Section 9.36. Energy Efficiency

9.36.1. General

9.36.1.1. Scope

1) This Section is concerned with the energy used by *buildings* as a result of

a) the design and construction of the *building* envelope, and

b) the design and construction or specification of systems and equipment for

i) heating, ventilating or air-conditioning, and

ii) service water heating.

(See Note A-9.36.1.1.(1).)

9.36.1.2. Definitions

1) For the purpose of this Section, the term "common space" shall mean all spaces required to be *conditioned spaces* by Article 9.33.2.1. that are not within a *suite* but shall not include crawl spaces and *vertical service spaces*. (See Note A-9.36.1.3.(3).)

2) For the purpose of this Section, the term "overall thermal transmittance," or U-value, shall mean the rate, in W/(m^2·K), at which heat is transferred through a *building* assembly that is subject to temperature differences. (See Note A-9.36.1.2.(2).)

3) For the purpose of this Section, the term "effective thermal resistance," or RSI value, shall mean the inverse of the overall thermal transmittance of an assembly, in (m^2·K)/W. (See Note A-9.36.1.2.(3).)

4) For the purpose of this Section, the term "fenestration" shall mean all *building* envelope assemblies, including their frames, that transfer visible light, such as windows, clerestories, skylights, translucent wall panels, glass block assemblies, transoms, sidelights, sliding, overhead or swinging glass doors, and glazed inserts in doors, etc. (See Note A-9.36.1.2.(4).)

9.36.1.3. Compliance and Application

(See Note A-9.36.1.3.)

1) Except as provided in Sentences (2) to (5), *buildings* shall comply with

a) the prescriptive or trade-off requirements in Subsections 9.36.2. to 9.36.4.,

b) the performance requirements in Subsection 9.36.5.,

c) notwithstanding Article 1.1.1.1. of Division A of the NECB, the NECB, or

d) Subsection 9.36.6.

2) Subsections 9.36.2. to 9.36.4. apply to

a) *buildings* of *residential occupancy* to which Part 9 applies,

b) *buildings* containing *business and personal services*, *mercantile* or *low-hazard industrial occupancies* to which Part 9 applies whose combined total *floor area* does not exceed 300 m^2, excluding parking garages that serve *residential occupancies*, and

c) *buildings* containing a mix of the *residential* and non-*residential occupancies* described in Clauses (a) and (b).

3) Subsections 9.36.5. and 9.36.6. apply only to

a) houses with or without a *secondary suite*, and

b) *buildings* containing only *dwelling units* and common spaces whose total *floor area* does not exceed 20% of the total *floor area* of the *building*.

(See Note A-9.36.1.3.(3).)

4) *Buildings* containing non-*residential occupancies* whose combined total *floor area* exceeds 300 m^2 or *medium-hazard industrial occupancies* shall comply with the NECB.

5) *Buildings* or portions of *buildings* that are not *conditioned spaces*, and *residential buildings* that are not intended for use in the winter months on a continuing basis, are exempted from the requirements of this Section. (See Note A-9.36.1.3.(5).)

9.36.2. Building Envelope

9.36.2.1. Scope and Application

1) Except as provided in Sentence (2), this Subsection is concerned with the loss of energy due to heat transfer and air leakage through materials, components and assemblies, including their interfaces, forming part of the *building* envelope where it separates *conditioned space* from unconditioned space, the exterior air or the ground.

2) The requirements of this Subsection also apply to components of a *building* envelope assembly that separate a *conditioned space* from an adjoining *storage garage*, even if the *storage garage* is intended to be heated. (See Notes A-9.36.2.1.(2) and A-9.36.1.3.(5).)

3) Except for skylight shafts addressed in Sentence 9.36.2.6.(4), for the purpose of this Subsection, wall assemblies inclined less than 60° from the horizontal shall be considered as roof assemblies, and roof assemblies inclined 60° or more from the horizontal shall be considered as wall assemblies.

4) The properties, performance and installation of windows, doors and skylights shall also conform to Section 9.7.

5) The properties, location and installation of thermal insulation, *air barrier systems*, *vapour barriers*, and materials with low air or vapour permeance shall also conform to Section 9.25.

9.36.2.2. Determination of Thermal Characteristics of Materials, Components and Assemblies

1) The thermal characteristics of materials shall be determined by calculation or by testing in accordance with the applicable product standards listed in the Code or, in the absence of such standards or where such standards do not address the determination of thermal resistance, in accordance with

a) ASTM C 177, "Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus," or

b) ASTM C 518, "Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus."

(See Table A-9.36.2.4.(1)-D for the thermal characteristics of commonly used materials.)

2) Calculations and tests performed in accordance with Sentence (1) shall be carried out at an average temperature of 24±2°C and under a temperature differential of 22±2°C.

3) The thermal characteristics of windows, doors and skylights shall be determined by calculation or testing in accordance with

a) CSA A440.2/A440.3, "Fenestration Energy Performance/User Guide to CSA A440.2-14, Fenestration Energy Performance," for the reference sizes listed therein, or

b) NFRC 100, "Determining Fenestration Product U-factors," and NFRC 200, "Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence," for the reference sizes listed therein.

(See Note A-9.36.2.2.(3).)

4) The effective thermal resistance of opaque *building* assemblies shall be determined from

a) calculations conforming to Article 9.36.2.4., or

b) laboratory tests performed in accordance with ASTM C 1363, "Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus," using an indoor air temperature of 21±1°C and an outdoor air temperature of ?18±1°C.

5) The thermal characteristics of log walls shall be determined by calculation in accordance with Section 305 of ICC 400, "Design and Construction of Log Structures." (See Note A-9.36.2.2.(5).)

9.36.2.3. Calculation of Ceiling, Wall, Fenestration and Door Areas

1) The gross ceiling or roof area shall be calculated as the sum of the interior surface areas of insulated ceiling and/or roof assemblies and of skylight openings.

2) Except as permitted by Sentence (3), the gross wall area shall be calculated as the sum of the interior surface areas of all exterior *building* envelope assemblies above the finished ground level that are inclined 60° or more from the horizontal, including

a) *rim joists*,

b) fenestration and opaque portions of doors,

c) insulated walls extending from finished ground level to the interior side of the insulated ceiling and/or roof assembly, and

d) the exposed areas of below-ground *building* envelope assemblies, where fenestration or doors are located below the plane of the adjacent finished ground.

(See Note A-9.36.2.3.(2) and (3).)

3) Where a *building* of *residential occupancy* contains more than 2 *dwelling units*, the gross wall area enclosing *conditioned space* shall be permitted to include the interior surface areas of walls that enclose a *suite*, measured from the top surface of the lowest floor to the underside of the highest ceiling in the *suite*. (See Note A-9.36.2.3.(2) and (3).)

4) Fenestration and door areas shall be the actual sizes of windows, doors and skylights including all related frame and sash members.

5) The fenestration area made of flat panes that are not all in the same plane or curved panes shall be measured along the surface of the glass. (See Note A-9.36.2.3.(5).)

9.36.2.4. Calculation of Effective Thermal Resistance of Assemblies

1) In calculating the effective thermal resistance of assemblies for the purpose of comparison with the requirements of Articles 9.36.2.6. and 9.36.2.8., the thermal bridging effect of closely spaced, repetitive structural members, such as studs and joists, and of ancillary members, such as lintels, sills and plates, shall be accounted for. (See Note A-9.36.2.4.(1).)

2) Minor penetrations through assemblies, such as pipes, ducts, equipment with through-the-wall venting, packaged terminal air conditioners or heat pumps, shelf angles, anchors and ties and associated fasteners, and minor structural members that must partially or completely penetrate the *building* envelope to perform their intended function need not be taken into account in the calculation of the effective thermal resistance of that assembly.

3) Major structural penetrations, such as balcony and canopy slabs, beams, columns and ornamentation or appendages that must completely penetrate the *building* envelope to perform their intended function, need not be taken into account in the calculation of the effective thermal resistance of the penetrated assembly, provided

a) the insulation is installed tight against the outline of the penetration, and

b) the sum of the areas of all such major structural penetrations is limited to a maximum of 2% of the gross wall area calculated as described in Sentence 9.36.2.3.(2).

(See Note A-9.36.2.4.(3).)

4) Where a component of the *building* envelope is protected by an enclosed unconditioned space, such as a sun porch, enclosed veranda, vestibule or attached garage, the required effective thermal resistance of the *building* envelope component between the *building* and the unconditioned enclosure is permitted to be reduced by 0.16 (m^2·K)/W. (See Note A-9.36.2.4.(4).)

9.36.2.5. Continuity of Insulation

1) Except as provided in Sentences (2) to (9) and in Sentence 9.36.2.4.(3) regarding balcony and canopy slabs, and except for clearances around components required for fire safety reasons, interior *building* components that meet *building* envelope components and major structural members that partly penetrate the *building* envelope shall not break the continuity of the insulation and shall not decrease the effective thermal resistance at their projected area to less than that required in Articles 9.36.2.6. and 9.36.2.8. (See Note A-9.36.2.5.(1).)

2) Where an interior wall, *foundation* wall, *firewall*, *party wall* or structural element penetrates an exterior wall or insulated roof or ceiling and breaks the continuity of the plane of insulation, the penetrating element shall be insulated

a) on both of its sides, inward or outward from the *building* envelope, for a distance equal to 4 times its uninsulated thickness to an effective thermal resistance not less than that required for exterior walls as stated in Table 9.36.2.6.-A or 9.36.2.6.-B,

b) within the plane of insulation of the penetrated element to an effective thermal resistance not less than 60% of that required for the penetrated element, or

c) within itself to an effective thermal resistance not less than that required for the penetrated element.

(See Note A-9.36.2.5.(2).)

3) Where a masonry fireplace or flue penetrates an exterior wall and breaks the continuity of the plane of insulation, it shall be insulated within the plane of insulation of the wall or within itself to an effective thermal resistance not less than 55% of that required for the exterior wall as stated in Table 9.36.2.6.-A or 9.36.2.6.-B (See Note A-9.36.2.5.(3).)

4) Where an ornamentation or appendage penetrates an exterior wall and breaks the continuity of the plane of insulation, the penetrating element shall be insulated

a) on both of its sides, inward or outward from the *building* envelope, for a distance equal to 4 times the insulated thickness of the exterior wall to an effective thermal resistance not less than that required for the wall as stated in Table 9.36.2.6.-A or 9.36.2.6.-B,

b) within the plane of insulation of the wall to an effective thermal resistance not less than 55% of that required for the exterior wall, or

c) within the penetrating element to an effective thermal resistance not less than that required for the exterior wall.

5) Except as provided in Sentences (8) and (9), where two planes of insulation are separated by a *building* envelope assembly and cannot be physically joined, one of the planes of insulation shall be extended for a distance equal to at least 4 times the thickness of the assembly separating the two planes. (See Note A-9.36.2.5.(5).)

6) Except as permitted by Article 9.36.2.11., where mechanical, plumbing or electrical system components, such as pipes, ducts, conduits, cabinets, chases, panels or recessed heaters, are placed within and parallel to a wall assembly required to be insulated, the effective thermal resistance of that wall at the projected area of the system component shall be not less than that required by Tables 9.36.2.6.-A, 9.36.2.6.-B, 9.36.2.8.-A and 9.36.2.8.-B (See Note A-9.36.2.5.(6).)

7) Except as permitted by Article 9.36.2.11., where mechanical ducts, plumbing pipes, conduits for electrical services or communication cables are placed within the insulated portion of a floor or ceiling assembly, the effective thermal resistance of the assembly at the projected area of the ducts, pipes, conduits or cables shall be not less than 2.78 $(m^2 \cdot K)/W$.

8) Joints and junctions between walls and other *building* envelope components shall be insulated in a manner that provides an effective thermal resistance that is no less than the lower of the minimum values required for the respective adjoining components. (See Note A-9.36.2.5.(8).)

9) Sentence (1) does not apply where the continuity of the insulation is interrupted

a) between the insulation in the *foundation* wall and that of the floor slab,

b) by an integral perimeter footing of a slab-on-grade (see Sentences 9.25.2.3.(5) and 9.36.2.8.(8)), or

c) at the horizontal portion of a *foundation* wall that supports masonry veneer and is insulated on the exterior.

9.36.2.6. Thermal Characteristics of Above-ground Opaque Building Assemblies

1) Except as provided in Sentences (2) and 9.36.2.8.(3) and Articles 9.36.2.5. and 9.36.2.11., the effective thermal resistance of above-ground opaque *building* assemblies or portions thereof shall be not less than that shown for the applicable heating-degree day category in

a) Table 9.36.2.6.-A, where the ventilation system does not include heat-recovery equipment, or

b) Table 9.36.2.6.-B, where the ventilation system includes heat-recovery equipment conforming to Article 9.36.3.9.

(See Note A-9.36.2.6.(1).)

Table 9.36.2.6.-A
Effective Thermal Resistance of Above-ground Opaque Assemblies in Buildings without a Heat-Recovery Ventilator
Forming Part of Sentence 9.36.2.6.(1)

Above-ground Opaque *Building* Assembly	Heating Degree-Days of *Building* Location,(1) in Celsius Degree-Days					
	Zone 4 < 3000	Zone 5 3000 to 3999	Zone 6 4000 to 4999	Zone 7A 5000 to 5999	Zone 7B 6000 to 6999	Zone 8 ≥ 7000
	Minimum Effective Thermal Resistance (RSI), $(m^2 \cdot K)/W$					
Ceilings below attics	6.91	8.67	8.67	10.43	10.43	10.43
Cathedral ceilings and flat roofs	4.67	4.67	4.67	5.02	5.02	5.02
Walls(2)	2.78	3.08	3.08	3.08	3.85	3.85
Floors over unheated spaces	4.67	4.67	4.67	5.02	5.02	5.02

Notes to Table 9.36.2.6.-A:

(1) See Article 1.1.3.1.

(2) See Sentence 9.36.2.8.(3) for requirements concerning the above-ground portion of *foundation* walls.

Table 9.36.2.6.-B
Effective Thermal Resistance of Above-ground Opaque Assemblies in Buildings with a Heat-Recovery Ventilator
Forming Part of Sentence 9.36.2.6.(1)

Above-ground Opaque *Building* Assembly	Heating Degree-Days of *Building* Location,(1) in Celsius Degree-Days					
	Zone 4 < 3000	Zone 5 3000 to 3999	Zone 6 4000 to 4999	Zone 7A 5000 to 5999	Zone 7B 6000 to 6999	Zone 8 ≥ 7000
	Minimum Effective Thermal Resistance (RSI), $(m^2 \cdot K)/W$					
Ceilings below attics	6.91	6.91	8.67	8.67	10.43	10.43
Cathedral ceilings and flat roofs	4.67	4.67	4.67	5.02	5.02	5.02
Walls(2)	2.78	2.97	2.97	2.97	3.08	3.08
Floors over unheated spaces	4.67	4.67	4.67	5.02	5.02	5.02

Notes to Table 9.36.2.6.-B:

(1) See Article 1.1.3.1.

(2) See Sentence 9.36.2.8.(3) for requirements concerning the above-ground portion of *foundation* walls.

2) The effective thermal resistance of *rim joists* shall be not less than that required for above-ground walls in Table 9.36.2.6.-A or 9.36.2.6.-B, as applicable.

3) A reduction in the effective thermal resistance of ceiling assemblies in attics under sloped roofs is permitted for a length no greater than 1 200 mm but only to the extent imposed by the roof slope and minimum venting clearance, provided the nominal thermal resistance of the insulation directly above the exterior wall is not less than 3.52 $(m^2 \cdot K)/W$. (See Note A-9.36.2.6.(3).)

4) Except for tubular daylighting devices, the minimum effective thermal resistance values for walls stated in Tables 9.36.2.6.-A and 9.36.2.6.-B shall also apply to shafts for skylights.

9.36.2.7. Thermal Characteristics of Fenestration, Doors and Skylights

1) Except as provided in Sentences (2) to (10) and Article 9.36.2.11., fenestration and doors shall have an overall thermal transmittance (U-value) not greater than the values listed in Table 9.36.2.7.-A for the applicable heating-degree day category. (See Note A-9.36.2.7.(1) and (2).)

Table 9.36.2.7.-A
Required Thermal Characteristics of Fenestration and Doors
Forming Part of Sentence 9.36.2.7.(1)

Components	Thermal Characteristics[1]	Heating Degree-Days of *Building* Location,[2] in Celsius Degree-Days					
		Zone 4 < 3000	Zone 5 3000 to 3999	Zone 6 4000 to 4999	Zone 7A 5000 to 5999	Zone 7B 6000 to 6999	Zone 8 ≥ 7000
Fenestration[3] and doors	Max. U-value, W/(m²•K)	1.80	1.80	1.60	1.60	1.40	1.40

Notes to Table 9.36.2.7.-A:

(1) See Note A-Table 9.36.2.7.-A.

(2) See Article 1.1.3.1.

(3) Except skylights (see Sentence (2)) and glass block assemblies (see Sentence (4)).

2) Skylights shall have an overall thermal transmittance not greater than the values listed in Table 9.36.2.7.-B for the applicable heating-degree day category. (See Note A-9.36.2.7.(1) and (2).)

Table 9.36.2.7.-B
Overall Thermal Transmittance of Skylights
Forming Part of Sentence 9.36.2.7.(2)

Component	Heating Degree-Days of *Building* Location,[1] in Celsius Degree-Days					
	Zone 4 < 3000	Zone 5 3000 to 3999	Zone 6 4000 to 4999	Zone 7A 5000 to 5999	Zone 7B 6000 to 6999	Zone 8 ≥ 7000
	Maximum Overall Thermal Transmittance, W/(m²·K)					
Skylights	2.90	2.90	2.70	2.70	2.40	2.40

Notes to Table 9.36.2.7.-B:

(1) See Article 1.1.3.1.

3) Except for site-assembled or site-glazed factory-made fenestration products, curtain wall construction, and site-built windows and glazed doors that are tested in accordance with Sentence 9.36.2.2.(3), site-built windows and glazed doors need not comply with Sentence (1), provided they are constructed in accordance with one of the options presented in Table 9.36.2.7.-C for the applicable climate zone. (See Note A-9.36.2.7.(3).)

Table 9.36.2.7.-C
Compliance Options for Site-built Windows and Glazed Portion of Doors
Forming Part of Sentence 9.36.2.7.(3)

Component	Description of Component	Compliance Options							
		Climate Zones 4 and 5			Climate Zones 6 and 7A			Climate Zones 7B and 8	
		≤ 3999 HDD			4000 to 5999 HDD			≥ 6000 HDD	
		1	2	3	1	2	3	1	2
Frame	non-metallic	✓	✓	–	✓	✓	–	✓	✓
	thermally broken metallic	–	–	✓	–	–	✓	–	–
Glazing	double	–	✓	–	–	–	–	–	–
	triple	✓	–	✓	✓	✓	✓	✓	✓
	argon-filled	–	✓	–	✓	–	✓	–	✓
Low-e coating	none	✓	–	–	–	–	–	–	–
	number of panes with ≤ 0.10	–	≥ 1	–	–	–	–	≥ 2	–
	number of panes with ≤ 0.20	–	–	2	≥ 1	2	≥ 2	–	≥ 2
Spacer	size, mm	12.7	–	12.7	≥ 12.7	12.7	≥ 12.7	≥ 12.7	≥ 12.7
	non-metallic	–	✓	–	–	–	–	–	–

4) Glass block assemblies separating *conditioned space* from unconditioned space or the exterior shall have

a) an overall thermal transmittance of not more than 2.9 W/(m²·K), and

b) a total aggregate area of not more than 1.85 m².

5) Reserved.

6) Storm windows and doors need not comply with Sentence (1).

7) Vehicular access doors separating a *conditioned space* from an unconditioned space or the exterior shall have a nominal thermal resistance of not less than 1.1 (m²·K)/W.

8) Access hatches separating a *conditioned space* from an unconditioned space shall be insulated to a nominal thermal resistance of not less than 2.6 (m²·K)/W.

9) A door separating a *conditioned space* from an unconditioned space or the exterior is not required to conform to Sentence (1) if,

a) in the case of a *building* in a location with a heating degree-day value of less than or equal to 3999, the door is one of not more than three nonconforming doors, each of which has an overall thermal transmittance not greater than 2.10 W/m²·K,

b) in the case of a *building* in a location with a heating degree-day value of at least 4000 and not greater than 5999, the door is one of not more than two nonconforming doors, each of which has an overall thermal transmittance not greater than 2.10 W/m²·K,

c) in the case of a *building* in a location with a heating degree-day value of greater than or equal to 6000, the door is one of not more than two nonconforming doors, each of which has an overall thermal transmittance not greater than 2.00 W/m²·K, or

d) in any case, the door is the only nonconforming door and has an overall thermal transmittance not greater than 2.60 W/m²·K.

10) A *building* described in Clause (9)(a) or (b) is permitted to have an additional nonconforming door with an overall thermal transmittance not greater than 2.10 W/m²·K if the effective thermal resistance of the ceilings of the *building* is at least 0.88 m²·K/W greater than the relevant value shown in Table 9.36.2.6.A. or Table 9.36.2.6.B., as applicable.

9.36.2.8. Thermal Characteristics of Building Assemblies Below-Grade or in Contact with the Ground

1) Except as provided in Sentence (2) and Article 9.36.2.5., the effective thermal resistance of *building* assemblies that are below-*grade* or in contact with the ground shall be not less than that shown for the applicable heating-degree day category in

a) Table 9.36.2.8.-A, where the ventilation system does not include heat-recovery equipment, or

b) Table 9.36.2.8.-B, where the ventilation system includes heat-recovery equipment conforming to Article 9.36.3.9.

(See Note A-9.36.2.8.(1).)

Table 9.36.2.8.-A
Effective Thermal Resistance of Assemblies Below-Grade or in Contact with the Ground in Buildings without a Heat-Recovery Ventilator
Forming Part of Sentences 9.36.2.8.(1) to (9)

Building **Assembly Below-*Grade* or in Contact with the Ground[1]**	**Heating Degree-Days of *Building* Location,[2] in Celsius Degree-Days**					
	Zone 4 < 3000	**Zone 5 3000 to 3999**	**Zone 6 4000 to 4999**	**Zone 7A 5000 to 5999**	**Zone 7B 6000 to 6999**	**Zone 8 ≥ 7000**
	Minimum Effective Thermal Resistance (RSI), (m²·K)/W					
Foundation walls	1.99	2.98	2.98	3.46	3.46	3.97
Unheated floors[3]						
below frost line[4][5]	uninsulated	uninsulated	uninsulated	uninsulated	uninsulated	uninsulated
above frost line[5]	1.96	1.96	1.96	1.96	1.96	1.96
Heated and unheated floors on permafrost	n/a	n/a	n/a	n/a	4.44	4.44
Heated floors[6]	2.32	2.32	2.32	2.84	2.84	2.84
Slabs-on-grade with an integral footing[6]	1.96	1.96	1.96	3.72	3.72	4.59

Notes to Table 9.36.2.8.-A:

(1) See Note A-Tables 9.36.2.8.-A and -B.

(2) See Article 1.1.3.1.

(3) Does not apply to below-grade floors over heated crawl spaces.

(4) Typically applies to floors-on-ground in full-height *basements*.

(5) Refers to undisturbed frost line before house is constructed.

(6) See Sentence 9.25.2.3.(5) for requirement on placement of insulation. The design of slabs-on-grade with an integral footing is addressed in Part 4 (see Article 9.16.1.2.).

Table 9.36.2.8.-B
Effective Thermal Resistance of Assemblies Below-Grade or in Contact with the Ground in Buildings with a Heat-Recovery Ventilator
Forming Part of Sentences 9.36.2.8.(1) to (9)

Building Assembly Below-*Grade* or in Contact with the Ground[1]	Heating Degree-Days of *Building* Location,[2] in Celsius Degree-Days					
	Zone 4 < 3000	Zone 5 3000 to 3999	Zone 6 4000 to 4999	Zone 7A 5000 to 5999	Zone 7B 6000 to 6999	Zone 8 ≥ 7000
	Minimum Effective Thermal Resistance (RSI), $(m^2 \cdot K)/W$					
Foundation walls	1.99	2.98	2.98	2.98	2.98	2.98
Unheated floors[3]						
below frost line[4][5]	uninsulated	uninsulated	uninsulated	uninsulated	uninsulated	uninsulated
above frost line[5]	1.96	1.96	1.96	1.96	1.96	1.96
Heated and unheated floors on permafrost	n/a	n/a	n/a	n/a	4.44	4.44
Heated floors[6]	2.32	2.32	2.32	2.84	2.84	2.84
Slabs-on-grade with an integral footing[6]	1.96	1.96	1.96	2.84	2.84	3.72

Notes to Table 9.36.2.8.-B:

(1) See Note A-Tables 9.36.2.8.-A and -B.

(2) See Article 1.1.3.1.

(3) Does not apply to below-grade floors over heated crawl spaces.

(4) Typically applies to floors-on-ground in full-height *basements*.

(5) Refers to undisturbed frost line before house is constructed.

(6) See Sentence 9.25.2.3.(5) for requirement on placement of insulation. The design of slabs-on-grade with an integral footing is addressed in Part 4 (see Article 9.16.1.2.).

2) Where an entire floor assembly falls into two of the categories listed in Tables 9.36.2.8.-A and 9.36.2.8.-B, the more stringent value shall apply. (See Note A-9.36.2.8.(2).)

3) Where the top of a section of *foundation* wall is on average less than 600 mm above the adjoining ground level, the above-ground portion of that section of wall shall be insulated to the effective thermal resistance required in Table 9.36.2.8.-A or 9.36.2.8.-B.

4) Unheated floors-on-ground that are above the frost line and have no embedded heating pipes, cables or ducts shall be insulated to the effective thermal resistance required in Table 9.36.2.8.-A or 9.36.2.8.-B

a) on the exterior of the *foundation* wall down to the footing, or

b) on the interior of the *foundation* wall and, as applicable,

i) beneath the slab for a distance not less than 1.2 m horizontally or vertically down from its perimeter with a thermal break along the edge of the slab that meets at least 50% of the required thermal resistance,

ii) on top of the slab for a distance not less than 1.2 m horizontally from its perimeter, or

iii) within the wooden sleepers below the floor for a distance not less than 1.2 m horizontally from its perimeter.

(See Note A-9.36.2.8.(4).)

5) Except as provided in Sentence (6), floors-on-ground with embedded heating ducts, cables or pipes shall be insulated to the effective thermal resistance required in Table 9.36.2.8.-A or 9.36.2.8.-B under their full bottom surface including the edges.

6) Where only a portion of a floor-on-ground has embedded heating ducts, cables or pipes, that heated portion shall be insulated to the effective thermal resistance required in Table 9.36.2.8.-A or 9.36.2.8.-B under its full bottom surface to 1.2 m beyond its perimeter including exterior edges if applicable.

7) In addition to the requirements stated in Sentences (5) and (6), heated floors-on-ground shall be insulated to the effective thermal resistance required in Table 9.36.2.8.-A or 9.36.2.8.-B vertically

a) around their perimeter, or

b) on the outside of the *foundation* wall, extending down to the level of the bottom of the floor.

8) Floors on permafrost shall be insulated to the effective thermal resistance required in Table 9.36.2.8.-A or 9.36.2.8.-B under the entire slab and around all edges, and under the integral perimeter footing.

9) Slabs-on-grade with an integral perimeter footing shall

a) be insulated to the effective thermal resistance required in Table 9.36.2.8.-A or 9.36.2.8.-B under the entire slab and around all edges, but not under the integral perimeter footing, and

b) be constructed with skirt insulation having the same effective thermal resistance as the insulation installed under the slab.

(See Note A-9.36.2.8.(9).) (See also Sentences 9.25.2.3.(5) and 9.36.2.5.(8).)

10) Junctions between below-*grade* assemblies shall be protected from the ingress of *soil* gas in conformance with Subsection 9.25.3.

9.36.2.9. Airtightness

1) The leakage of air into and out of *conditioned spaces* shall be controlled by constructing

a) a continuous *air barrier system* in accordance with Sentences (2) to (6), Subsection 9.25.3. and Article 9.36.2.10.,

b) a continuous *air barrier system* in accordance with Sentences (2) to (6) and Subsection 9.25.3. and a *building* assembly having an air leakage rate not greater than 0.20 L/(s·m^2) (Type A4) when tested in accordance with CAN/ULC-S742, "Air Barrier Assemblies – Specification," at a pressure differential of 75 Pa, or

c) a continuous *air barrier system* in accordance with Sentences (2) to (6) and Subsection 9.25.3. and a *building* assembly having an air leakage rate not greater than 0.20 L/(s·m^2) when tested in accordance with ASTM E 2357, "Determining Air Leakage of Air Barrier Assemblies," where

i) the *building* will not be subjected to sustained wind loads calculated based on a 1-in-50 hourly wind pressure that exceed 0.65 kPa, and

ii) the air barrier assembly is installed on the warm side of the thermal insulation of the opaque *building* assembly.

(See Note A-9.36.2.9.(1).)

2) An *air barrier system* installed to meet the requirements of Sentence (1) shall be continuous

a) across construction, control and expansion joints,

b) across junctions between different *building* materials and assemblies, and

c) around penetrations through all *building* assemblies.

3) Windows, doors and skylights and their components shall comply with the minimum air leakage requirements stated in

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

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

4) Vehicular access doors that separate heated garages from unconditioned spaces or the exterior shall be weatherstripped around their perimeter to prevent air leakage.

5) Fireplaces shall be equipped with doors, enclosures or devices to restrict air movement through the *chimney* when the fireplace is not in use. (See Note A-9.36.2.9.(5).)

6) Where the airtight material used in the *air barrier system* is installed toward the exterior of the *building* envelope, its location and properties shall conform to Subsection 9.25.5. (See Note A-9.36.2.9.(6).)

9.36.2.10. Construction of Air Barrier Details

1) Materials intended to provide the principal resistance to air leakage shall conform to CAN/ULC-S741, "Air Barrier Materials – Specification."

(See Note A-9.25.5.1.(1) for air leakage characteristics and water vapour permeance values for a number of common materials.)

2) Materials referred to in Sentence (1) shall be

a) compatible with adjoining materials, and

b) free of holes and cracks.

(See Note A-9.36.2.10.(5)(b).)

3) Where the *air barrier system* consists of rigid panel-type material, all joints shall be sealed. (See Note A-9.36.2.10.(5)(b).)

4) Where the *air barrier system* consists of timber logs, all joints shall be sealed to resist airflow through gaps between logs that have shifted due to in-service conditions such as shrinkage and settling.

5) Where the *air barrier system* consists of flexible sheet material, all joints shall be

a) lapped not less than 50 mm,

b) sealed (see Note A-9.36.2.10.(5)(b)), and

c) structurally supported.

6) Sealant material used for the purpose of creating a continuous *air barrier system* shall

a) be a non-hardening type, or

b) conform to

i) Subsection 9.27.4.,

ii) CAN/ULC-S710.1, "Thermal Insulation – Bead-Applied One Component Polyurethane Air Sealant Foam, Part 1: Material Specification," or

iii) CAN/ULC-S711.1, "Thermal Insulation – Bead-Applied Two Component Polyurethane Air Sealant Foam, Part 1: Material Specification."

7) Penetrations by electrical wiring, outlets, switches or recessed light fixtures through the plane of airtightness shall be constructed airtight

a) where the component is designed to provide a seal against air leakage, by sealing the component to the air barrier material (see Note A-9.36.2.10.(7)(a)), or

b) where the component is not designed to provide a seal against air leakage, by covering the component with an air barrier material and sealing it to the adjacent air barrier material.

8) The joints between the *foundation* wall and the sill plate, between the sill plate and *rim joist*, between the *rim joist* and the subfloor material, and between the subfloor material and the bottom plate of the wall above shall be constructed airtight by

a) sealing all joints and junctions between the structural components, or

b) covering the structural components with an air barrier material and sealing it to the adjacent air barrier material.

9) The interfaces between windows, doors and skylights and wall/ceiling assemblies shall be constructed airtight by sealing all joints and junctions between the air barrier material in the wall and the window, door or skylight frame. (See Note A-9.36.2.10.(9).) (See also Subsection 9.7.6.)

10) Cantilevered floors and floors over unheated spaces or over the exterior shall be constructed airtight by one of the following methods or a combination thereof:

a) sealing all joints and junctions between the structural components, or

b) covering the structural components with an air barrier material and sealing it to the adjacent air barrier material.

11) Interior walls that meet exterior walls or ceilings whose plane of airtightness is on the interior of the *building* envelope and knee walls that separate *conditioned space* from unconditioned space shall be constructed airtight by

a) sealing all junctions between the structural components,

b) covering the structural components with an air barrier material and sealing it to the adjacent air barrier material, or

c) maintaining the continuity of the *air barrier system* above or through the interior wall or below or through the knee wall, as applicable.

12) Steel-lined *chimneys* that penetrate the *building* envelope shall be constructed airtight by blocking the void between required clearances for metal *chimneys* and surrounding construction with sheet metal and sealant capable of withstanding high temperatures.

13) *Masonry or concrete chimneys* that penetrate the *building* envelope shall be constructed airtight by mechanically fastening a metal flange or steel stud that extends not less than 75 mm out from the *chimney* and sealing the air barrier material to it with a sealant capable of withstanding high temperatures.

14) Ducts that penetrate the *building* envelope shall be constructed airtight by sealing the penetration through the *building* envelope. (See Note A-9.36.2.10.(14).)

15) Plumbing vent stack pipes that penetrate the *building* envelope shall be constructed airtight by

a) sealing the air barrier material to the vent stack pipe with a compatible sealant or sheathing tape, or

b) installing a rubber gasket or prefabricated roof flashing at the penetration of the plane of airtightness then sealing it and mechanically fastening it to the top plate.

16) Where a *party wall* meets the plane of airtightness, that junction shall be constructed airtight by sealing any voids within the *party wall* at the perimeter to the adjacent air barrier material and by

a) sealing all junctions between the structural components, or

b) covering the structural components with an air barrier material and sealing it to the adjacent air barrier material.

17) Where the concrete in a flat insulating concrete form wall acts as the air barrier, the continuity of the plane of airtightness shall be maintained between the concrete and adjacent air barrier materials.

9.36.2.11. Trade-off Options for Above-ground Building Envelope Components and Assemblies

(See Note A-9.36.2.11.)

1) Subject to the limitations stated in Sentences (6) to (8), the trade-off options described in Sentences (2) to (4) apply only to above-ground *building* envelope components and assemblies, or portions thereof, of a single *building*.

2) The effective thermal resistance of one or more above-ground opaque *building* envelope assemblies is permitted to be less than that required in Article 9.36.2.6., provided

a) the total areas of all proposed and reference assemblies are equal,

b) the effective thermal resistance of one or more other proposed above-ground opaque *building* envelope assembly areas is increased to more than that required by Article 9.36.2.6., and

c) the sum of the areas of all traded above-ground opaque *building* envelope assemblies divided by their respective effective thermal resistance is less than or equal to what it would be if all assemblies complied with Article 9.36.2.6.

(See Notes A-9.36.2.11.(2) and A-9.36.2.11.(2) and (3).)

3) The effective thermal resistance of one or more windows, as calculated in accordance with Sentence (5), is permitted to be less than that required in Article 9.36.2.7., provided

a) the total areas of all traded windows are equal,

b) the traded windows are located in the same orientation,

c) the effective thermal resistance of one or more other windows is increased to more than that required by Article 9.36.2.7., and

d) the sum of the areas of all traded windows divided by their respective effective thermal resistance is less than or equal to what it would be if all windows complied with Article 9.36.2.7.

(See Notes A-9.36.2.11.(3) and A-9.36.2.11.(2) and (3).)

4) The effective thermal resistance of one or more portions of floor insulation or ceiling insulation in attics under sloped roofs in *buildings* that are one *storey* in *building height* is permitted to be less than that required in Article 9.36.2.6., provided

a) the total area of fenestration, excluding skylights, and doors does not exceed 15% of the above-ground gross wall area as calculated in accordance with Article 9.36.2.3.,

b) the floor-to-ceiling height measured from the top of the subfloor to the underside of the finished ceiling of the *storey* does not exceed 2.34 m,

c) the distance measured from the top of the subfloor to the underside of the bottom chord of the truss or joist of the roof is not more than 2.39 m, and

d) the difference between the sum of the proposed areas of ceilings or floors divided by their respective proposed effective thermal resistance and the sum of the reference areas of ceilings or floors divided by their respective thermal resistance required in Article 9.36.2.6. is not more than the difference between 17% fenestration and door area and the proposed fenestration and door areas divided by the required effective thermal resistance values for windows and doors in Article 9.36.2.7.

(See Notes A-9.36.2.11.(4) and A-9.36.2.11.(2) and (3).)

5) The effective thermal resistance of windows shall be determined using one of the following equations, as applicable:

a) RSI = 1/U, where the U-value is known, or

b) reserved.

6) The reduction in effective thermal resistance of above-ground opaque *building* envelope assemblies permitted by Sentences (2) and (4) shall result in an RSI value that is not less than

a) 55% of that required in Article 9.36.2.6. for above-ground walls and joist-type roofs (see Note A-9.36.2.11.(6)(a)), and

b) 60% of that required in Article 9.36.2.6. for other opaque assemblies.

7) The effective thermal resistances of above-ground opaque assemblies with embedded heating cables, pipes or membranes are not permitted to be traded.

8) The effective thermal resistances of doors and access hatches described in Sentences 9.36.2.7.(3) to (7) are not permitted to be traded.

9.36.3. HVAC Requirements

9.36.3.1. Scope and Application

1) This Subsection is concerned with the efficient use of energy by systems and equipment used for heating, ventilating and air-conditioning (HVAC).

2) Where HVAC systems, equipment or techniques other than those described in this Subsection are used, the *building* shall be designed and constructed in accordance with the energy efficiency requirements of the NECB.

9.36.3.2. Equipment and Ducts

1) HVAC systems shall be sized in accordance with good practice as described in Sections 9.32. and 9.33. (See Note A-9.36.3.2.(1).)

2) Ducts shall be designed and installed in accordance with Sections 9.32. and 9.33. (See Note A-9.36.3.2.(2).)

3) Except for *exhaust ducts* leading directly to the exterior, ducts and *plenums* carrying conditioned air and located outside the plane of insulation shall

a) except as provided in Sentence (4), have all joints sealed against air infiltration and exfiltration with

i) sealants or gaskets made from liquids, mastics or heat-applied materials,

ii) mastic with embedded fabric, or

iii) foil-faced butyl tape, and

b) except as provided in Sentence (5), be insulated to the same level as required in Subsection 9.36.2. for exterior above-ground walls.

4) Fabric-backed tape with rubber adhesives shall not be used as a primary sealant to meet the requirements of Clause (3)(a).

5) The underside of rectangular ducts installed under an insulated floor over an unconditioned space is permitted to be insulated to a lower level than required in Sentence (3) but not to less than 2.11 ($m^2 \cdot K/W$, provided both sides of such ducts are insulated to a compensating higher thermal resistance so that the resulting heat loss does not exceed that of ducts complying with Sentence (3). (See Note A-9.36.3.2.(5).)

9.36.3.3. Air Intake and Outlet Dampers

1) Except as provided in Sentences (3) and (4), every duct or opening intended to discharge air to the outdoors shall be equipped with

a) a motorized damper, or

b) a gravity- or spring-operated backflow damper.

2) Except as provided in Sentences (3) and (4) and except in locations with fewer than 3 500 heating degree-days as listed in Appendix C, every outdoor air intake duct or opening shall be equipped with a motorized damper that remains in the "open" position if the damper fails.

3) Where other regulations are in effect that do not permit dampers, air intakes and outlets need not comply with Sentences (1) and (2).

4) Air intakes and outlets serving HVAC systems that are required to operate continuously need not comply with Sentences (1) and (2). (See Note A-9.36.3.3.(4).)

9.36.3.4. Piping for Heating and Cooling Systems

1) Piping for heating and cooling systems shall be designed and installed in accordance with Subsection 9.33.8. (See Note A-9.36.2.10.(5)(b).)

2) Except for high-temperature refrigerant piping, all piping forming part of a heating or air-conditioning system shall be located

a) inside the plane of insulation, or

b) within or outside the plane of insulation, provided the piping is insulated to a thermal resistance not less than that required in Subsection 9.36.2. for exterior above-ground walls.

(See Note A-9.36.3.4.(2).)

9.36.3.5. Equipment for Heating and Air-conditioning Systems

1) Equipment for heating and air-conditioning systems shall be located

a) inside the plane of insulation, or

b) outdoors or in an unconditioned space, provided the equipment is designated by the manufacturer for such installation.

(See Note A-9.36.3.5.(1).)

9.36.3.6. Temperature Controls

1) Except for manually fuelled solid-fuel-fired *appliances*, the supply of heating and cooling energy to each *dwelling unit*, *suite* or common space shall be controlled by thermostatic controls that activate the appropriate supply when the temperature in a *conditioned space* fluctuates ±0.5°C from the set-point temperature for that space.

2) Where heating and cooling systems are controlled by separate thermostatic controls, means shall be provided to prevent these controls from simultaneously calling for heating and cooling.

3) Space temperature control devices used to control unitary electric resistance *space heaters* shall conform to CSA C828, "Thermostats Used with Individual Room Electric Space Heating Devices."

4) Controls required by Sentence (1) shall be designed such that lowering the set-point temperature on the thermostat for the heating system will not cause cooling energy to be expended to reach the lowered setting, and raising the set-point temperature on the thermostat for the cooling system will not cause heating energy to be expended to reach the raised setting.

5) Automatic devices or manually operated dampers, valves or switches shall be provided, as appropriate for the heating system used, to allow the heating of each zone to be adjusted.

6) 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.

7) 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. (See Note A-9.36.3.6.(7).)

9.36.3.7. Humidification

1) Where an HVAC system is equipped with a means for adding moisture to maintain specific humidity levels, an automatic humidity control device shall be provided.

9.36.3.8. Heat Recovery from Dehumidification in Spaces with an Indoor Pool or Hot Tub

(See Note A-9.36.3.8.)

1) Except as provided in Sentences (2) and (3), spaces containing an indoor pool or hot tub shall be equipped with air exhaust systems conforming to Sentence (4) at design conditions. (See also Article 9.25.4.2.)

2) Spaces containing an indoor pool need not comply with Sentence (1), provided a stationary mechanical or desiccant dehumidification system is installed that provides at least 80% of the dehumidification that would result from compliance with Sentence (1).

3) Spaces containing an indoor pool or hot tub having a total water surface area of less than 10 m^2 need not comply with Sentence (1), provided they are equipped with a cover having a nominal thermal resistance not less than 2.1 $(m^2 \cdot K)/W$.

4) Heat-recovery systems used to meet the requirements of Sentence (1) shall

a) be capable of recovering at least 40% of the sensible heat from exhausted air when tested in accordance with AHRI 1060 (I-P), "Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment,"(see Note A-9.36.3.8.(4)(a)), or

b) have a sensible-heat-recovery efficiency complying with Sentence 9.36.3.9.(3) when tested in accordance with CAN/CSA-C439, "Rating the Performance of Heat/Energy-Recovery Ventilators."

5) The sensible heat, in kW, referred to in Clause (4)(a), which is the sensible heat content of the total quantity of exhausted air, shall be calculated as follows:

$$\text{Sensible Heat} = 0.00123 \cdot Q \cdot (T_e - T_o)$$

where

T_e = temperature of exhausted air before heat recovery, in °C,

T_o = outdoor 2.5% January design temperature as listed in Appendix C, in °C, and

Q = rated capacity of exhaust system at normal temperature of exhausted air, in L/s.

9.36.3.9. Heat Recovery from Ventilation Systems

1) This Article applies where a self-contained mechanical ventilation system is installed whose principal exhaust component is equipped with heat-recovery capability. (See Note A-9.36.3.9.(1).)

2) Where an integrated mechanical system (IMS) with a heat-recovery ventilator provides the principal exhaust ventilation, the IMS shall

a) be tested in accordance with CSA P.10, "Performance of Integrated Mechanical Systems for Residential Heating and Ventilation," and

b) have a minimum overall thermal performance factor conforming to Table 9.36.3.10.

3) When tested in conformance with the low-temperature thermal and ventilation test methods described in CAN/CSA-C439, "Rating the Performance of Heat/Energy-Recovery Ventilators," heat-recovery ventilators described in Sentence (1) shall have a sensible heat-recovery efficiency of

a) at least 60% at an outside air test temperature of 0°C for locations with a 2.5% January design temperature greater than or equal to ?10°C, and

b) at least 60% at an outside air test temperature of 0°C and at least 55% at an outside air test temperature of ?25°C for locations with a 2.5% January design temperature less than ?10°C.

(See Note A-9.36.3.9.(3).)

4) The requirements of Sentence (3) shall be met using a principal ventilation rate not less than that required in Section 9.32. (See Note A-9.36.3.9.(3).)

9.36.3.10. Equipment Efficiency

1) HVAC equipment and components shall comply with the performance requirements stated in Table 9.36.3.10. (See Note A-9.36.3.10.(1).)

Table 9.36.3.10.
HVAC Equipment Performance Requirements
Forming Part of Sentences 9.36.3.9.(2) and 9.36.3.10.(1)

Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance[1]
Air-Cooled Unitary Air Conditioners and Heat Pumps – Electrically Operated			
Split system	≤ 19	CSA C656	SEER = 14.5
			EER = 11.5
			HSPF = 7.1 (region 5 in standard)
Single-package system	≤ 19	CSA C656 (including General Instruction No. 2)	SEER = 14
			EER = 11
			HSPF = 7.0 (region 5 in standard)
All systems	> 19	CAN/CSA-C746	See Level 2 in standard
Water-Cooled Unitary Air Conditioners and Heat Pumps – Electrically Operated			
Ground-source and water-source heat pumps			
open loop	< 40	CAN/CSA-C13256-1	$COP_c \geq 4.75$, $COP_h \geq 3.6$
closed loop			$COP_c \geq 3.93$, $COP_h \geq 3.1$
Water-to-water heat pumps			
open loop	< 40	CAN/CSA-C13256-2	$COP_c \geq 5.60$, $COP_h \geq 3.4$
closed loop			$COP_c \geq 4.21$, $COP_h \geq 2.8$
Internal water-loop heat pumps	< 5	CAN/CSA-C13256-1	$COP_c \geq 3.28$, $COP_h \geq 4.2$
	≥ 5 and ≤ 40		$COP_c \geq 3.52$, $COP_h \geq 4.2$
Water-cooled air conditioners – all types	< 19	ANSI/AHRI 210/240 or CTI STD-201RS	COP = 3.54, ICOP = 3.60
Direct-Expansion Ground-Source Heat Pumps – Electrically Operated			
Direct-expansion ground-source heat pumps	≤ 21	CSA C748	EER = 13.0
			COPh = 3.1

Table 9.36.3.10. *(continued)*
HVAC Equipment Performance Requirements
Forming Part of Sentences 9.36.3.9.(2) and 9.36.3.10.(1)

Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance[1]
Room Air Conditioners and Room Air Conditioner Heat Pumps			
Room air conditioners with reverse cycle			
with louvered sides	< 10.55	ANSI/AHAM RAC-1	EER = 8.5
without louvered sides			EER = 8.0
Room air conditioners without reverse cycle and with louvered sides	< 1.8	CSA C368.1	EER = 10.7
	≥ 1.8 and < 2.3		EER = 10.7
	≥ 2.3 and < 4.1		EER = 10.8
	≥ 4.1 and < 5.9		EER = 10.7
	≥ 5.9		EER = 9.4
Room air conditioner heat pumps with louvered sides	< 5.9		EER = 9.9
	≥ 5.9		EER = 9.5
Room air conditioners without louvered sides and without reverse cycle	< 1.8		EER = 9.9
	≥ 1.8 and < 2.3		EER = 9.9
	≥ 2.3 and < 4.1		EER = 9.4
	≥ 4.1 and < 5.9		EER = 9.4
	≥ 5.9		EER = 9.4
Room air conditioner heat pumps without louvered sides	< 4.1		EER = 9.2
	≥ 4.1		EER = 8.8
Room air conditioner, casement only	All capacities		EER = 9.5
Room air conditioner, casement slider	All capacities		EER = 9.5
Boilers			
Electric *boilers*	≤ 88	–	Must be equipped with automatic water temperature control[2]
Gas-fired *boilers*[3]	≤ 88	CSA P.2	AFUE ≥ 90%
	> 88 and ≤ 117.23	AHRI BTS	E_t ≥ 83%
Oil-fired *boilers*	≤ 88	CSA B212 or ANSI/ASHRAE 103	AFUE ≥ 85%
Warm-Air Furnaces, Combination Warm-Air Furnace/Air-conditioning Units, Duct Furnaces and Unit Heaters			
Gas-fired warm-air *furnaces*[3]	≤ 65.9	CSA P.2	AFUE ≥ 92%
	> 65.9 and ≤ 117.23	CAN/CSA-P.8	E_t ≥ 78.5%
Gas-fired duct *furnaces*[3]	≤ 117.23	ANSI Z83.8/CSA 2.6	E_t ≥ 81%
Gas-fired *unit heaters*[3]	≤ 117.23	CAN/CSA-P.11	E_t ≥ 82%
Oil-fired warm-air *furnaces*	≤ 66	CSA B212	AFUE ≥ 85%
Oil-fired duct *furnaces* and *unit heaters*	–	UL 731	E_c ≥ 80%

Table 9.36.3.10. *(continued)*
HVAC Equipment Performance Requirements
Forming Part of Sentences 9.36.3.9.(2) and 9.36.3.10.(1)

Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance[1]
Combined space- and water-heating systems (combos)	≤ 87.9 if *boiler*-based	CAN/CSA-P.9[4]	TPF = 0.65
	≤ 73.2 if based on *service water heater*		
Integrated mechanical systems	–	CSA P.10	OTPF = 0.78
Other			
Gas-fired fireplaces and *stoves*[3]	–	–	[5]
Solid-fuel-burning space-heating equipment	–	EPA 40 CFR, Part 60, Subpart AAA or CSA B415.1[6]	See standard[7]
Dehumidifiers	≤ 87.5 L/day	CAN/CSA-C749	See standard[7]

Notes to Table 9.36.3.10.:

(1) The symbols and abbreviations that appear in this column have the following meanings:
AFUE = annual fuel utilization efficiency
COP = coefficient of performance, in W/W (COPc = in cooling mode and COPh = in heating mode)
E_c = combustion efficiency, in %
EER = energy efficiency ratio, in (Btu/h)/W (no metric equivalent)
E_t = thermal efficiency
FE = fireplace efficiency
HSPF = heating season performance factor, in watt-hours
ICOP = integrated coefficient of performance, in W/W
OTPF = overall thermal performance factor
SEER = seasonal energy efficiency ratio, in (Btu/h)/W (no metric equivalent)
TPF = thermal performance factor

(2) No standard addresses the performance efficiency of electric boilers; however, their efficiency typically approaches 100%.

(3) Includes propane.

(4) See the exception stated in Sentence (3).

(5) See Sentence (2).

(6) CSA B415.1 does not apply to *stoves* with an oven whose volume is greater than 0.028 m^3 and automatically fuelled *appliances*.

(7) Minimum performance values are omitted from the Table in cases where the referenced standard itself contains such requirements.

2) Natural gas and propane fireplaces shall be

a) direct-vent (sealed), and

b) pilot-on-demand, interrupted or intermittent ignition systems without a standing pilot light.

3) The heat source component of combined space- and service water heating systems that are not within the scope of CAN/CSA-P.9, "Performance of Combined Space and Water Heating Systems (Combos)," shall meet the performance requirements stated in Table 9.36.3.10. for the applicable equipment type. (See Note A-9.36.3.10.(3).)

9.36.3.11. Solar Thermal Systems

1) Space-heating systems that use solar thermal technology shall conform to the manufacturer's design requirements and installation procedures.

2) Service water heating systems that use solar thermal technology shall be installed in accordance with the Book II (Plumbing Systems) of this Code.

3) Hot water storage tanks associated with the systems referred to in Sentence (2) shall be installed in a *conditioned space*.

9.36.4. Service Water Heating Systems

9.36.4.1. Scope and Application

1) This Subsection is concerned with the efficient use of energy by systems used to heat service water for household use as well as for indoor pools and hot tubs.

2) Where service water heating equipment or techniques other than those described in this Subsection are used, the *building* shall be designed and constructed in accordance with the energy efficiency requirements of the NECB.

9.36.4.2. Equipment Efficiency

1) Service water heaters, boilers, pool heaters and storage tanks shall comply with the performance requirements stated in Table 9.36.4.2. (See Note A-9.36.4.2.(1).)

2) Hot service water storage tanks not listed in Table 9.36.4.2. shall be covered with insulation having a minimum thermal resistance of 1.8 ($m^2 \cdot K/W$).

Table 9.36.4.2.
Service Water Heating Equipment Performance Standards
Forming Part of Sentences 9.36.4.2.(1) and (2)

Component	Input[1]	Standard	Performance Requirement[2]
Storage-Type Service Water Heaters			
Electric	≤ 12 kW (50 L to 270 L capacity)	CAN/CSA-C191	SL ≤ 35 + 0.20V (top inlet)
			SL ≤ 40 + 0.20V (bottom inlet)
	≤ 12 kW (> 270 L and ≤ 454 L capacity)		SL ≤ (0.472V) – 38.5 (top inlet)
			SL ≤ (0.472V) – 33.5 (bottom inlet)
	>12 kW (> 75 L capacity)	ANSI Z21.10.3/CSA 4.3 and DOE 10 CFR, Part 431, Subpart G	$S = 0.30 + 27/V_m$
Heat pump water heaters	≤ 24 A and ≤ 250 V	CAN/CSA-C745	EF ≥ 2.0
Gas-fired[3]	< 22 kW	CAN/CSA-P.3	EF ≥ 0.67 – 0.0005V
	≥ 22 kW	ANSI Z21.10.3/CSA 4.3	Et ≥ 80% and standby loss ≤ rated input[4]/(800 + 16.57·√V)
Oil-fired	≤ 30.5 kW	CAN/CSA-B211	EF ≥ 0.59 – 0.0005V
	> 30.5 kW	ANSI Z21.10.3/CSA 4.3 and DOE 10 CFR, Part 431, Subpart G	Et ≥ 78% and standby loss ≤ (rated input[4]/800) + 16.57·√V

Table 9.36.4.2. *(continued)*
Service Water Heating Equipment Performance Standards
Forming Part of Sentences 9.36.4.2.(1) and (2)

Component	Input[1]	Standard	Performance Requirement[2]
Tankless Service Water Heaters			
Gas-fired	≤ 73.2 kW	CAN/CSA-P.7	EF ≥ 0.8
	> 73.2 kW	ANSI Z21.10.3/CSA 4.3 and DOE 10 CFR, Part 431, Subpart G	E_t ≥ 80%
Oil-fired	≤ 61.5 kW[5]	DOE 10 CFR, Part 430, Subpart B, Appendix E	EF ≥ 0.59 − 0.0019V_m
	Other	ANSI Z21.10.3/CSA 4.3 and DOE 10 CFR, Part 431, Subpart G	E_t ≥ 80%
Electric	–	–	[6]
Combined space- and water-heating systems (combos)	≤ 87.9 kW if boiler-based	CAN/CSA-P.9	TPF = 0.65
	≤ 73.2 kW if based on service water heater		
Integrated mechanical systems	–	CSA P.10	OTPF = 0.78
Pool Heaters			
Gas-fired[3]	< 117.2 kW	ANSI Z21.56/CSA 4.7 or CSA P.6	Et ≥ 82%
Oil-fired	–	CSA B140.12	Et ≥ 75%

Notes to Table 9.36.4.2.:

(1) 1 kW = 3412 Btu/h

(2) The symbols and abbreviations used in this column have the following meanings:

EF = energy factor, in %/h

E_t = thermal efficiency with 38.9°C water temperature difference

OTPF = overall thermal performance factor

S = standby loss, in %/h (percentage heat content of stored water per hour)

SL = standby loss, in W

TPF = thermal performance factor

V = storage volume, in L, as specified by the manufacturer

V_m = measured storage volume, in US gallons

(3) Includes propane.

(4) Rated input is measured in watts.

(5) Consistent with the U.S. Congress "National Appliance Energy Conservation Act of 1987."

(6) No standard addresses the performance efficiency of electric tankless *service water heaters*; however, their efficiency typically approaches 100%.

3) Except for components that are required to be installed outdoors, service water heating equipment shall be installed in a *conditioned space*. (See Note A-9.36.4.2.(3).)

9.36.4.3. Solar Domestic Hot Water Systems

1) Service water heating systems that use solar thermal technology shall conform to the manufacturer's design requirements and installation procedures.

2) Service water heating systems that use solar thermal technology shall be installed in accordance with the Book II (Plumbing Systems) of this Code.

3) Hot water storage tanks associated with the systems referred to in Sentence (2) shall be installed in a *conditioned space*.

9.36.4.4. Piping

1) The first 2 m of outlet piping downstream and of inlet piping upstream leading from a storage tank or heating vessel shall be covered with piping insulation that is at least 12 mm thick.

2) All piping forming part of a continuously operating recirculating service water heating system shall be covered with piping insulation that is at least 12 mm thick.

3) Where piping forming part of the service water heating system is located outside the *building* envelope or in an unconditioned space, it shall be insulated to a thermal resistance not less than the effective thermal resistance required for the exterior above-ground walls.

9.36.4.5. Controls

1) Service water heating systems with storage tanks shall be equipped with automatic temperature controls capable of adjustment between the minimum and maximum temperature settings permitted for the intended use.

9.36.4.6. Indoor Swimming Pool Equipment Controls

1) Heaters for indoor swimming pools shall be equipped with

a) a thermostat, and

b) a readily accessible and clearly labeled device that allows the heater to be shut off without adjusting the thermostat setting.

2) Pumps and heaters for indoor swimming pools shall be equipped with time switches or other types of controls that can be set to automatically turn off the pumps and heaters when their operation is not required. (See Note A-9.36.4.6.(2).)

9.36.5. Energy Performance Compliance

9.36.5.1. Scope and Application

1) This Subsection is concerned with modeling the energy performance of components, systems and assemblies, including heat gains from internal loads described in Sentence 9.36.5.4.(4), that are addressed in the scope of the prescriptive requirements in Subsections 9.36.2. to 9.36.4. and that are installed in *buildings* described in Sentence 9.36.1.3.(3).

2) Internal loads other than those described in Sentence 9.36.5.4.(4) shall be excluded from the performance compliance calculations as they relate to

a) the lighting of unconditioned spaces,

b) exterior lighting, and

c) the ventilation of unconditioned spaces.

9.36.5.2. Definitions

(See Note A-9.36.5.2.)

1) For the purpose of this Subsection, the term "reference house" shall mean a hypothetical replica of the proposed house design using the same energy sources for the same functions and having the same environmental requirements, *occupancy*, climatic data and operating schedules, but made to comply with all applicable prescriptive requirements of Subsections 9.36.2. to 9.36.4.

2) For the purpose of this Subsection, the term "annual energy consumption" shall mean the annual sum of service water heating and space-conditioning energy consumption of the proposed house design, as calculated in accordance with this Subsection.

3) For the purpose of this Subsection, the term "house energy target" shall mean the annual energy consumption of the reference house, as calculated in accordance with this Subsection.

4) For the purpose of this Subsection, the term "principal ventilation rate" shall mean the normal operating exhaust capacity of the principal ventilation fan as required by Article 9.32.3.3.

9.36.5.3. Compliance

1) The performance compliance calculations shall determine

a) the annual energy consumption of the proposed house, and

b) the house energy target of a reference house.

2) The annual energy consumption of the proposed house shall not exceed the house energy target of the reference house. (See Note A-9.36.5.3.(2).)

3) In establishing the house energy target, *building* components, systems and assemblies shall be accounted for in accordance with the prescriptive requirements of Subsections 9.36.2. to 9.36.4. for the climate zone under consideration.

4) In establishing the annual energy consumption, *building* components, systems and assemblies that are addressed in the scope of the prescriptive requirements of Subsections 9.36.2. to 9.36.4. shall be accounted for for the climate zone under consideration.

5) Where the construction techniques or *building* components, systems or assemblies used are more energy-efficient than those prescribed by the prescriptive requirements, the performance compliance calculations are permitted to take this increased performance level into account in the determination of the annual energy consumption, provided it can be quantified and is not dependent on occupant interaction.

6) Both the proposed and reference houses shall be modeled using the same climatic data, *soil* conditions, operating schedules in Article 9.36.5.4. and temperature set-points.

9.36.5.4. Calculation Methods

1) Except as provided in Sentence (2), the energy model calculations shall account for the annual energy consumption of systems and equipment required for

a) space heating,

b) ventilation,

c) service water heating, and

d) where installed, space cooling.

(See Note A-9.36.5.4.(1).)

2) Redundant or back-up equipment for the systems and equipment listed in Sentence (1) is permitted to be excluded from the energy model, provided it is equipped with controls and is not required to meet the space-conditioning load of the house. (See Note A-9.36.5.4.(2).)

3) The schedules used in the energy model shall

a) be based on a time interval not greater than one hour, where the energy model evaluates the performance of the house over hourly intervals, or

b) be applied in an hourly-bin model then averaged, where the energy model does not evaluate the performance of the house over hourly intervals.

4) The energy model calculations shall account for the loads due to heat gains from occupants, lighting and miscellaneous equipment using the default schedule provided in Table 9.36.5.4. for every day of the year and such loads shall be

a) multiplied by the following adjustment factors, as applicable:

i) 1 for a house with or without a *secondary suite*,

ii) 0.625 for each *suite* in a residential *building* containing 2 *suites*,

iii) 0.606 for each *suite* in a residential *building* containing 3 *suites*, or

iv) 0.598 for each *suite* in a residential *building* containing more than 3 *suites*, and

b) increased for each hour by 3.58 W per square metre of *floor area* in common spaces, if applicable.

Table 9.36.5.4.
Default Schedule for Internal Heat Gain Loads(1)
Forming Part of Sentence 9.36.5.4.(4)

Average Load, in W, Before Noon											
12 a.m.	**1 a.m.**	**2 a.m.**	**3 a.m.**	**4 a.m.**	**5 a.m.**	**6 a.m.**	**7 a.m.**	**8 a.m.**	**9 a.m.**	**10 a.m.**	**11 a.m.**
786	552	549	523	521	547	634	726	847	880	906	986
Average Load, in W, After Noon											
12 p.m.	**1 p.m.**	**2 p.m.**	**3 p.m.**	**4 p.m.**	**5 p.m.**	**6 p.m.**	**7 p.m.**	**8 p.m.**	**9 p.m.**	**10 p.m.**	**11 p.m.**
992	934	898	911	924	1 089	1 410	1 588	1 568	1 483	1 194	952

Notes to Table 9.36.5.4.:

(1) The schedule indicates at what time of day the heat gains from internal loads and hot water draws are present; it does not account for heat gains from exterior lighting and from lighting of unconditioned spaces.

5) The energy model calculations shall account for the following space-heating temperature set-points:

a) 21°C in all living spaces above the *basement*,

b) 19°C in *basements* and common spaces, and

c) 15°C in crawl spaces intended to be *conditioned spaces*.

6) The energy model calculations shall account for a space-cooling temperature set-point of 25°C in all *conditioned spaces* served by the cooling system.

7) The energy model calculations shall account for a thermostatic control that responds to fluctuations of ±0.5°C from the temperature set-point. (See Note A-9.36.5.4.(7).)

8) If a computer program is used to carry out the compliance calculations, the calculation methods employed in the energy model shall

a) be used for both the reference and proposed houses, and

b) be tested in accordance with ANSI/ASHRAE 140, "Evaluation of Building Energy Analysis Computer Programs," with variations in the computer program from the range recommended therein reported in accordance with Division C.

9) The proposed and reference houses shall both be modeled using the same approach and assumptions, except where *building* components or energy efficiency features are permitted by this Subsection to be different.

10) The energy model calculations shall account for the effect of airtightness in accordance with Article 9.36.5.10.

11) The energy model calculations shall account for heat transfer through elements separating *conditioned space* from unconditioned space, the exterior or the ground.

9.36.5.5. Climatic Data

1) To calculate the effect of heating and cooling consumption, the energy model calculations shall be performed using climatic data measured at time intervals no greater than one hour for one year (8 760 hours) based on the average of at least 10 years of measured data collected at the weather station nearest to the region in which the proposed house is located. (See Note A-9.36.5.5.(1).)

2) For urban regions with several climatic data sets and for locations for which climatic data are not available, the energy model calculations shall be performed using climatic data that best represent the climate at the *building* site.

3) The energy model calculations shall account for ground reflectance by

a) increasing ground reflectance due to snow cover in a ratio of 30% without snow cover and 70% with snow cover, or

b) taking into account changes in ground reflectance throughout the heating season.

9.36.5.6. Building Envelope Calculations

1) For each hour of the year, the energy model calculations shall account for heat transfer through wall assemblies, roof-ceiling assemblies, including attics where applicable, and exposed floor assemblies due to the thermal characteristics of the particular assembly and thermal bridging.

2) The following *building* envelope assemblies and components shall be addressed in the energy model calculations:

a) above-ground walls and roof-ceiling assemblies,

b) floors and walls in contact with the ground, and

c) doors, windows and skylights.

(See Subsection 9.36.2.)

3) For each wall assembly, fenestration component, roof-ceiling assembly and exposed floor assembly, the energy model calculations shall account for

a) the area of the interior side of the insulated surface,

b) emissivity, and

c) the effective thermal resistance or overall thermal transmittance, as applicable.

4) The energy model calculations shall account for the effect that each assembly in contact with the ground has on below-*grade* heat transfer due to

a) the geometry of the *foundation*,

b) *soil* conditions (see Note A-1.1.3.1.(1)), and

c) the configuration of the insulation.

5) The energy model calculations shall account for heat transfer through fenestration separating *conditioned spaces* from the outdoors, including skylights, while accounting for both temperature difference and transmission of solar radiation based on

a) orientation as a function of azimuth and tilt of the surface,

b) area of frame opening and glazed area,

c) overall thermal transmittance, and

d) solar heat gain coefficient.

6) Where the energy model calculations account for the effect of thermal mass, the contents of the house shall be excluded. (See Note A-9.36.5.6.(6).)

7) The energy model calculations shall account for the presence of thermally active walls, floors and ceilings with embedded conditioning systems that form part of the *building* envelope.

8) Where skylights are installed in the roof, the gross roof area shall be determined in accordance with Sentence 9.36.2.3.(1).

9) Skylights shall be considered to have no shading.

10) The energy model calculations shall account for the effects of exterior permanent and fixed shading only on solar heat gain from fenestration.

11) The ratio of fenestration area to opaque area of doors shall be the same for the proposed and reference houses. (See Note A-9.36.5.6.(11).)

9.36.5.7. HVAC System Calculations

1) The energy model calculations shall account for the energy consumption of each heating, ventilating and, where installed, cooling system for each hour of the year. (See Note A-9.36.5.7.(1).)

2) Each heating system and, where installed, cooling system shall be accounted for separately in the energy model calculations.

3) *Conditioned spaces* in both the reference and proposed houses shall be modeled as being

a) heated, where only heating systems are provided in the proposed house,

b) cooled, where only cooling systems are provided in the proposed house, or

c) heated and cooled, where complete heating and cooling systems are provided in the proposed house.

4) The performance requirements stated in Table 9.36.3.10. shall be used in the energy model calculations.

5) Where duct and piping losses are accounted for in the energy model calculations, they shall be included for both the proposed and reference houses and calculated the same way for both houses. (See Note A-9.36.5.7.(5).)

6) The same time periods shall be used in the simulation of the operation of the ventilation system for both the proposed and reference houses.

7) During the heating season, any solar and internal heat gains that cause an increase in space temperature beyond 5.5°C above the setpoint shall be

a) excluded from the energy model calculations, or

b) calculated as being vented from the house.

8) The energy model calculations shall account for the part-load performance of equipment, including electrical consumption.

9) The energy model calculations shall account for the heat-recovery efficiency of heat-recovery ventilators using a minimum of 2 data test points derived from testing in accordance with Clause 9.36.3.9.(3)(a) or (b), as applicable.

9.36.5.8. Service Water Heating System Calculations

1) The energy model calculations shall account for the energy consumption of all service water heating systems.

2) The performance requirements stated in Table 9.36.4.2. shall be used in the energy model calculations.

3) Where piping or standby losses are accounted for in the energy model calculations, they shall be included for both the proposed and reference houses, including their effect on space heating and cooling, and calculated the same way for both houses.

4) The energy model calculations shall use a supply cold water temperature, in °C, that is

a) equal to –0.002 (HDD) + 20.3, where HDD < 7 999,

b) equal to 4.3, where HDD ≥ 8 000, or

c) determined based on the ground and air temperatures in the climatic data file.

5) The energy model calculations shall use a service water delivery temperature of 55°C. (See Note A-9.36.5.8.(5).)

6) The energy model calculations shall take into account the service water heating use schedule presented in Table 9.36.5.8. using a load of

a) 225 L/ day for houses with or without a *secondary suite*, or

b) 140 L/day per *dwelling unit* for other types of residential *buildings*.

Table 9.36.5.8.
Default Schedule of Service Water Heating Use
Forming Part of Sentence 9.36.5.8.(6)

Type of Small Residential *Building*	Distribution of Hourly Draws on Service Water Heating, L/h											
Houses with or without a *secondary suite* (225 L/day/house)	12 a.m.	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.
	0	0	0	0	0	0	0	5	20	30	55	27.5
	12 p.m.	1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.	10 p.m.	11 p.m.
	7.5	2.5	5	12.5	22.5	15	15	5	2.5	0	0	0
Dwelling units in other types of residential *buildings* (140 L/day/*dwelling unit*)	12 a.m.	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	6 a.m.	7 a.m.	8 a.m.	9 a.m.	10 a.m.	11 a.m.
	0	0	0	0	0	0	0	3.1	12.4	18.7	34.2	17.1
	12 p.m.	1 p.m.	2 p.m.	3 p.m.	4 p.m.	5 p.m.	6 p.m.	7 p.m.	8 p.m.	9 p.m.	10 p.m.	11 p.m.
	4.7	1.6	3.1	7.8	14	9.3	9.3	3.1	1.6	0	0	0

9.36.5.9. General Requirements for Modeling the Proposed House

1) Except where permitted by Articles 9.36.5.10. to 9.36.5.12., the energy model calculations for the proposed house shall be consistent with the proposed construction specifications for that house with regard to

a) fenestration and opaque *building* envelope assembly type, effective thermal resistance and areas,

b) HVAC system types and capacities, and

c) service water heating system types and capacities.

(See Note A-9.36.5.9.(1).)

9.36.5.10. Modeling Building Envelope of Proposed House

1) Except as provided in Sentences (2) and (3), the energy model calculations for the proposed house shall be consistent with the proposed construction specifications for that house with regard to

a) the area of the above-ground portion of *foundation* walls,

b) the effective thermal resistance of above-ground walls, ceilings below attics, roof assemblies and *rim joists*,

c) the maximum overall thermal transmittance of doors, as calculated in accordance with Sentence 9.36.2.2.(3),

d) the effective thermal resistance of below-ground walls and slabs-on-ground,

e) exterior walls, roof-ceiling assembly, doors, walls, exposed floors, and floors in contact with the ground,

f) distribution, orientation and area of fenestration and doors, as calculated in accordance with Article 9.36.2.3.,

g) solar heat gain coefficient and overall thermal transmittance of fenestration, as calculated in accordance with Sentence 9.36.2.2.(3),

h) configuration of insulation in assemblies in contact with the ground, and

i) effective thermal resistance of *foundation* walls.

2) Except for penetrations, slab-on-ground edge insulation and assemblies with embedded heating pipes, where a *building* envelope component or assembly covers less than 2% of the total area of the assembly type to which it belongs, its thermal characteristics are not required to be calculated as belonging to a distinct assembly, provided the area of the component or assembly is included in an adjacent assembly having the same orientation (See Note A-9.36.5.10.(2).)

3) *Building* envelope assemblies with the same thermal characteristics and orientation are not required to be calculated as distinct assemblies, provided their area is included in an adjacent assembly.

4) *Building* envelope assemblies and components separating *conditioned space* from enclosed unconditioned space shall have a solar heat gain coefficient equal to 0.

5) Except as stated in Sentence 9.36.5.6.(9), the energy model calculations for the proposed house shall account for the effects of exterior permanent and fixed shading devices, including fins, overhangs, and light shelves, on solar heat gain.

6) Where thermal mass is included in the energy model calculations for the proposed house, it shall be set as

a) the specified mass up to the inside edge of insulation in exterior walls, the mass of interior walls, the mass up to the centre-line of *party walls*, and the mass of floors, as applicable,

b) the specified mass of the *building* envelope assembly, where the energy model calculations include a transient analysis of thermal transfer of the entire *building* envelope assembly, or

c) a default value of 0.060 $MJ/m^2 \cdot °C$.

7) Exterior walls, roofs and exposed floors shall have a solar absorptance of 0.4.

8) The orientation of the *foundation* of the proposed house as constructed shall be within 22.5° of the orientation used in the energy model calculations.

9) The airtightness value used in the energy model calculations for the proposed house shall be

a) 4.5 air changes per hour at 50 Pa pressure differential, where the construction complies with Section 9.25.,

b) 3.5 air changes per hour at 50 Pa pressure differential, where it can be shown that the *air barrier system* is constructed in accordance with Subsection 9.25.3. and Articles 9.36.2.9. and 9.36.2.10., or

c) tested in accordance with Sentence (11), and shall be

i) the number of air changes per hour at 50 Pa pressure differential, and

ii) the equivalent leakage area (see Note A-9.36.5.10.(9)(c)(ii)).

10) Where airtightness is measured in accordance with Clause 9.36.5.10.(9)(c), the applicable airtightness value in Clause 9.36.5.10.(9)(a) or (b) shall be assigned for use in the energy model calculations until the actual airtightness has been measured in accordance with Sentence (11).

11) Where measured airtightness is used in the energy model calculations, it shall be determined in accordance with CAN/CGSB-149.10-M, "Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method,"

a) as written, or

b) excluding Clause 6.1.6, which allows intentional openings for mechanical equipment to be left unsealed.

(See Note A-9.36.5.10.(11).)

12) Reserved.

13) Where airtightness is determined in accordance with Clause (11)(b), its rate shall be adjusted in the energy model calculations to account for air leakage through mechanical equipment.

9.36.5.11. Modeling HVAC System of Proposed House

1) Where multiple HVAC systems serve a single space, the energy model calculations for the proposed house shall call each system in the order of priority established by the system control in the proposed house.

2) Where a heat pump is included in the proposed house, the energy model calculations shall include

a) the effect of the source temperature on the heat pump's efficiency, and

b) the temperature at which the heat pump shuts down.

3) Permanent supplementary heating systems that are operated by a thermostat or automatic control shall be included in the energy model calculations for the proposed house.

4) The performance characteristics of the heat-recovery ventilation system of the proposed house shall be as specified at not less than the principal ventilation rate required for a system designed in accordance with Section 9.32.

5) The ventilation system shall be modeled as operating 8 hours a day at the principal ventilation rate.

6) The energy model calculations shall determine the required principal ventilation rate, in L/s, in accordance with Article 9.32.3.3. based on the number of bedrooms in the proposed house.

7) The energy model calculations may include duct and piping losses, taking into account the properties of the specified duct and piping insulation of the proposed house.

8) The energy model calculations shall include a heating system and, where installed, a cooling system sized according to the specifications for the proposed house.

9) The energy model calculations shall include the effect of part-load performance of equipment using

a) the same modeled part-load performance data used for the reference house as per Clause 9.36.5.15.(6)(a),

b) the default part-load performance characteristics stated in Clause 9.36.5.15.(6)(b), or

c) measured data for the specified equipment.

(See Note A-9.36.5.11.(9).)

10) Where a heat-recovery ventilator is installed in the proposed house, the energy model calculations shall only account for the recovery of sensible heat using the efficiency ratings in Sentence 9.36.3.9.(3).
(See Note A-9.36.5.11.(10).)

11) Except as provided in Sentence (12), where a forced-air system is installed in the proposed house, the energy model calculations shall assume the circulation fan operates when the heating, cooling or principal ventilation system is operating. (See Note A-9.36.5.11.(11).)

12) Where a forced-air system is installed in the proposed house and where the principal ventilation system in the proposed house is a separate, fully ducted ventilation system, the energy model calculations shall assume the circulation fan operates only when the heating or cooling system is operating.

13) Where the proposed house contains multiple HVAC systems, the circulation fan power shall be the sum of the circulation fan power capacity of each system.

14) The ventilation fan power consumption shall be modeled

a) as being 2.32 W/L/s for each ventilation fan on the exhaust side and, where applicable, on the supply side, or

b) as specified, where a heat-recovery ventilator is used.

15) Where a forced-air system is installed in the proposed house, the energy model calculations shall determine the flow rate, in L/s, of the circulation fan in the reference house by multiplying the capacity, in W, of the heating system in the proposed house by

a) 0.0604 for heat pumps, and

b) 0.0251 for all other types of heating systems.

16) Where a forced-air system is installed in the proposed house, the energy model calculations shall determine the minimum electricity requirement, in W, of the circulation fan by multiplying the flow rate, in L/s, of the circulation fan in the reference house, determined in accordance with Sentence (15), by a factor of 2.30.

17) Where a forced-air system is installed in the proposed house, the flow rate of the circulation fan shall be modeled as being the larger of

a) the flow rate of the circulation fan of the reference house, determined in accordance with Sentence (15), or

b) the flow rate of the circulation fan for the forced-air system specified in the design for the proposed house.

18) Except as provided in Sentence (19), where a forced-air system is installed in the proposed house, the power capacity of the circulation fan shall be modeled as specified in the design for the proposed house.

19) Where the design for the proposed house specifies a forced-air system with a circulation fan flow rate that is lower than that of the flow rate of the circulation fan in the reference house, as determined in accordance with Sentence (15), the electricity capacity, in W, of the circulation fan shall be modeled as being the larger of

a) the electricity capacity specified for the circulation fan in the proposed forced-air system, or

b) the minimum circulation fan electricity capacity determined in accordance with Sentence (16).

20) For natural gas-, oil-, propane- and wood-burning heating systems, the energy model calculations shall set the auxiliary electricity requirements, including that of combustion fans, to those specified for the proposed house.

9.36.5.12. Modeling Service Water Heating System of Proposed House

1) The service water heating system used in the energy model calculations shall be sized as specified in the design for the proposed house.

2) The energy model calculations may include

a) piping losses, and

b) drain-water heat recovery, provided the calculation of the heat recovered is based on the efficiency of the drain-water heat-recovery unit specified for the proposed house and the energy savings are determined using a drain-water

i) inlet temperature to the recovery system of 36°C,

ii) flow rate of 9.5 L/min, and

iii) flow that is available for recovery 15 min/day for a house and 10 min/day per *suite* for a multi-unit residential *building* with more than 2 *suites*.

(See Note A-9.36.5.12.(2).)

9.36.5.13. General Requirements for Modeling the Reference House

1) Except as provided in Sentence (2) and Articles 9.36.5.14. to 9.36.5.16., the energy model calculations for the reference house shall be consistent with the prescriptive requirements of Subsections 9.36.2. to 9.36.4. with regard to

a) fenestration and opaque *building* envelope assembly types and areas,

b) HVAC system types and capacities, and

c) service water heating system types and capacities.

(See Note A-9.36.5.9.(1).)

2) The energy model calculations for the reference house shall include the same values as those used for the proposed house with regard to

a) *floor area*,

b) heated volume, and

c) number and types of rooms.

9.36.5.14. Modeling Building Envelope of Reference House

1) The energy model calculations for the reference house shall include the same values as those used for the proposed house with regard to

a) the gross area of above-ground portion of *foundation* walls,

b) *soil* conditions,

c) the orientation of the *foundation*, and

d) the ratio of fenestration area to opaque area of doors.

2) The energy model calculations for the reference house shall use the following set values:

a) 0.060 MJ/m^2·°C for thermal mass,

b) a solar absorptance of 0.4 for the exterior walls, roofs and exposed floors,

c) 0.26 for the solar heat gain coefficient of fenestration, and

d) 2.5 air changes per hour at 50 Pa pressure differential for airtightness.

3) The effective thermal resistance and overall thermal transmittance values, as applicable, used in the energy model calculations for the reference house shall be determined for the applicable heating degree-day zone in accordance with

a) Table 9.36.2.6.-A for walls, ceilings below attics, roof assemblies and *rim joists*,

b) Table 9.36.2.7.-A for doors, and

c) Table 9.36.2.8.-A for below-*grade* walls and slabs-on-ground.

4) Except as provided in Sentences (5) and (6), the exterior walls, roof-ceiling assembly, doors, walls, exposed floors, and floors of the reference house that are in contact with the ground shall have the same area as those of the proposed house.

5) The area and orientation of fenestration and doors of the reference house shall be modeled as being equally distributed on all sides of the house.

6) The gross wall area and the area of fenestration and doors of the reference house shall be determined in accordance with Article 9.36.2.3.

7) Windows and other glazed components in the reference house shall have a maximum overall thermal transmittance as required in Table 9.36.2.7.-A for the applicable heating degree-day category.

8) The configuration of insulation in assemblies of the reference house that are in contact with the ground shall be modeled as conforming to Article 9.36.2.8.

9) *Foundation* walls shall be modeled using the applicable effective thermal resistance values in Table 9.36.2.8.-A and as conforming to Sentence 9.36.2.8.(2).

10) The fenestration and door area to gross wall area ratio (FDWR) of the reference house shall be

a) for houses containing 1 or 2 *dwelling units*,

   i) as per the proposed house, where its FDWR is between 17% and 22%,

   ii) 17%, where the FDWR of the proposed house is less than 17%, or

   iii) 22%, where the FDWR of the proposed house is greater than 22%, and

b) for *buildings* of *residential occupancy* containing more than 2 *dwelling units*,

   i) the FDWR determined in Clause (a) for the areas determined in accordance with Sentence 9.36.2.3.(2) and, where the FDWR determined in accordance with the calculation in Sentence 9.36.2.3.(3) only does not exceed 40%, or

   ii) 40% of the gross wall area enclosing *conditioned space* where the area of fenestration and doors is greater than 40% of the gross wall area enclosing *conditioned space* determined in accordance with Sentence 9.36.2.3.(2).

(See Note A-9.36.5.14.(10).)

9.36.5.15. Modeling HVAC System of Reference House

1) Where multiple HVAC systems serve a single space, the energy model calculations for the reference house shall use the same order of priority as that used for the proposed house. (See Sentence 9.36.5.11.(1).)

2) The energy model calculations for the reference house shall include the same features as those used for the proposed house with regard to

a) the principal heating and cooling energy sources, which are gas, electricity, oil, propane, wood or a heat pump,

b) the primary and secondary energy sources, which are gas, electricity, oil, propane, wood or a heat pump, and

c) the ventilation rate (see Sentence 9.36.5.11.(6)).

3) Except as required in Sentence 9.36.3.8.(1), the reference house shall be modeled without a heat-recovery ventilator.

4) The ventilation system shall be modeled as operating 8 hours a day.

5) The heating system and, where installed, the cooling system shall be sized in accordance with Article 9.33.5.1. with regard to total heat output capacity and nominal cooling capacity. (See Note A-9.36.5.15.(5).)

6) The part-load performance of HVAC equipment in the reference house shall be calculated using

a) modeled part-load performance characteristics, where applicable, or

b) the performance values for each type of system multiplied by an adjustment factor from Table 9.36.5.15.-A, 9.36.5.15.-B or 9.36.5.15.-C as follows:

i) for *furnaces*, by multiplying the *furnace* steady-state efficiency by the adjustment factor given in Table 9.36.5.15.-A,

ii) for heat pumps and air conditioners, by multiplying the heat pump steady-state coefficient of performance by the adjustment factor given in Table 9.36.5.15.-B, and

iii) for *boilers*, combination space-heating and service water heating systems, and integrated mechanical systems, by multiplying the net-full-load heating efficiency by the adjustment factor given in Table 9.36.5.15.-C.

(See Note A-9.36.5.15.(6).)

Table 9.36.5.15.-A
Part-Load Adjustment Factors for Furnaces
Forming Part of Subclause 9.36.5.15.(6)(b)(i)

Fuel Source	Type of Equipment	Capacity	Part-Load Ratio		
			0.15	0.4	1.0
			Adjustment Factors		
Gas	Warm-air *furnaces*	≤ 65.9 kW	1.03	1.02	1.0
		> 65.9 kW	0.91	0.97	1.0
	Duct *furnaces* and *unit heaters*	All capacities	0.91	0.97	1.0
Oil	All types	All capacities	0.95	0.98	1.0

Table 9.36.5.15.-B
Part-Load Adjustment Factors for Heat Pumps and Air Conditioners
Forming Part of Subclause 9.36.5.15.(6)(b)(ii)

Type of Equipment	Part-Load Ratio		
	0.15	0.4	1.0
	Adjustment Factors		
Air-source heat pumps and air conditioners	0.72	0.86	1.0
Water-source heat pumps	0.93	0.98	1.0
Ground-source heat pumps	0.93	0.98	1.0

Table 9.36.5.15.-C
Part-Load Adjustment Factors for Boilers, Combination Systems and Integrated Mechanical Systems
Forming Part of Subclause 9.36.5.15.(6)(b)(iii)

Fuel Source	Type of Equipment	Part-Load Ratio		
		0.15	0.4	1.0
		Adjustment Factors		
Gas	*Boiler*	1.03	1.02	1.0
	Integrated mechanical systems(1) within the scope of CSA P.10(2)	N/A	N/A	N/A
	Combination space- and service water heating systems within the scope of CAN/CSA-P.9(2)	N/A	N/A	N/A
	Combination space- and service water heating systems not within the scope of CAN/CSA-P.9	Same as gas *boiler*		
Oil	*Boiler*	1.03	1.02	1.0
	Combination space- and service water heating systems within the scope of CAN/CSA-P.9(2)	N/A	N/A	N/A
	Combination space- and service water heating systems not within the scope of CAN/CSA-P.9	Same as oil *boiler*		

Notes to Table 9.36.5.15.-C:

(1) Integrated mechanical systems perform all three functions of space-heating, water-heating and heat-recovery ventilation.

(2) The part-load characteristics of these types of systems shall not be accounted for in the energy model calculations.

7) The performance of the HVAC equipment in the reference house shall be modeled

a) as conforming to Table 9.36.3.10. for the corresponding type, fuel source and capacity of equipment in the proposed house, or

b) where the HVAC equipment for the proposed house is not addressed in Table 9.36.3.10., as a gas warm-air *furnace* with a minimum performance rating of 92% annual fuel utilization efficiency.

8) Where a heat-recovery ventilator is installed in the reference house, the energy model calculations shall only account for the recovery of sensible heat using the efficiency ratings in Sentence 9.36.3.9.(3).
(See Note A-9.36.5.15.(8).)

9) The energy model calculations shall assume all ventilation and circulation fans required to be modeled in the reference house are equipped with permanent-split capacitor (PSC) motors.

10) Where a forced-air system is installed in the reference house, the energy model calculations shall assume the circulation fan operates when the heating, cooling or principal ventilation system is called for.

11) Where the reference house contains multiple HVAC systems, the circulation fan power shall be the sum of the circulation fan power capacity of each system.

12) The principal ventilation flow rate, in L/s, prescribed in Section 9.32. shall be multiplied by 2.32 W/L/s to determine the ventilation fan power capacity, in W, to be used in the energy model calculations for each fan on the exhaust side and, where applicable, on the supply side.

13) Where a heat-recovery ventilator is required in the reference house in accordance with Article 9.36.3.8., the ventilation flow rate, in L/s, in the zone served by the pool or hot tub shall be multiplied by 4.18 W/L/s to determine the heat-recovery ventilator power, in W, to be used in the energy model calculations.

14) Where a forced-air system is installed in the reference house, the system's capacity, in W, shall be multiplied by one of the following factors to determine the circulation fan flow rate, in L/s:

a) 0.0604 for heat pumps, and

b) 0.0251 for all other types of heating systems.

15) Where a forced-air system is installed in the reference house, the circulation fan flow rate, in L/s, shall be multiplied by 2.30 W/L/s to determine the circulation fan power capacity, in W.

16) For natural gas-, oil-, propane- and wood-burning heating systems, the energy model calculations shall set the auxiliary electricity capacity, including that of combustion fans, to 208 W during operation.

9.36.5.16. Modeling Service Water Heating System of Reference House

1) The energy source of the reference house's service water heating system, which is gas, electricity, oil, propane, wood or a heat pump, shall be the same as that for the system in the proposed house.

2) The service water heating system in the reference house shall be sized in accordance with Subsection 9.31.6. with regard to output capacity.

3) Except as required by Table 9.36.5.16., the performance of the service water heating equipment in the reference house shall be modeled as conforming to Table 9.36.4.2. for the energy source, capacity and type of service water heating equipment in the proposed house.

Table 9.36.5.16.
Performance of Service Water Heating (SWH) Equipment in the Reference House
Forming Part of Sentence 9.36.5.16.(3)

Type of SWH Equipment in Proposed House	Input for Proposed SWH Equipment	Type of SWH Equipment to be Used for Reference House	Input for Reference SWH Equipment
Gas-fired tankless *service water heater*	≤ 73.2 kW	Gas-fired storage type	≤ 22 kW
	> 73.2 kW		> 22 kW
Oil-fired tankless *service water heater*	≤ 61.5 kW(1)	Oil-fired storage type	≤ 30.5 kW(1)
	Other		> 30.5 kW
Not listed in Table 9.36.4.2.	–	Gas-fired storage type	≥ 22 kW (E_t ≥ 80%)

Notes to Table 9.36.5.16.:

(1) Consistent with the U.S. Congress "National Appliance Energy Conservation Act of 1987."

9.36.6. Energy Step Code

9.36.6.1. Application

1) Where a *building* contains more than one *dwelling unit*, the requirements of this Subsection shall apply to the energy performance of the *building* and not to individual *dwelling units*.

9.36.6.2. Definitions

(See Note A-9.36.6.2.)

1) For the purpose of this Subsection, the term "mechanical energy use intensity" shall mean a metric of the energy used over a year by the *building*, estimated by using an energy model in accordance with Article 9.36.6.4., normalized per square metre of floor area of *conditioned space* and expressed in kWh/(m^2•year), for all of the following combined:

a) space-heating equipment,

b) space-cooling equipment,

c) fans,

d) service water heating equipment,

e) pumps, and

f) auxiliary HVAC equipment (see Note A-9.36.6.2.(1)(f)).

2) For the purpose of this Subsection, the term "EnerGuide Rating % lower than EnerGuide Reference House" shall mean the metric that results when, using HOT2000 software, version 11 or newer and Natural Resources Canada's EnerGuide Rating System, version 15 or newer, the energy consumption of the following are compared:

a) the proposed *building*, not including the EnerGuide assumed electric base loads, and

b) the corresponding automatically-generated reference house, not including the EnerGuide assumed electric base loads.

3) For the purpose of this Subsection, the term "thermal energy demand intensity" shall mean a metric of the annual heating required by the *building* for space conditioning and for conditioning of ventilation air, estimated by using an energy model in accordance with Article 9.36.6.4., normalized per square metre of floor area of *conditioned space* and expressed in kWh/(m^2•year), taking into account all of the following:

a) thermal transmittance of above-ground walls and roof-ceiling assemblies,

b) thermal transmittance of floors and walls in contact with the ground, or with space that is not *conditioned space*,

c) thermal transmittance and solar heat gain of windows, doors and skylights,

d) air leakage through the *air barrier system*,

e) internal heat gains from occupants and equipment, and

f) heat recovery from exhaust ventilation.

4) For the purpose of this Subsection, the term "Step" shall mean a Step referred to in Tables 9.36.6.3.-A to 9.36.6.3.-G.

5) For the purpose of this Subsection, the term "envelope performance improvement over the EnerGuide Reference House" shall mean the difference between the annual heating demand of the proposed *building* and the reference house, where

a) the reference house is generated using HOT2000 software, version 11 or newer and Natural Resources Canada's EnerGuide Rating System, version 15 or newer,

b) the proposed *building* is modelled with same space heating, space cooling, ventilation and service water heating equipment as the reference house, in accordance with the requirements of Articles 9.36.5.15 and 9.36.5.16., and

c) the difference between annual heating demand of the proposed *building* and the automatically-generated reference house is calculated in conformance with 9.36.6.3.(5).

9.36.6.3. Compliance Requirements

1) *Buildings* conforming to the requirements of any of Steps 1 to 5 shall be designed and constructed to conform to the applicable energy performance requirements in Tables 9.36.6.3.-A to 9.36.6.3.-G.

Table 9.36.6.3.-A
Requirements for Buildings Located Where the Degree-Days Below 18°C Value is less than 3000(1)
Forming Part of Sentence 9.36.6.3.(1)

Step	Airtightness (Air Changes per Hour at 50 Pa Pressure Differential)	Performance Requirement of *Building* Equipment and Systems	Performance Requirement of *Building* Envelope
1	N/A	EnerGuide Rating % lower than EnerGuide Reference House: not less than 0% lower energy consumption or conform to Subsection 9.36.5.	
2	≤ 3.0	EnerGuide Rating % lower than EnerGuide Reference House: not less than 10% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 35 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 5% performance improvement over the EnerGuide Reference House
3	≤ 2.5	EnerGuide Rating % lower than EnerGuide Reference House: not less than 20% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 30 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 10% performance improvement over the EnerGuide Reference House
4	≤ 1.5	EnerGuide Rating % lower than EnerGuide Reference House: not less than 40% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 20 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 20% performance improvement over the EnerGuide Reference House
5	≤ 1.0	the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 15kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 50% performance improvement over the EnerGuide Reference House

Notes to Table 9.36.6.3.A:

(1) See Sentence 1.1.3.1.(1) and Table C-2 in Appendix C.

Table 9.36.6.3.-B
Requirements for Buildings Located Where the Degree-Days Below 18°C Value is 3000 to 3999(1)
Forming Part of Sentence 9.36.6.3.(1)

Step	Airtightness (Air Changes per Hour at 50 Pa Pressure Differential)	Performance Requirement of *Building* Equipment and Systems	Performance Requirement of *Building* Envelope
1	N/A	EnerGuide Rating % lower than EnerGuide Reference House: not less than 0% lower energy consumption or conform to Subsection 9.36.5.	
2	≤ 3.0	EnerGuide Rating % lower than EnerGuide Reference House: not less than 10% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 45 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 5% performance improvement over the EnerGuide Reference House
3	≤ 2.5	EnerGuide Rating % lower than EnerGuide Reference House: not less than 20% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 40 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 10% performance improvement over the EnerGuide Reference House
4	≤ 1.5	EnerGuide Rating % lower than EnerGuide Reference House: not less than 40% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 30 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 20% performance improvement over the EnerGuide Reference House
5	≤ 1.0	the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 20kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 50% performance improvement over the EnerGuide Reference House

Notes to Table 9.36.6.3.B:
(1) See Sentence 1.1.3.1.(1) and Table C-2 in Appendix C.

Table 9.36.6.3.-C
Requirements for Buildings Located Where the Degree-Days Below 18°C Value is 4000 to 4999(1)
Forming Part of Sentence 9.36.6.3.(1)

Step	Airtightness (Air Changes per Hour at 50 Pa Pressure Differential)	Performance Requirement of *Building* Equipment and Systems	Performance Requirement of *Building* Envelope
1	N/A	EnerGuide Rating % lower than EnerGuide Reference House: not less than 0% lower energy consumption or conform to Subsection 9.36.5.	
2	≤ 3.0	EnerGuide Rating % lower than EnerGuide Reference House: not less than 10% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤60 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 5% performance improvement over the EnerGuide Reference House
3	≤ 2.5	EnerGuide Rating % lower than EnerGuide Reference House: not less than 20% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 50 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 10% performance improvement over the EnerGuide Reference House
4	≤ 1.5	EnerGuide Rating % lower than EnerGuide Reference House: not less than 40% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 40 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 20% performance improvement over the EnerGuide Reference House
5	≤ 1.0	the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 25kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 50% performance improvement over the EnerGuide Reference House

Notes to Table 9.36.6.3.C:
(1) See Sentence 1.1.3.1.(1) and Table C-2 in Appendix C.

Table 9.36.6.3.-D
Requirements for Buildings Located Where the Degree-Days Below 18°C Value is 5000 to 5999[1]
Forming Part of Sentence 9.36.6.3.(1)

Step	Airtightness (Air Changes per Hour at 50 Pa Pressure Differential)	Performance Requirement of *Building* Equipment and Systems	Performance Requirement of *Building* Envelope
1	N/A	EnerGuide Rating % lower than EnerGuide Reference House: not less than 0% lower energy consumption or conform to Subsection 9.36.5.	
2	≤ 3.0	EnerGuide Rating % lower than EnerGuide Reference House: not less than 10% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤80 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 5% performance improvement over the EnerGuide Reference House
3	≤ 2.5	EnerGuide Rating % lower than EnerGuide Reference House: not less than 20% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 70 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 10% performance improvement over the EnerGuide Reference House
4	≤ 1.5	EnerGuide Rating % lower than EnerGuide Reference House: not less than 40% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 55 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 20% performance improvement over the EnerGuide Reference House
5	≤ 1.0	the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 35kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 50% performance improvement over the EnerGuide Reference House

Notes to Table 9.36.6.3.D:
(1) See Sentence 1.1.3.1.(1) and Table C-2 in Appendix C.

Table 9.36.6.3.-E
Requirements for Buildings Located Where the Degree-Days Below 18°C Value is 6000 to 6999(1)
Forming Part of Sentence 9.36.6.3.(1)

Step	Airtightness (Air Changes per Hour at 50 Pa Pressure Differential)	Performance Requirement of *Building* Equipment and Systems	Performance Requirement of *Building* Envelope
1	N/A	EnerGuide Rating % lower than EnerGuide Reference House: not less than 0% lower energy consumption or conform to Subsection 9.36.5.	
2	≤ 3.0	EnerGuide Rating % lower than EnerGuide Reference House: not less than 10% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤100 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 5% performance improvement over the EnerGuide Reference House
3	≤ 2.5	EnerGuide Rating % lower than EnerGuide Reference House: not less than 20% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 90 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 10% performance improvement over the EnerGuide Reference House
4	≤ 1.5	EnerGuide Rating % lower than EnerGuide Reference House: not less than 40% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 65 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 20% performance improvement over the EnerGuide Reference House
5	≤ 1.0	the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 50 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 50% performance improvement over the EnerGuide Reference House

Notes to Table 9.36.6.3.E:
(1) See Sentence 1.1.3.1.(1) and Table C-2 in Appendix C.

Table 9.36.6.3.-F
Requirements for Buildings Located Where the Degree-Days Below 18°C Value is greater than 6999(1)
Forming Part of Sentence 9.36.6.3.(1)

Step	Airtightness (Air Changes per Hour at 50 Pa Pressure Differential)	Performance Requirement of *Building* Equipment and Systems	Performance Requirement of *Building* Envelope
1	N/A	EnerGuide Rating % lower than EnerGuide Reference House: not less than 0% lower energy consumption or conform to Subsection 9.36.5.	
2	≤ 3.0	EnerGuide Rating % lower than EnerGuide Reference House: not less than 10% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤120 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 5% performance improvement over the EnerGuide Reference House
3	≤ 2.5	EnerGuide Rating % lower than EnerGuide Reference House: not less than 20% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 105 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 10% performance improvement over the EnerGuide Reference House
4	≤ 1.5	EnerGuide Rating % lower than EnerGuide Reference House: not less than 40% lower energy consumption or the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 80 kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 20% performance improvement over the EnerGuide Reference House
5	≤ 1.0	the applicable mechanical energy use intensity requirements in Table 9.36.6.3.-G	thermal energy demand intensity ≤ 60kWh/(m²•year), thermal energy demand intensity not exceeding the value calculated in accordance with Sentence (4), or not less than 50% performance improvement over the EnerGuide Reference House

Notes to Table 9.36.6.3.F:

(1) See Sentence 1.1.3.1.(1) and Table C-2 in Appendix C.

Table 9.36.6.3.-G
Mechanical Energy Use Intensity Requirements
Forming Part of Sentence 9.36.6.3.(1)

Heating Degree-Days of *Building* Location,(1) in Celsius Degree-Days	Amount of the *Building*'s Conditioned Space Served by Space-Cooling Equipment	Step	Floor Area of *Conditioned Space* (m^2)					
			≤ 50	51 to 75	76 to 120	121 to 165	166 to 210	> 210
			Mechanical Energy Use Intensity, kWh/(m^2•year)					
Less than 3000	Not more than 50%	2	135	120	90	75	65	60
		3	120	100	75	63	53	50
		4	90	80	60	48	40	40
		5	65	55	40	30	25	25
	More than 50%	2	170	148	108	85	73	65
		3	155	128	93	73	60	55
		4	125	108	78	58	48	45
		5	100	83	58	40	33	30
3000 to 3999	Not more than 50%	2	145	130	100	85	75	70
		3	135	115	90	78	68	65
		4	100	90	70	58	50	50
		5	70	60	45	35	30	30
	More than 50%	2	180	158	118	95	83	75
		3	170	143	108	88	75	70
		4	135	118	88	68	58	55
		5	105	88	63	45	38	35
4000 to 4999	Not more than 50%	2	160	145	115	100	90	85
		3	145	125	100	88	78	75
		4	105	95	75	63	55	55
		5	80	70	55	45	40	40
	More than 50%	2	195	173	133	110	98	90
		3	180	153	118	98	85	80
		4	140	123	93	73	63	60
		5	115	98	73	55	48	45
5000 to 5999	Not more than 50%	2	185	170	140	125	115	110
		3	165	145	120	108	98	95
		4	120	110	90	78	70	70
		5	95	85	70	60	55	55
	More than 50%	2	220	198	158	135	123	115
		3	200	173	138	118	105	100
		4	155	138	108	88	78	75
		5	130	113	88	70	63	60

Table 9.36.6.3.-G *(continued)*
Mechanical Energy Use Intensity Requirements
Forming Part of Sentence 9.36.6.3.(1)

Heating Degree-Days of *Building* Location,(1) in Celsius Degree-Days	Amount of the *Building*'s Conditioned Space Served by Space-Cooling Equipment	Step	Floor Area of *Conditioned Space* (m^2)					
			≤ 50	51 to 75	76 to 120	121 to 165	166 to 210	> 210
			Mechanical Energy Use Intensity, kWh/(m^2•year)					
6000 to 6999	Not more than 50%	2	205	190	160	145	135	130
		3	185	165	140	128	118	115
		4	135	125	105	93	85	85
		5	105	95	80	70	65	65
	More than 50%	2	240	218	178	155	143	135
		3	220	193	158	138	125	120
		4	170	153	123	103	93	90
		5	140	123	98	80	73	70
More than 6999	Not more than 50%	2	225	210	180	165	155	150
		3	200	180	155	143	133	130
		4	150	140	120	108	100	100
		5	115	105	90	80	75	75
	More than 50%	2	260	238	198	175	163	155
		3	235	208	173	153	140	135
		4	185	168	138	118	108	105
		5	150	133	108	90	83	80

Notes to Table 9.36.6.3.-G:
(1) See Sentence 1.1.3.1.(1) and Table C-2 in Appendix C.

2) Except as permitted by Sentence (3),

a) energy performance shall be calculated in conformance with Article 9.36.6.4., and

b) airtightness shall be tested in accordance with Article 9.36.6.5.

(See Note A-9.36.6.3.(2).)

3) *Buildings* designed and constructed to conform to Step 5 of any of the Tables referred to in Sentence (1) and to the Passive House Planning Package, version 9 or newer, are deemed to comply with this Subsection if the energy model according to which the *building* is designed and constructed is prepared by a Certified Passive House Designer, or Certified Passive House Consultant, who is approved by the Passive House Institute.

4) For *buildings* conforming to the requirements of any of Steps 1 to 5, thermal energy demand intensity requirements may be calculated using the applicable following formula

for *buildings* located where the degree-days below 18°C value is less than 3000

$$TEDI_{adjusted} = TEDI_{step} + (TEDI_{higher} - TEDI_{step})(HDD_{actual} - HDD_{lowest})/500$$

for *buildings* located where the degree-days below 18°C value is 3000 to 6999

$$TEDI_{adjusted} = TEDI_{step} + (TEDI_{higher} - TEDI_{step})(HDD_{actual} - HDD_{lowest})/1000$$

for *buildings* located where the degree-days below 18°C value is 7000 or greater

$$TEDI_{adjusted} = TEDI_{step} + (TEDI_{step} - TEDI_{lower})(HDD_{actual} - HDD_{lowest})/1000$$

where

$TEDI_{adjusted}$ = thermal energy demand intensity requirement adjusted by heating degree-days,

$TEDI_{step}$ = applicable maximum thermal energy demand intensity requirement in Tables 9.36.6.3.-A to 9.36.6.3.-F,

$TEDI_{higher}$ = maximum thermal energy demand intensity requirement for the same Step as stated in the subsequent Table of Tables 9.36.6.3.-A to 9.36.6.3.-F,

$TEDI_{lower}$ = maximum thermal energy demand intensity requirement for the same Step as stated in the preceding Table of Tables 9.36.6.3.-A to 9.36.6.3.-F,

HDD_{actual} = actual degree-days below 18°C for the *building* location determined in accordance with Subsection 1.1.3.,

HDD_{lowest} = lowest degree-days below 18°C value within the range of the applicable Table of Tables 9.36.6.3.-A to 9.36.6.3.-F.

(See Note 9.36.6.3.(4).)

5) For compliance with Tables 9.36.6.3.-A to 9.36.6.3.-F, envelope performance improvement over the EnerGuide reference house shall be calculated by

a) computing the annual space heating energy use for both the reference house and the proposed house, and

b) expressing the difference between the reference house space heating energy use and proposed house space heating energy use as a percentage of the space heating energy requirement.

9.36.6.4. Energy Modelling

1) Energy modelling shall be performed using a computer program that employs calculation methods that have been tested in accordance with ANSI/ASHRAE 140, "Evaluation of Building Energy Analysis Computer Programs" with variations in the computer program from the range recommended therein reported in accordance with Division C.

2) Energy modelling shall conform to

a) Subsection 9.36.5.,

b) the EnerGuide Rating System, version 15 or newer (see Note A-9.36.6.4.(2)(b)), or

c) Clauses 10.2.3.4.(1)(a) and (b) and Sentences 10.2.3.4.(3) and (4). (See Note A-9.36.6.4.(2)(c).)

3) The Performance Requirement of Building Equipment and Systems and the Performance Requirement of Building Envelope required under Sentence 9.36.6.3.(1) shall both be modelled using the same

a) energy modelling methods, and

b) climatic data, *soil* conditions, operating schedules and temperature set-points.

4) For *buildings* conforming to the requirements of any of Steps 2 to 5, energy modelling shall account for the air leakage rate derived in accordance with Article 9.36.6.5.
(See Note A-9.36.6.4.(4).)

9.36.6.5. Building Envelope Airtightness Testing

1) *Buildings* shall be tested for airtightness in accordance with

a) CAN/CGSB 149.10, "Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method",

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

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

d) the applicable standards and requirements of the EnerGuide Rating System, Version 15 or newer.

2) Where airtightness is determined in accordance with Sentence (1) with intentional openings for mechanical equipment left unsealed, the airtightness rate shall be adjusted in the energy model calculations to account for air leakage through mechanical equipment.

3) *Buildings* shall be tested for airtightness to an induced test pressure of not less than 50 Pa.