non-recirculating hot water piping leading from both electrically heated and gas heated hot water tanks, and the last 1 m of piping leading to the hot water tank connection, shall have insulation with a minimum RSI value of 0.35.

10.2.2.12. Domestic Hot Water Heaters

1) In a *building* required to comply with this Article, water heating appliances shall comply with the following and be electrically operated except as permitted by Sentence (2).

a) CSA C191, "Performance of electric storage tank water heaters for domestic hot water service", or

b) CAN/CSA-C745 "Energy Efficiency of Electric Storage Tank Water Heaters and Heat Pump Water Heaters, or

c) CAN/CSA-P.9 Combined space- and water-heating systems

2) *Buildings* that are complying with Article 10.2.2.5 may provide gas-fired appliances providing domestic hot water, and shall have a uniform energy factor of not less than 0.92 or alternatively a thermal efficiency of not less than 90% as determined by the following:

a) CSA P.3-04, "Testing Method for Measuring Energy Consumption and Determining Efficiencies of Gas-Fired Storage Water Heaters",

b) CSA P.7-10, "Testing Method for Measuring Energy Loss of Gas-Fired Instantaneous Water Heaters",

c) CAN/CSA-P.9 Combined space- and water-heating systems,

d) CSA C191, "Performance of electric storage tank water heaters for domestic hot water service", or

e) CSA 4.3/ANSI Z21.10.3, "Gas Water Heaters Volume III, Storage Water Heaters, with Input Ratings above 75,000 Btu per hour, Circulating and Instantaneous".

10.2.2.13. Domestic Boilers

1) Except as permitted by Sentence (2), in a *building* required to comply with this Article, domestic boilers providing heat, or heat and domestic hot water, shall be electric and be tested using CAN/CSA-C22.2 No 165, "Testing Method for Electric Boilers",

2) *Buildings* that are complying with Article 10.2.2.5 may provide gas-fired appliances have an Annual Fuel Utilization Efficiency (AFUE) rating of not less than 92%, and be tested using CSA P.2-07, "Testing Method for Measuring the Annual Fuel Utilization Efficiency of Residential gas fired Furnaces and Boilers".

10.2.2.14. Domestic Heat Pumps, Furnaces or Make Up Air Units

1) In a *building* required to comply with this Article, except as permitted by Sentence (5), domestic heat pumps, furnaces or make up air units shall be electrically-operated and have been tested using CAN/CSA-C22.2 No. 236 "Heating and Cooling Equipment",

2) Heat pumps equipped with supplementary heaters shall incorporate controls to prevent supplementary heater operation when the heating load can be met by the heat pump alone, except during defrost cycles,

3) Heat pumps with a programmable thermostat shall be equipped with setback controls that will temporarily suppress electrical back-up or adaptive anticipation of the recovery point, in order to prevent the activation of supplementary heat during the heat pump's recovery.

4) Heat pumps shall conform to the performance requirements of Table 10.2.2.14

Table 10.2.2.14
Heat Pump Equipment Performance Requirements

Component or Equipment	Heating or Cooling Capacity kW	Standard	Minimum Performance (no units)
Air Cooled Unitary Air Conditioners and Heat Pumps – Electrically Operated			
Split Systems	≤ 19	CSA C656	SEER = 14.5 EER = 11.5 HSPF = 7.1
Single Package System	≤ 19	CSA C656 (Including General Instruction No 2)	SEER = 14 EER = 11 HSPF = 7.0
All Systems	> 19	CAN/CSA-C746	See Level 2 in standard
Water Cooled Unitary Air Conditioners and Heat Pumps – Electrically Operated			
Ground Source Closed Loop			COP_h ≥3.91
Water loop heat pumps		CAN/CSA-C13256-1	COP_h ≥3.91
Direct Expansion Ground Source Heat Pumps – Electrically Operated			
Direct Expansion Ground Source Heat Pumps	≥ 21	CSA C748	COP_h ≥3.1

Notes to Table 10.2.2.14

The symbols and abbreviations that appear in this column have the following meanings:

COP = coefficient of performance, in W/W (COPc = in cooling mode and COPh = in heating mode)

EER = energy efficiency ratio, in (Btu/h)/W (no metric equivalent)

HSPF = heating season performance factor, in watt-hours

SEER = seasonal energy efficiency ratio, in (Btu/h)/W (no metric equivalent)

5) Buildings that comply with Article 10.2.2.5 may provide domestic gas-fired furnaces or make up air units that shall have an Annual Fuel Utilization Efficiency (AFUE) rating of not less than 92%, as tested using CSA 2.6/ANSI Z83.8, "Gas unit heaters, gas packaged heaters, gas utility heaters and gas-fired duct furnaces".

6) Heat pumps used to provide space heating shall be of the variable or multi stage compressor type.

7) Heat pumps providing space heating shall not provide for domestic hot water production, except where the heat pump only provides pre-heated water to a separate and independent electric domestic hot water system.

10.2.2.15. Domestic Gas-Fired Fireplaces

(See Note A-10.2.2.15.)

1) In a *building* required to comply with this Article, domestic gas-fired fireplaces in conditioned spaces shall be equipped with

a) intermittent pilot ignition (IPI) systems,

b) on-demand ignition systems that automatically shut off within

i) 7 days of appliance non-use in a one or two family dwelling *building*, or

ii) 6 hours of appliance non-use in a multifamily dwelling, or

c) match ignition.

2) In a *building* required to comply with this Article, domestic gas-fired fireplaces shall be direct vented (Naturally Aspirating Fuel-Fired Appliances (NAFFVA) are not permitted).

3) In a *building* required to comply with this Article, domestic gas-fired fireplaces must be on a timer.

4) Where exterior gas fireplaces are provided as an ancillary equipment to a *building* required to comply with this Article, then the exterior fireplaces shall be considered as part of the *building* for the purposes of this Part.

5) In a *building* required to comply with this Article, the total rated input of all gas fireplaces installed shall not exceed 17.59 kW (60,000 Btu per hour).

6) In a building required to comply with this Article, gas-fired fireplaces are not permitted as the primary heating appliance.

10.2.2.16. Domestic Wood Burning Heating Appliances

1) In a *building* required to comply with this Article, and except for cooking stoves and ranges, a wood domestic burning heating appliance installed in a residential *dwelling unit* shall be tested in accordance with CAN/CSA B415.1-10 "Performance Testing of Solid-Fuel-Burning Heating Appliances" or EPA Title 40, Part 60, Subpart AAA - "Standards of Performance for New Residential Wood Heaters", and shall

a) produce not more than 2.5 grams per hour of particulate air contaminant emissions for catalytic appliances, or

b) produce not more than 4.5 grams per hour of particulate air contaminant emissions for non-catalytic appliances.

2) Open masonry fireplaces and factory-built fireplaces are not permitted.

10.2.2.17. Domestic Heat Recovery Ventilators

1) In a *building* required to comply with this Article, each dwelling unit shall be served by a heat recovery ventilator located in

a) each dwelling *unit*, or

b) a commonly accessible location if serving multiple *dwelling units*.

2) In a *building* required to comply with this Article, components of mechanical ventilation systems not specifically described in this Subsection shall be designed, constructed and installed in accordance with good engineering practice and as described in the ASHRAE Handbooks and Standards, HRAI Digest, TECA Ventilation Guideline, Hydronics Institute Manuals or the SMACNA manuals.

3) In a *building* required to comply with this Article, a heat recovery ventilator (HRV) shall

a) be sized to run at its rated speed for continuous operation while achieving the performance requirements of Table 10.2.2.17 as designed and tested in conformance with CAN/CSA-C439:

Table 10.2.2.17

Heat Recovery Ventilator Performance Requirements	
Building's Conditioned Space (m^2)	**Sensible Heat Recovery Efficiency (SRE) at 0° Celsius**
≤110 m^2	65%
>110 m^2	75%

b) be designed and tested to meet the CSA International Standard CAN/CSA-F326-M91, "Residential Mechanical Ventilation Systems",
c) be installed and commissioned by persons trained by the Thermal Environmental Comfort Association (TECA) or the Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI) or equivalent,
d) supply outdoor air directly to the principal living area, to each bedroom, and to any *floor area* without a bedroom, including similar rooms within *secondary suites* and *lock-off units*, directly or indirectly, through a central recirculation system with a continuously operating fan,
e) be designed to run continuously to comply with the minimum ventilation rates of Table 9.32.3.5 of Division B,
f) not be connected to kitchen and bathroom exhaust fans,
g) except for mechanical ducts cast into concrete structure, have exterior connected supply-air ducts and exhaust ducts insulated to not less than RSI 0.75 (R 4.25) and shall have an effective vapour barrier,
h) have balanced HRV supply and exhaust air flows within plus or minus 20% of the actual normal operating exhaust capacity,
i) be labelled with tested supply and exhaust air flows for high and low settings, measured in CFM, and
j) be located in a fully serviceable space that can be readily accessed for replacement or maintenance, and

i) designed and installed to operate with an acceptable level of weather and freeze protection if not within a conditioned space, and
ii) in a *building* containing not more than two primary *dwelling units* and their contained *ancillary residential units*, be within a conditioned space and provided with direct access from at least one of the *dwelling units* that it serves.

4) In a *building* required to comply with this Article, the HRV system contractor or installer shall provide a completed Mechanical Ventilation Checklist to the Chief Building Official.

5) In a *building* required to comply with this Article, a contractor trained in the installation of energy recovery ventilators (ERV) may install an ERV in lieu of a heat recovery ventilator (HRV).

10.2.2.18. [UTV Deleted]

10.2.2.19. [UTV Deleted]

10.2.2.20. Passive House Planning Package (PHPP), EnerGuide, or Other Energy Documentation

1) In a *building* required to comply with this Article, at the time of *permit* application, and at the time of final inspection, the owner shall provide to the Chief Building Official *acceptable* documentation, in the form of

a) a PHPP file from a Certified Passive House Consultant or Designer, or
b) an EnerGuide Rating System Audit, or

c) equivalent energy modelling documentation, *acceptable* to the Chief Building Official.

2) In a *building* required to comply with this article, at the time of mid-construction inspection, the owner shall provide to the Chief Building Official *acceptable* documentation, in the form of,

a) a mid-construction checklist

b) a blower door test result that achieves an *acceptable* level of performance

3) In a *building* required to comply with this Article, that contains more than 325 m^2 of *conditioned space*, and does not consist of more than *one principal dwelling unit*, the owner shall provide a calculation utilizing the EnerGuide rating system to demonstrate that the proposed home has a greenhouse gas (GHG) footprint that is no more than two (2) metric tonnes annually (See Note A-10.2.2.20.(3)).

10.2.2.21. Building and Dwelling Unit Airtightness Testing

1) In a *building* required to comply with this Article, the *building* and *dwelling units* shall be tested for airtightness in accordance with

a) ASTM E 779, Standard Test Method for Determining Air Leakage Rate by Fan Pressurization,

b) USACE Version 3, Air Leakage Test Protocol for Building Envelopes, or

c) airtightness protocol recognized by Natural Resources Canada for use in homes and buildings labeled under the EnerGuide for New Homes program.

2) A *building* required to comply with this Article shall have, at time of final inspection, maximum tested air leakage rates in conformance with Table 10.2.2.21., or sealed to the satisfaction of the Chief Building Official.

Table 10.2.2.21.
Maximum Tested Air Leakage Rates
Forming part of Sentence 10.2.2.21.(2)

Building Classification	Maximum Tested Air Leakage Rate
Buildings, excluding *buildings* containing not more than two principle *dwelling units* and ground-oriented *dwelling units*	2.0 L/s/m² at 75 pascals
Ground-oriented *dwelling units*	2.5 air changes per hour at 50 pascals
Ground-oriented *dwelling units* alternative measure	Normalized leakage area of 1.7 cm^2/m^2 at 10 Pa
Suites in *multi-family* buildings	1.23 L/s/m² at 50 pascals

10.2.2.22. System Requirements for Heating within Exterior Spaces

(See Note A-10.2.2.22.)

1) Any space heating or occupant heating within an exterior space associated with a *building* shall comply with the requirements of this Article.

2) The design and/or installation of space heating or occupant heating systems within exterior spaces shall be limited to spaces directly served by licensed beverage establishments or licensed food establishments.

3) Any exterior space designed with a heating system and directly served by a licensed beverage establishment or a licensed food establishment, shall prioritize the heating system design in the following order:

a) In-slab or in-floor radiant heat, using non fossil fuel or low-carbon system,
b) Electric fixed infrared radiant heat with metal-sheath element,
c) Heated seating, using non fossil fuel or low-carbon system,
d) Non-electric radiant heat using non fossil fuel system.

4) In spaces required to comply with Sentence (3), the design of exterior space heating or occupant heating systems shall comply with Table 10.2.2.22, as applicable,

Table 10.2.2.22.A
Exterior Space or Occupant Heating System Design Requirements
Forming a part of 10.2.2.22.

System Type	Maximum output	Control type	Management Requirements
In-slab or in-floor radiant heat	15 W/ft^2	Zone-based controls interconnected with centralized automatic control system	Independent zone management
Electric radiant heat	18 W/ft^2	Unit-based or zone-based controls interconnected with centralized automatic control system	Independent unit or zone management
Heated seating	20 W per seat	Zone-based controls, interconnected with i) individual seat shutoff, or ii) a centralized automatic control system	Individual seat heater shutoff and independent zone management
Non-electric and non-fossil fuel radiant heat	18 W/ft^2	Unit-based controls interconnected with centralized automatic control system	Independent zone management

5) Heating systems designed to sentence (3) shall include

a) an automatic shut-off (ambient temperature sensor - lockout),
b) an automatic shut-off (space temperature sensors – integral/ zone), and
c) an automatic shut-off using programmable timeclock.

6) Heated zones within a zone-based design shall not exceed 4.8 kW per zone.

7) Heating systems designed with overhead radiant systems within a space containing a ceiling or roof of adequate height, shall be designed with circulation fans interconnected to heating mode operations, with an override for independent fan operation.

8) In a space required to comply with Sentence (2), any exterior space designed with a combination of systems contained in Sentence (3) shall

a) comply with the specific requirements pertaining to each system, without duplication of requirements, and

b) not contain an area where the combined heating exceeds the performance requirement of the least restrictive system.

Section 10.3. Electric Vehicle Charging

10.3.1. Electric Vehicle Charging for Buildings

10.3.1.1. Electrical Service and Capacity
(See Note A-10.3.1.1.)

1) The electrical installations, including the service capacity of the installation, the number and distribution of circuits and receptacles, shall meet the requirements of the "Electrical Safety Regulation."

2) Where the requirements of section 4.14.1(a) of the Parking By-Law would cause the *dwelling unit* calculated load to exceed 200 A in *one-family dwellings, two-family dwellings, one-family dwellings with secondary suite* or a l*ock-off unit, two family dwellings with secondary suites* or a l*ock-off unit, row housing, or laneway houses*, the installation of an energized outlet for Level 2 charging may be omitted provided that a minimum nominal trade size of 21 raceway supplied with pull string leading from the *dwelling unit* panelboard to an electrical outlet box is installed in the *storage garage* or carport and is labelled to identify its intended use with the *electric vehicle supply equipment.*

3) Where an *electric vehicle energy management system* is implemented, *Chief Building Official* may specify a minimum performance standard to ensure a sufficient rate of electric vehicle charging."

Section 10.4. Objectives and Functional Statements

10.4.1. Objectives and Functional Statements

10.4.1.1. Attribution to Acceptable Solutions

1) For the purposes of compliance with this By-law as required in Clause 1.2.1.1.(1)(b) of Division A of Division A, the objectives and functional statements attributed to the acceptable solutions in this Part shall be the objectives and functional statements listed in Table 10.4.1.1. (See Note A-1.1.1.2.(1) of Division A.)

Table 10.4.1.1.

Table 10.4.1.1.
Objectives and Functional Statements Attributed to the Acceptable Solutions in Part 10
Forming part of Sentence 10.4.1.1.(1)

Acceptable Solutions	Functional Statements and Objectives[1]
10.2.2.2. ANSI/ASHRAE/IESNA 90.1	
(1)	[F85, F86-OE1]
10.2.2.3. National Energy Code of Canada for Buildings	
(1)	[F85, F86-OE1]
10.2.2.5. Building Energy and Emissions Performance	
(1)	[F85, F86-OE1]
(2)	[F85, F86-OE1]
10.2.2.6. Building Envelope Opaque Elements	
(1)	[F85-OE1]

(2)	[F85-OE1]
10.2.2.7. Windows, Glass Doors and Skylights	
(1)	[F85-OE1]
10.2.2.8. Building Envelope Vestibules	
(1)	[F85-OE1]
10.2.2.9. Sub-metering in Buildings	
(1)	[F86, OE1]
(2)	[F86, OE1]
10.2.2.10. Lighting Controls in Residential Buildings	
(1)	[F86, OE1]
10.2.2.11. Hot Water Tank Piping	
(1)	[F85-OE1]
(2)	[F85, F86-OE1]
(3)	[F100-OE1]
10.2.2.12. Domestic Gas-Heated Hot Water Heaters	
(1)	[F86-OE1]
10.2.2.13. Domestic Gas-Heated Boilers	
(1)	[F86-OE1]
10.2.2.14. Domestic Gas-Heated Furnaces	
(1)	[F86-OE1]
10.2.2.15. Domestic Gas-Fired Fireplaces	
(1)	[F86-OE1] [F41, F44-OS3.4] [F44-OH1.1]
10.2.2.16. Domestic Wood Burning Heating Appliances	
(1)	[F86-OE1] [F44-OS3.4] [F44-OH1.1]
10.2.2.17. Domestic Heat Recovery Ventilators	
(1)	[F85-OE1]
(2)	[F85-OE1]
10.2.2.20. Passive House Planning Package (PHPP), EnerGuide, or Other Energy Documentation	
(1)	[F85-OE1]
10.2.2.21. Building and Dwelling Unit Airtightness Testing	
(1)	[F85-OE1]
(2)	[F85-OE1]

10.3.1.1. Electrical Service and Capacity	
(1)	[F02-OS1.2]
	[F02-OP1.2]
(2)	[F81-OP1.2]
(3)	[F41-OE1]

Notes to Part 10
Energy and Water Efficiency

A-10.2.1.1.(4) Building or Independent Parts Thereof
The intention of sentence (4), for the purposes of Part 10, is to recognize that multiple independent structures atop a parkade, for example, can and should have their respective energy and emissions performances evaluated independently, both during design as well as operationally throughout their respective lifespans. The intention is to prevent the performance assessment of one independent structure from effecting the performance assessment of any other, thus eliminating the ability to trade-off energy and/or emissions performance(s) between independent structures.

A-10.2.1.2.(1)(a) If designing to Passive House then contact the Office of the CBO for potential recognition as being compliant with Article 10.2.1.2., where buildings and major occupancies designed and constructed to conform to the certification criteria for the Passive House Standard, may, at the discretion of the CBO, be deemed to comply with Article 10.2.1.2. provided the design's energy model is

a) version 9 or newer of the Passive House Planning Package, and
b) prepared by a Certified Passive House Designer, or Certified Passive House Consultant.

A-10.2.1.5.(1)(a)(ii) Subsidiary Structures with Conditioned Space
The intention of this wording is to allow separate ancillary structures such as garages or workshops, with conditioned space(s), to be constructed to the same requirements of a residential *building* with not more than 2 principal *dwelling units* rather than another standard such as ASHRAE 90.1, NECB, or ZEPB (10.2.2.5.) requirements that may be triggered based on use. Conditioned space is considered to be the alteration of interior space temperature, through the provision of heating or cooling.

A-10.2.2.5.(4) Passive House (PER)
Exceedances of the published Primary Energy Renewable (PER) criterion of the Passive House Standard may be accepted as complying with this Sentence where written approval has been provided by the Passive House Institute, or where additional energy efficiency measures have been included to the satisfaction of the Chief Building Official.

A-10.2.2.6. Calculating the Effective Thermal Resistance of Building Envelope Assemblies. The general theory of heat transfer is based on the concept of the thermal transmittance through an element over a given surface area under the temperature difference across the element.

To calculate effective thermal resistance, contributions from all portions of an assembly including heat flow through studs and insulation, must be taken into account because the same insulation product (nominal insulation value) can produce different effective thermal resistance values in different framing configurations. The resulting effective thermal resistance of an assembly also depends on the thermal properties and thickness of the building materials used and their respective location.

The following paragraphs provide the calculations to determine the effective thermal resistance values for certain assemblies and the thermal characteristics of common building materials.

<u>Calculating the Effective Thermal Resistance of an Assembly with Continuous Insulation: Isothermal-Planes Method</u>
To calculate the effective thermal resistance of a building envelope assembly containing only continuous materials – for example, a fully insulated floor slab – simply add up the RSI values for each material. This procedure is described as the "isothermal-planes method" in the "ASHRAE Handbook – Fundamentals."

<u>Calculating the Effective Thermal Resistance of a Wood-frame Assembly: Isothermal-Planes and Parallel-Path Flow Methods</u>

To calculate the effective thermal resistance of a building envelope assembly containing wood framing, RSI_{eff}, add up the results of the following calculations:
A. calculate the effective thermal resistance of all layers with continuous materials using the isothermal-planes method, and
B. calculate the effective thermal resistance of the framing portion, $RSI_{parallel}$, using the following equation, which is taken from the parallel-path flow method described in the "ASHRAE Handbook – Fundamentals":

$$RSI_{parallel} = \frac{100}{\frac{\%\ \text{area of framing}}{RSI_F} + \frac{\%\ \text{area of cavity}}{RSI_C}}$$

where
RSI_F = thermal resistance of the framing member,
RSI_C = thermal resistance of the cavity (usually filled with insulation),
% area of framing = value between 0 and 100, and
% area of cavity = value between 0 and 100.

Calculating the Effective Thermal Resistance of a Steel-frame Assembly
The parallel-path flow method described above for wood-frame assemblies involves simple one-dimensional heat flow calculations based on two assumptions:
• that the heat flow through the thermal bridge (the stud) is parallel to the heat flow through the insulation, and
• that the temperature at each plane is constant.
Tests performed on steel-frame walls have shown that neither of these assumptions properly represents the highly two-dimensional heat flow that actually occurs. The difference between what is assumed and what actually occurs is even more significant in steel-frame assemblies. Designers should consider the potential discrepancies in such assemblies and include them as part of their evaluation and energy models.

Calculating Gross Wall Area
Where the structure of the lowest floor and rim joist assembly is above the finished ground level or where the above-grade portion of foundation walls separates conditioned space from unconditioned space, they should be included in the calculation of gross wall area. Figure A-10.2.2.6.-A shows the intended measurements for the most common type of housing construction.

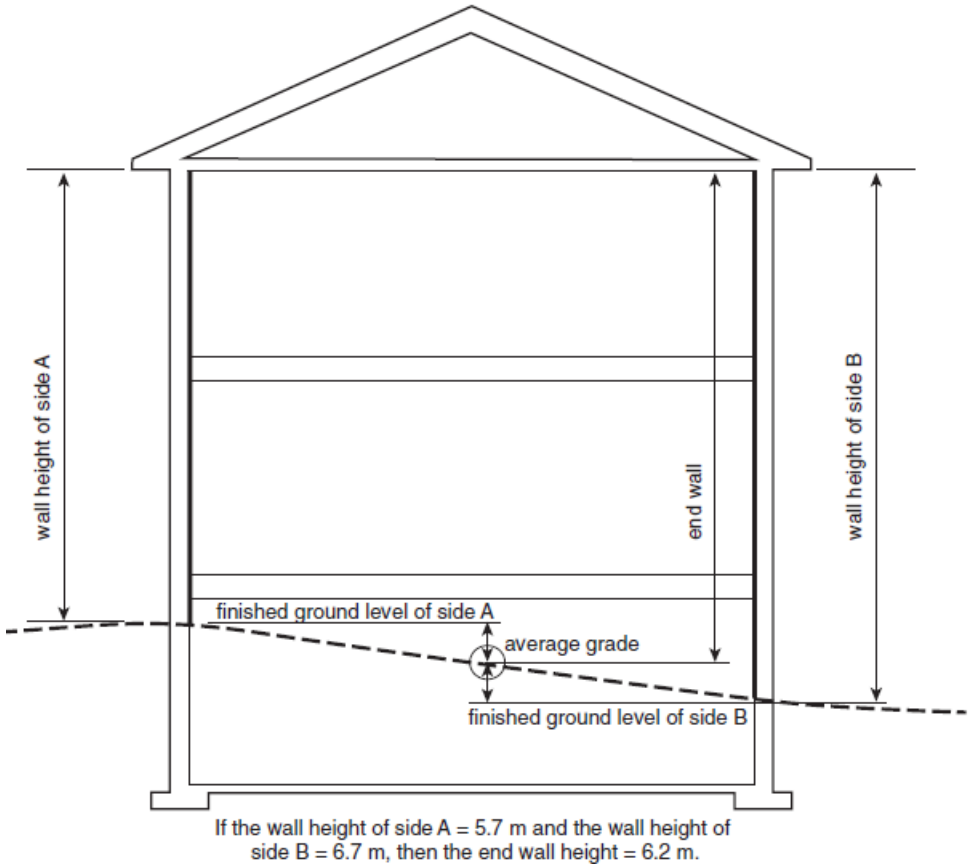
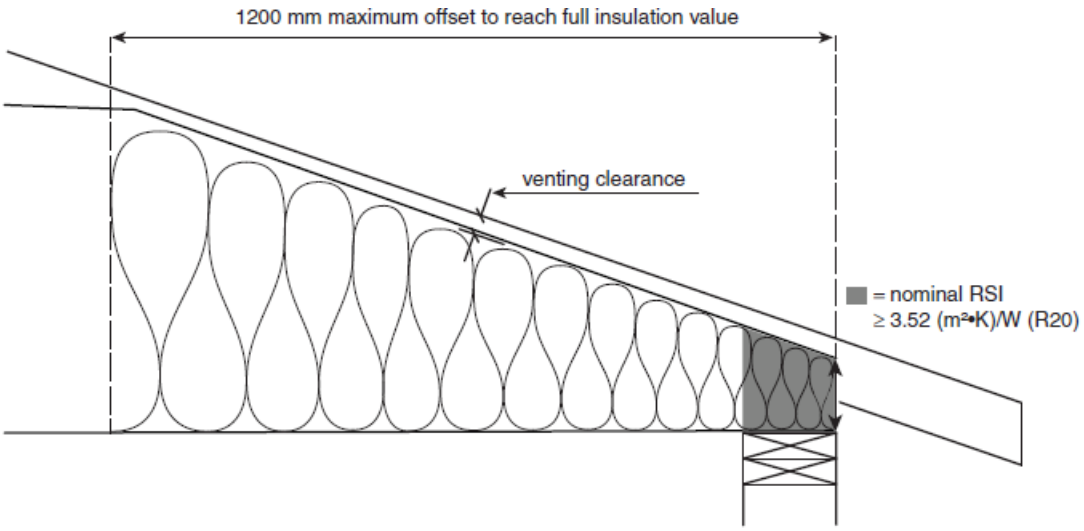


Figure A-10.2.2.6.-A
Example of interior wall height to be used in the calculation of gross wall area

Reduced Effective Thermal Resistance Near the Eaves of Sloped Roofs~~.~~
Minimum thermal resistance values for attic-type roofs are significantly higher than those for walls. The exemption in Note (1) of T-10.2.2.6. recognizes that the effective thermal resistance of a ceiling below an attic near its perimeter will be affected by roof slope, truss design and required ventilation of the attic space. It is assumed that the thickness of the insulation will be increased as the roof slope increases until there is enough space to allow for the installation of the full thickness of insulation required.

Figure A-10.2.2.6.-B
Area of ceiling assemblies in attics permitted to have reduced thermal resistance



A-10.2.2.7.(3) Building Envelope Windows, Skylights, Doors and Other Glazed Products

There are three compliance paths ('A' to 'C') available for fenestration products to comply with the energy performance requirements in Article 10.2.2.7. General guidelines are provided first, followed by the details of each compliance path.

General Requirements for Labels On Factory-Assembled Fenestration Products

The U-value (either IP or SI) labeling and verification requirements for windows, doors, and skylights in British Columbia are stipulated in the Energy Efficiency Standards Regulation of the BC Energy Efficiency Act.

Labels bear the mark of a third-party verifier and follow NFRC 100-2010 or CSA A440.2-14 standards. Each product shall bear two labels: a removable "temporary" label indicating the product U-value, and a non-removable "permanent" marking or label identifying the verification entity, the product line and the manufacturer.

The organizations that verify U-values according to these standards require these labels to be applied at the factory. They do not permit labels to be applied at the jobsite without prior authorization of the verifier.

The U-value on a label is reported to two decimal places. To demonstrate compliance, the U-value must meet or be below code stipulated values; for example: a USI-value of U 1.23 would not meet requirements where USI 1.22 is required.

General Requirements for Simulated U-value Reports

Products may comply with the By-law under a "flexibility provision" that demonstrates compliance by means of a simulated U-value report accompanied by supporting documentation. This provision provides a path by which a designer can provide "suitable documentation" of U-values for products that cannot be labeled

because they are outside the scope of existing energy performance certification programs, and for imported products that do not yet have U-values determined using NFRC 100 or CSA A440.2 methods.

An electronic copy of the report and description of the chosen compliance path should be provided to the Building Official prior to sheathing inspection. A paper copy of the report must be present on-site for the Building Official at time of sheathing inspection.

Simulation reports must include the following:

1) A cover letter on the professional's letterhead that includes:

a) the professional's identity and contact information.

b) the street address(es) of the building.

c) the U-values (reported to two decimal places) for each product type, at its standard size as identified in NFRC 100 or CSA A440.2, at the actual project size, or at an average size product, depending on the compliance option.

d) verification by the registered professional that the information provided in the energy performance certification and accompanying documentation supports the U-value of the fenestration assembly or assemblies identified in the report.

e) the name, address and contact information of the fenestration product supplier(s).

f) the name, address and contact information of the glass supplier(s), if different from the fenestration product supplier(s).

g) the name, address and contact information of any individuals or firms that carried out energy performance simulations, if different from the registered professional.

h) a complete list of the supporting documentation attached to the letter.

i) the registered professional's seal and signature.

2) An attached documentation package that includes:

a) a list of each fenestration product type, quantity, size, area, description and U-value.

b) the sizes and configurations of the simulated products as shown by frame elevations and/or shop drawings, keyed to the list.

c) a table of the area-weighting calculations performed to determine the overall average U-value of all products using Method 1 or Method 2, of Option 2 of Compliance Path C, when applicable.

d) a description of each framing system used, including manufacturer name, series, and model numbers, as well as frame material and any internal reinforcing used.

e) a complete description of the glazing, including overall glass thickness, number of panes, pane thicknesses, gap widths, low-E coating manufacturer and type, low-E coating emissivity, and surfaces to which coatings are applied, type of gap fill with percentages of inert gas, complete description of spacer by make, series, and model, and its constituent materials, and insulating glass edge sealant materials.

f) NFRC or CSA A440.2 certified test data for each system, or isotherms for each unique framing member used in each system covered by the letter, (heads, sills, jambs, mullions) as well as all reinforcing metal in mullions and perimeter frames.

Compliance Path 'A' (Prescriptive U-value compliance)

Compliance is demonstrated by means of verifier labels, affixed to factory-assembled fenestration products at the manufacturing location in which each individual fenestration product has a compliant U-value. Compliance is achieved if each product meets the USI-value requirements required by Article 10.2.2.7., at its standard size as identified in NFRC 100 or CSA A440.2.

When one or more products exceed the applicable USI-value in Table 10.2.2.7.(1), compliance Paths B or C may be employed.

Compliance Path 'B' (Labeled / Tested U-value area-weighted average compliance)

Compliance Path 'B' is intended for projects in which all products have U-values simulated at NFRC standard sizes.

Compliance path B requires area-weighting calculations but does not require actual size or project-specific simulation. When one or more products within Table 10.2.2.7.(1) exceed the applicable USI-value , compliance may be demonstrated by calculating the overall average USI-value by means of a tabulated USI x A reporting format. In such a table, the USI-values for the standard size of each product are to be multiplied by the area of the product to determine the average area weighted USI-value of all the products.

Under this option, standard size U-values from test and simulation reports from accredited laboratories may be used for unlabeled products. The U-value report with area-weighting calculations shall be submitted under the seal of a registered professional and may be subject to independent review at the discretion of city staff.

$$Overall\ U\ value = \frac{\Sigma U_1 A_1 \ + \cdots U_n A_n}{Total\ Area}$$

The area-weighting report shall include documentation of verified U-values by means of label reproductions or attached laboratory simulation reports. In the case of NFRC certified products, CPD numbers may be used in place of label reproductions.

Compliance Path 'C' (Simulated U-value compliance)

Compliance path 'C' is intended for projects that use products that cannot demonstrate compliance at standard size by means of labels or accredited laboratory test/simulation reports. Such products include:

- site-assembled windows, doors,
- imported windows and doors not previously tested in Canada,
- curtainwalls and sloped glazing assemblies, and
- factory-assembled curtainwalls and window wall assemblies.

Under this compliance path qualified professionals perform simulations for each Individual Product simulated in accordance with NFRC 100 procedures at the size and configuration defined in NFRC 100 Table 4-3, including the normative table footnotes. Individual Products are defined in NFRC 100 and may be grouped according to NFRC 100 Grouping Rules. Products that require metal reinforcing at project sizes shall be simulated with metal reinforcing. U-values may be reported using one of the following options:

Option 1 - All products conform to Table 10.2.2.7.(1) at standard sizes.

If all products are found to have USI-values that conform to Table 10.2.2.7.(1) at sizes in NFRC 100 Table 4-3, the standard size USI-values may be reported to demonstrate compliance with Article 10.2.2.7.

Option 2 - One or more products do not conform to Table 10.2.2.7.(1) at standard sizes.

Area-weighting the USI-values of products within a U-value group at actual project sizes may be employed to demonstrate compliance for that U-value group.

To comply with Option 2, area-weighted average USI-values may be computed using one of two methods:

Method 1 USI x A table of all products within a U-value group, tabulating frame size, frame area and USI-value for each individual product to compute an overall area-weighted average for all products within the U-value group.

Method 2 USI x A table of USI-values for each individual product at its average project frame size.

$$Overall\ U\text{-}value = \frac{\Sigma U_{avg\,(1)} A_{System\ 1} + \cdots U_{avg\,(n)} A_{System\ n}}{Total\ Area}$$

Average project frame sizes shall be determined as follows:

1) Average frame sizes shall be determined for each individual product.

2) For fixed windows, the average frame size shall be based on averaging the width and height of all fixed daylight opening sizes for the fixed product type.

3) For curtain wall framing at single storey height, the average frame size shall be based on averaging the width and height of all fixed daylight opening sizes for the Window Wall product type.

4) For single panel operable windows and swinging doors, the average frame size shall be the average of all single panel operable product frame sizes of the same operator type.

5) For multiple panel side hinged products (swinging doors, folding doors), the average frame size shall be based on averaging the width and height of all panel sizes for the Swinging Door with Frame product type.

6) For sliding doors, the average frame size and number of panels will depend on the number of sliding door tracks. (The fixed lite of a sliding door shall be considered a panel.)

a) For two-track sliding doors, a two-panel door configuration shall be simulated having a frame size shall be based on two average size panels.

b) For three-track sliding doors, a three-track, three-panel door configuration shall be simulated having a frame size based on three average size panels.

c) For four-track sliding doors, a four-track, four-panel door configuration shall be simulated having a frame size based on four average size panels. (Etc.)

d) Simulations shall include two jambs, head and sill simulations with the glass in each panel position, and one interlock for each panel-panel joint of the configuration.

7) For individual unit (single lite) skylights, the average frame size shall be the average of all frame sizes of the same product type.

8) For skylights with more than one lite, the average frame size shall be based on averaging the width and height of all daylight opening sizes for the Sloped Glazing product type at the solarium-sunroom configuration in NFRC 100 Table 4-3 Note 3.

A-10.2.2.8 Vestibules The intention of the vestibule requirements within 10.2.2.8. are to recognize that vestibules are breeches within a building's envelope and are the last line of defense against the interaction between a building's interior conditioned space and the ambient conditions. The vestibule design requirements are intended to minimize the transference of air and associated energy properties through the opening of these breeches, with or without the assistance of pressure differentials from internal sources such as stack effect or elevator operation, or external pressures such as wind load. Vestibules are therefore to be enclosed spaces without direct access by stairwells and elevators.

Specified distances between interior and exterior vestibule doors support typical daily operation. These specified minimum separation distances are to be deemed the vestibule's maximum separation distances as well, however, under circumstances deemed problematic by the CBO, these maximum distances may be extended by 1 foot increments until the design issue is resolved. For example, a 7 foot minimum spacing may not be possible due to interference from a structural column, in which case an application may be requested for an 8 foot separation. No request for a 9 foot separation will be considered without review of the 7 foot and 8 foot separation scenarios.

A-10.2.2.10 Exterior Lighting in Residential Buildings

10.2.2.10.(1)(b) Master Switch The objective is to require a master switch that will permit non-essential lighting to be turned off when an occupant leaves the premises. As this was only intended to consider residential portions of a building, it is considered acceptable to consider each portion of the building structure located above the parkade slab constructed to Article 3.2.1.2. on an individual basis given that the cost-effectiveness of such energy saving features would not be as significant for smaller structures with proportionally larger exterior wall and roof surface areas relative to their volume.

10.2.2.10.(2) Exterior Lighting A growing body of evidence exists that identifies that excessive amounts of nighttime lighting (frequently referred to as light pollution) may be potentially harmful to the environment and to human wellbeing. Poorly controlled night time lighting in urbanized areas has been widely documented to have significant effects on the environment, such as increased skyglow, and physiological and behavioral changes to individual organisms. Research suggests that excessive nighttime lighting may be detrimental to human health.

Consequently, Sentences 10.2.2.10.(2) attempts to limit the quantity and quality of exterior lighting of buildings to reduce the impact and consequences of external lighting. Interior lighting emitted through glazed openings is also a concern, but this is largely dependent upon human activity, and it is not presently considered as part of these requirements. Nonetheless, it can be seen that conceptually this would also have similar effect as exterior lighting, so an effort should be made to minimize the potential for lighting trespass where possible.

The key components of Sentence 10.2.2.10.(2) requirements are the requirements for appropriate lighting fixtures that eliminate the upwards emission of light, and cast more of the illumination produced across the intended surfaces. Horizontal emission of lighting across the property line is more challenging due to the varying heights of a given building, but measures should be taken to reduce the potential and extent of lighting trespass to the limits specified. Additionally, the reflectance of adjacent surfaces that may be illuminated must also be considered as these also contribute to the total lighting emitted into adjacent properties. The orientation, reflectance, and illumination of the adjacent surfaces should be evaluated to limit backscatter or unintended reflectance.

To increase the likelihood of meeting the requirements, designers opt to

- Choose light fixtures that minimize backlight, uplight, and glare (BUG). Light fixtures with a BUG rating of UO are optimal.
- Choose luminaires with the lowest possible intensity for the task needed
- Consider warmer tones of 2500-3000K to reduce impact. A practical maximum temperature is 4000K.

10.2.2.10.(3) External Illumination Understanding that there may be periodic needs to provide external illumination, the requirements of 10.2.2.10.(3) serve to exempt lighting specifically intended to enhance security, safety and improve visibility for limited periods of time.

A-10.2.2.15. Gas Fireplaces

Interior and exterior fireplaces connected to building services are to be included as part of the building for the purposes of meeting the energy targets of Part 10 of the Building By-law. The building performance model is to incorporate such features per the requirements of the City of Vancouver Modelling Guidelines.

A-10.2.2.17. Heat Recovery in Dwelling Units. Whereas Section 9.32. addresses the effectiveness of mechanical ventilation systems in dwelling units from a health and safety perspective, Article 10.2.2.17. is concerned with their functioning from an energy efficiency perspective.

The requirements of Subsection 9.32.3. can be met using one of several types of ventilation equipment, among them heat-recovery ventilators (HRVs), which are typically the system of choice in cases where heat recovery from the exhaust component of the ventilation system is required. As such, Article 10.2.2.17. should be read in conjunction with the provisions in Subsection 9.32.3. that deal with HRVs.

Efficiency of Heat-Recovery Ventilators (HRVs)
HRVs are required to be tested in conformance with CAN/CSA-C439, "Rating the Performance of Heat/Energy-Recovery Ventilators," under different conditions to obtain a rating.

The performance of an HRV product and its compliance with Article 10.2.2.17. can be verified using the sensible heat recovery at the 0°C test station (i.e. location where the temperature is measured) published in the manufacturer's literature or in product directories, such as HVI's Certified Home Ventilating Products Directory. Any energy model output must also demonstrate an SRE (%) that meets or exceeds the requirement of this By-law.

The rating of HRVs also depends on the flow rate used during testing. Therefore, the minimum flow rate required in Section 9.32. needs to be taken into consideration when selecting an HRV product.

Servicability of Heat Recovery Ventilators
Clause 10.2.2.17.(3)(j) identifies that heat recovery ventilators and similar devices form an integral part of the building ventilation and requires inspection,maintenance, repair, and cleaning from time to time to ensure that the building air quality remains within the original design parameters. In order to perform such regular maintenance or more extensive maintenance in the event of the failure of an HRV or similar device, the mechanical components of an Heat Recovery Ventilator are to be located and installed so as to provide a worker with adequate space and access to unit to conduct maintenance on the unite or replace it. Unusually tight, distant, or convoluted access may lead to regular maintenance being skipped, or lead to other significant challenges or costs for services and replacement.

A-10.2.2.20.(3) Modelling Guidelines for Large Homes
For a building required to comply with the greenhouse gas (GHG) limit, the total annual GHG footprint shall be calculated using approved modelling software and modelling criteria provided in the "Modelling Guidelines for Large Homes."

A-10.2.2.21. Building Airtightness Testing Requirements
The intent of this testing is to quantify the airtightness level of the air barrier system, not airtightness of the building at in-service operating conditions.

Air Barrier Assembly Testing
Air barrier assemblies are subjected to structural loading due to mechanical systems, wind pressure and stack effect. In addition, they may be affected by physical degradation resulting from thermal and structural movement. Where local climatic data and building conditions exceed these limits, the maximum building height and sustained 1-in-50 hourly wind pressure values are permitted to be extrapolated beyond the listed ranges to apply to any building height, in any location, provided the air barrier assembly in question has been tested to the specific building site and design parameters.

Air Barrier System Approaches
For an air barrier system to be effective, all critical junctions and penetrations addressed in must be sealed using either an interior or exterior air barrier approach or a combination of both.

Where the air barrier and vapour barrier functions are provided by the same layer, it must be installed toward the warm (in winter) side of the assembly or, in the case of mass walls such as those made of cast-in place concrete, provide resistance to air leakage through much of the thickness of the assembly. Where these functions are provided by separate elements, the vapour barrier is required to be installed toward the interior of the assembly while the airtight element can be installed toward the interior or exterior depending on its vapour permeance.

A-10.2.2.22 System Requirements for Heating within Exterior Spaces. The use of the terms "licensed beverage establishment" and "licensed food establishment" are meant to clarify how the allowance of 10.2.2.22 is limited to business-licensed establishments where the primary use is the consumption of food or beverages while seated.

The intention of Article 10.2.2.22 is not to require exterior heating, rather it is meant to minimize energy use and emissions when choosing the option of providing some level of occupant heating within an exterior space. The City of Vancouver recognizes a number of options however the prioritization of these options must also take into account their viability with existing and potential site conditions. Sentence 10.2.2.22.(2) is intended to be understood as "first consider the viability of option (a), either in whole or in part, then consider the viability of option (b) in whole or in part, then consider option (c)", and so on. If the most viable solution is a mixed system then this would be encouraged, but if the best, most viable solution is a single option then proceed with that option. Designers wishing to consider a unique system, such as using waste heat, are encouraged to do so and should contact the CBO's office if any customized system design does not easily fall into the options provided.

The control items within sentence 10.2.2.22.(4) are meant to assist with the efficient operation of the heating system. It is important to note that exterior spaces are not intended to operate as if they are interior conditioned spaces. The maximum recommended temperature for exterior spaces with heating systems is 18C, and so the ambient and space temperature sensors should be set accordingly. The ambient sensor is intended to prevent the heating system from operating during warm weather while the space temperature sensors are meant to accommodate naturally occurring temperature variations across adjacent zones (direct sun vs shade), and thus allowing independent zone control operation. The space temperature sensors may override the ambient sensor to prevent zones from either overheating or over cooling. The timeclock will satisfy the mandatory requirement of not operating exterior heating systems after the establishment's hours of operation. At no point should the controls system automatically activate exterior space heating.

Zoned systems are most likely to be electric radiant and so are limited to 4,800 W (240V @ 20 amp). At the maximum allowable intensity of 18 W/ft^2 this would equate to 266 ft^2 per zone, however less energy intensive systems would be allowed to cover a larger area, for example, a 15 W/ft^2 system would allow 320 ft^2 per zone.

For multi-system design scenarios, sentence 10.2.2.22.(6) is intended to clarify the options and opportunities this may provide. The total energy intensity of a combined system shall not exceed the highest allowable intensity of the system types involved. Example: where an overhead electric radiant system is allowed to operate at 18 W/ft^2, a combined system of in-slab heating with an overhead radiant system cannot be designed to exceed a combined total operation of 18 W/ft^2. This scenario allows in-slab heating at 8 W/ft^2 while limiting the overhead heating to 10 W/ft^2, or the possibility of 5 W/ft^2 and 13 W/ft^2 respectively. This concept allows one system to be used during warmer weather with the option for a secondary system as a top-up during colder weather.

A-10.3.1.1. Electric Vehicle Charging for Buildings

The Canadian Electrical Code, Part I contains the requirements of electric vehicle charging systems, the requirements of Rule 86-300(2) and (3) recognize the use of load management technologies via the manual transfer or automated control in a branch circuit that supplies the electric vehicle supply equipment load and other loads. This Rule requires that, where the electric vehicle supply equipment load and other loads are installed, only one load can

be operated at any one time and the branch circuit must be based on the calculated demand in accordance with Section 8.

All references to the electrical installation including receptacle, supply equipment and rating of voltage and ampere in Article 10.3.1.1. are intended to align with the requirements of SAE AC Level 2 charging requirements, whether in applying load managed solutions or separate branch circuits for each charging point. In addition to the requirements of Article 10.3.1.1., the installation of electric vehicle charging systems and electric vehicle supply equipment must meet the requirements of the Canadian Electrical Code, Part I and the manufacturer's instructions.