2010 National Building Code of Canada (NBC)

Revisions and Errata Package

Selected replacement pages have been produced for the NBC.

Please print and insert in your copy of the Code.

The CCBFC is advised on scope, policy and technical issues pertaining to the Codes by the Provincial/Territorial Policy Advisory Committee on Codes (PTPACC), which is a committee of senior representatives from provincial/territorial ministries responsible for the regulation of buildings, fire safety and plumbing in their jurisdictions. The PTPACC was created by the provinces and territories, with provision of guidance to the CCBFC as one of its main functions. Through the PTPACC and its subcommittees on building, fire and plumbing regulation, the provinces and territories are engaged in every phase of the model Code development process.

The Canadian Codes Centre of the National Research Council's Institute for Research in Construction provides technical and administrative support to the CCBFC and its standing committees. The National Research Council publishes the National Model Codes and periodic revisions to the Codes to address pressing issues.

The broader code-user community also makes a significant contribution to the model Code development process by submitting requests for changes or additions to the Codes and by commenting on the collected proposed changes during the public reviews that precede each new edition.

The CCBFC takes into consideration the advice received from the provinces and territories as well as code users' comments at each stage of Code development. The scope and content of the Model Codes are determined on a consensus basis, which involves the review of technical, policy and practical concerns and debate on the implications of these concerns.

More information on the Code development process is available on the Internet at www.nationalcodes.ca. Printed copies of this information may also be requested from the Secretary of the CCBFC, whose address is provided at the end of this Preface.

Code Requirements

Every NBC requirement must address at least one of the Code's four stated objectives, namely:

- safety
- health
- accessibility for persons with disabilities
- fire and structural protection of buildings

In dealing with proposed changes or additions to any of the National Model Codes, the CCBFC considers many issues such as the following:

- Does the proposed requirement provide the minimum level of performance—and no more than the minimum—needed to achieve the Code's objectives?
- Will persons responsible for Code compliance be able to act on or implement the requirement using commonly accepted practices?
- Will enforcement agencies be able to enforce the requirement?
- Are the costs of implementing the requirement justifiable?
- Have the potential policy implications of the requirement been identified and addressed?
- Is there broad consensus on this requirement among Code users representing all facets of the design and construction industries as well as among provincial and territorial governments?

Guidelines for requesting changes to the NBC are available on the Internet at www.nationalcodes.ca. Printed copies of the guidelines may also be requested from the Secretary of the CCBFC, whose address is provided at the end of this Preface.

Objective-Based Code Format

The National Building Code (NBC) was published in an objective-based code format for the first time in 2005. This was the result of ten years of work on an initiative that arose out of the strategic plan adopted by the Canadian Commission on Building and Fire Codes (CCBFC) in 1995.

The NBC comprises three Divisions:

- Division A, which defines the scope of the Code and contains the objectives, the functional statements and the conditions necessary to achieve compliance;
- Division B, which contains acceptable solutions (commonly referred to as "technical requirements") deemed to satisfy the objectives and functional statements listed in Division A; and
- Division C, which contains administrative provisions.

A more complete description of this division-based structure is included in the section entitled Structure of Objective-Based Codes.

Apart from the inclusion of changes resulting from the normal Code development process, the provisions in Division B are essentially the same as those found in the 2005 edition of the NBC. Each requirement in Division B is linked to:

- objectives (such as safety or health) which individual requirements help to address,
- functional statements (statements on the functions of the building that a particular requirement helps to achieve), and
- intent statements (detailed statements on the specific intent of the provision).

Objectives

The NBC's objectives are fully defined in Section 2.2. of Division A. Most of the top-level objectives have two levels of sub-objectives.

The objectives describe, in very broad terms, the overall goals that the NBC's requirements are intended to achieve. They serve to define the boundaries of the subject areas the Code addresses. However, the Code does not deal with all the issues that might be considered to fall within those boundaries.

The objectives describe undesirable situations and their consequences, which the Code aims to avoid occurring in buildings. The wording of most of the definitions of the objectives includes two key phrases: "limit the probability" and "unacceptable risk." The phrase "limit the probability" is used to acknowledge that the NBC cannot entirely prevent those undesirable situations from happening. The phrase "unacceptable risk" acknowledges that the NBC cannot eliminate all risk: the "acceptable risk" is the risk remaining once compliance with the Code has been achieved.

The objectives are entirely qualitative and are not intended to be used on their own in the design and approval processes.

The objectives attributed to the requirements or portions of requirements in Division B are listed in tables in Volume 1.

Functional Statements

The NBC's functional statements are listed in Section 3.2. of Division A.

The functional statements are more detailed than the objectives: they describe conditions in the building that help satisfy the objectives. The functional statements and the objectives are interconnected: there may be several functional statements related to any one objective and a given functional statement may describe a function of the building that serves to achieve more than one objective.

Like objectives, functional statements are entirely qualitative and are not intended to be used on their own in the design and approval processes.

The functional statements attributed to the requirements or portions of requirements in Division B are listed in tables in Volume 1.

Intent Statements

Intent statements explain, in plain language, the basic thinking behind each Code provision contained in Division B. Intent statements, each of which is unique to the provision with which it is associated, explain how requirements help to achieve their attributed objectives and functional statements. Like the objectives, the intent statements are expressed in terms of risk avoidance and expected performance. They offer insight into the views of the responsible standing committees on what the Code provisions are intended to achieve.

The intent statements serve explanatory purposes only and do not form an integral part of the Code provisions: as such, they are similar in function to appendix notes. Due to the sheer volume of intent statements—thousands for the NBC alone—they are only published as a separate electronic document entitled "Supplement to the NBC 2010: Intent Statements," which is available on-line at www.nationalcodes.ca.

All this additional information—objectives, functional statements and intent statements—is intended to facilitate the implementation of the Code in two ways:

- Clarity of intent: The objectives, functional statements and intent statements linked to a Code requirement clarify the reasoning behind that requirement and facilitate understanding of what must be done to satisfy that requirement. This added information may also help avoid disputes between practitioners and officials over these types of issues.
- Flexibility: The additional information allows for flexibility in Code compliance. A person seeking to propose a new method or material not described or covered in the Code will be able to use the added information to understand the expected level of performance that their alternative solution must achieve to satisfy the Code.

Structure of Objective-Based Codes

The National Building Code (NBC) is organized into three Divisions.

Division A: Compliance, Objectives and Functional Statements

Division A defines the scope of the NBC and presents the objectives that the Code addresses and the functions the building must perform to help to satisfy those objectives.

Division A cannot be used on its own as a basis for designing and constructing a building, or for evaluating a building's compliance with the Code.

Division B: Acceptable Solutions

In the 2005 edition of the Code, the commonly used term "requirements" was replaced with the term "acceptable solutions" to refer to the technical provisions contained in the Code. The change in terminology reflects the principle that building codes establish an acceptable level of risk or performance and underlines the fact that a code cannot describe all possible valid design and construction options. The new term provokes the question "To whom are these solutions considered acceptable?" As indicated previously in this Preface, the acceptable solutions represent the minimum level of performance that will satisfy the NBC's objectives and that is acceptable to an authority that adopts the NBC into law or regulation.

Division B of the 2010 NBC contains most of the provisions from the 2005 NBC together with the changes and additions resulting from the normal updating process. Compliance with these acceptable solutions is deemed to automatically satisfy the linked Division A objectives and functional statements.

The requirements in Division B—the acceptable solutions—are linked to at least one objective and functional statement found in Division A. These linkages play an important role in allowing objective-based codes to accommodate innovation.

It is expected that the majority of Code users will primarily follow the acceptable solutions given in Division B and that they will consult Division A only in cases where it may serve to clarify the application of Division B's requirements to a particular situation or when they are considering an alternative solution.

Division C: Administrative Provisions

Division C contains administrative provisions relating to the application of the Code. Many provinces and territories establish their own administrative provisions upon adopting or adapting the NBC; having all the administrative provisions in one Division facilitates their customization to suit jurisdictional needs.

Relationship between Division A and Division B

Sentence 1.2.1.1.(1) of Division A is a very important sentence: it is a precise statement of the relationship between Divisions A and B and is central to the concept of objective-based codes.

1) Compliance with this Code shall be achieved by
a) complying with the applicable acceptable solutions in Division B (see Appendix A), or
b) using alternative solutions that will achieve at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the applicable acceptable solutions (see Appendix A).

Clause (a) makes it clear that the acceptable solutions in Division B are automatically deemed to satisfy the linked objectives and functional statements of Division A.

Clause (b) makes it clear that alternative solutions can be used in lieu of compliance with the acceptable solutions. However, to do something different from the acceptable solutions described in Division B, a builder, designer or building owner must show that their proposed alternative solution will perform at least as well as the acceptable solution(s) it is replacing. The objectives and functional statements attributed to the acceptable solution(s) identify the areas of performance where this equivalence must be demonstrated.

Additional Information

Numbering System

A consistent numbering system has been used throughout the National Model Codes. The first number indicates the Part of the Code; the second, the Section in the Part; the third, the Subsection; and the fourth, the Article in the Subsection. The detailed provisions are found at the Sentence level (indicated by numbers in brackets), and Sentences may be broken down into Clauses and Subclauses. This structure is illustrated as follows:

3	Part
3.5.	Section
3.5.2.	Subsection
3.5.2.1.	Article
3.5.2.1.(2)	Sentence
3.5.2.1.(2)(a)	Clause
3.5.2.1.(2)(a)(i)	Subclause

Change Indication

Where a technical change or addition has been made relative to the 2005 edition, a vertical line has been added in the margin next to the affected provision. No change indication has been provided in cases where provisions have been renumbered or deleted.

Meaning of the words "and" and "or" between the Clauses and Subclauses of a Sentence

Multiple Clauses and Subclauses are connected by the word "and" or "or" at the end of the second last Clause or Subclause in the series. Although this connecting word appears only once, it is meant to apply to all the preceding Clauses or Subclauses within that series.

For example, in a series of five Clauses—a) to e)—in a Code Sentence, the appearance of the word "and" at the end of Clause d) means that all Clauses in the Sentence are connected to each other with the word "and." Similarly, in a series of five Clauses—a) to e)—in a Code Sentence, the appearance of the word "or" at the end of Clause d) means that all Clauses in the Sentence are connected to each other with the word "or."

In all cases, it is important to note that a Clause (and its Subclauses, if any) must always be read in conjunction with its introductory text appearing at the beginning of the Sentence.

Administration

A separate CCBFC document entitled Administrative Requirements for Use with the National Building Code of Canada 1985 is also published by the National Research Council. It is automatically adopted as per Article 2.2.1.1. of Division C if the adopting authority does not provide other administrative requirements.

Metric Conversion

All values in the NBC are given in metric units. A conversion table of imperial equivalents for the most common units used in building design and construction is located at the end of the Code.

Parts in Division B and Professional Disciplines

Division B is organized into Parts that are largely related to disciplines. However, this does not mean that persons of a certain discipline who are executing the design or construction of a particular building component can necessarily deal with only one Part of the Code in isolation since provisions related to that building component may be found in more than one Part.

Examples:

Provisions that deal with fire safety issues related to heating, ventilating and air-conditioning systems are located in Part 3 of Division B, Fire Protection, Occupant Safety and Accessibility, and not in Part 6, Heating, Ventilating and Air-conditioning.

Structural requirements related to loads on handrails and grab bars are located in Part 3 of Division B, Fire Protection, Occupant Safety and Accessibility, while structural requirements related to loads on guards are located in Part 4, Structural Design.

For this reason, the part-based structure of Division B is not well suited for use as the basis for allocating responsibilities to different professions or as the basis for contractual arrangements.

Commercial Rights to Reproduce the National Building Code

Contact Information

The CCBFC welcomes comments and suggestions for improvements to the National Building Code. Persons interested in requesting a change to an NBC provision should refer to the guidelines available on the Internet at www.nationalcodes.ca, where additional information is also presented.

Comments, suggestions and requests for printed copies of Internet material referred to in this Preface should be sent to:

The Secretary
Canadian Commission on Building and Fire Codes
Institute for Research in Construction
National Research Council of Canada
Ottawa, Ontario K1A 0R6

Revisions and Errata

Issued by the Canadian Commission on Building and Fire Codes

The Change History table that follows describes revisions, errata and editorial updates that apply to the National Building Code of Canada 2010:

- Revisions are changes deemed urgent that have been approved by the Canadian Commission on Building and Fire Codes.
- Errata are corrections to existing text.
- Editorial updates are provided for information purposes only.

Code pages containing revisions and/or errata are identified with the words "Amended Page" in the footer; pages with editorial updates and index pages with changes are not flagged.

Contact your local authority having jurisdiction to find out if these revisions and errata apply in your province or territory.

Change History — National Building Code of Canada 2010

Division	Code Reference	Change	Date (Y-M-D)	Description of Change
Preface	n/a	editorial update	2012-12-21	Text referring to application statements was deleted as these statements are no longer being published
A	1.4.2.1.(1)	editorial update	2012-12-21	The following abbreviations were added to the list as a result of the addition of new Section 9.36.: HDD, HVAC, K, R, RSI and U-value
A	1.5.1.1.(1)	revision	2012-12-21	Sentence was revised to read "Except as provided in Sentence (2), the provisions ..."
A	1.5.1.1.(2)	revision	2012-12-21	Sentence was added
A	2.1.1.2.	revision	2012-12-21	Reference to Appendix Note was added following Article title
A	2.1.1.2.(1)	revision	2012-12-21	Sentence was revised to read "Except as provided in Sentences (2) to (6), ..."
A	2.1.1.2.(6)	revision	2012-12-21	Sentence was added
A	2.2.1.1.(1)	revision	2012-12-21	Objective OE, Environment, and sub-objectives OE1, Resources, and OE1.1, excessive use of energy, were added
A	3.1.1.2.(1)	revision	2012-12-21	Sentence was revised to read "Except as provided in Sentences (2) to (4), ..."
A	3.1.1.2.(4)	revision	2012-12-21	Sentence was added
A	3.2.1.1.(1)	revision	2012-12-21	Functional Statements F90–F93, F95, F96 and F98–F100 were added
A	A-2.1.1.2.(6)	revision	2012-12-21	Appendix Note was added
A	A-2.2.1.1.(1)	revision	2012-12-21	Reference to the National Energy Code for Buildings was added
A	A-3.2.1.1.(1)	revision	2012-12-21	Reference to the National Energy Code for Buildings was added
B	Table 1.3.1.2.	revision	2012-12-21	Standards referenced in new Section 9.36. were added
B	Table 1.3.1.2.	revision	2012-12-21	ASTM F 1667-05 was added as a result of revisions to Sentences 9.23.3.1.(1), 9.26.2.2.(1) and 9.29.5.6.(1)

Change History — National Building Code of Canada 2010 (Continued)

Division	Code Reference	Change	Date (Y-M-D)	Description of Change
B	1.3.2.1.(1)	editorial update	2012-12-21	The following abbreviations and applicable addresses were added as a result of new Section 9.36.: AHAM, AHRI, CTI, DOE, ICC, NECB and NFRC; the address for TPIC was updated
B	3.2.3.4.(1)	erratum	2012-12-21	Change bar was added
B	3.2.4.22.(10)	erratum	2012-12-21	Sentence was corrected to read "... required by Sentence (7) .."
B	3.4.7.7.(1)	erratum	2012-12-21	Sentence was corrected to read "... Articles 3.4.6.3. and 3.4.6.4."
B	4.1.7.1.(5)(b)	erratum	2012-12-21	Clause was corrected to read "... or 20 times the height of the *building*, whichever is greater ..."
B	4.1.7.1.(5)(c)	erratum	2012-12-21	Clause was corrected to read "... or 20 times the height of the *building* from a change in terrain conditions ..."
B	5.2.2.1.(2)	revision	2012-12-21	Sentence was revised to read "... Except as provided in Article 4.1.8.18., the structural loads ..."
B	5.10.1.1.(1)	erratum	2012-12-21	Sentence was corrected to read "... Except as provided in Sentence (2) and elsewhere in this Part, .."
B	6.2.2.1.(3)	erratum	2012-12-21	Sentence was modified to clarify intent
B	6.2.4.1.(4)	erratum	2012-12-21	Change bar was added
B	Table 6.4.1.1.	erratum	2012-12-21	Functional Statement F43 was deleted from attribution for Sentence 6.2.1.7.(2)
B	8.2.1.3.(1)	erratum	2012-12-21	Sentence was corrected to read "... and is located 2 m or more from a *public way*, ..."
B	9.7.2.2.	revision	2012-12-21	Sentences (1) to (9) were reordered and Sentence (10) was added
B	9.10.9.7.(2)	erratum	2012-12-21	Term "firestop system" was replaced with defined term "*fire stop*"
B	9.10.14.5.(3)	erratum	2012-12-21	Word "and" at the end of the Clause (b) was deleted Subclause (e)(i) was corrected to read "... conforms to Subsection 9.27.12.,"
B	9.10.15.5.(2)	erratum	2012-12-21	Sublclause (b)(i) was corrected to read "... conform to Subsection 9.27.12.,"
B	9.12.2.2.(1)	erratum	2012-12-21	Sentence was corrected to read "... Except as provided in Sentences (4) to (7), ..."
B	9.19.2.1.(1)	revision	2012-12-21	Sentence was revised
B	9.23.3.1.	revision	2012-12-21	Sentence (1) was revised Sentence (2) was added
B	9.23.13.7.(7)	erratum	2012-12-21	Sentence was corrected to read "... the ratio of the length of *braced wall panels* in the respective upper *braced wall bands* to the length of *braced wall panels* in the reduced exterior *braced wall band* ..."
B	9.25.1.1.(2)	revision	2012-12-21	Subclause (a)(i) was revised to read "thermal insulation conforming to Subsection 9.25.2. and Section 9.36.," Subclause (a)(ii) was revised to read "an air barrier conforming to Subsection 9.25.3. and Section 9.36.,"
B	9.25.1.1.(3)	revision	2012-12-21	Sentence was revised to read "... Sections 9.32., 9.33. and 9.36."
B	9.25.5.1.(1)	erratum	2012-12-21	Word "and" was added at the end of Subclause (a)(i)
B	9.26.2.2.(1)(b)	revision	2012-12-21	Clause was added
B	9.29.5.6.(1)(b)	revision	2012-12-21	Clause was added
B	9.31.1.1.(4)	revision	2012-12-21	Sentence was added
B	9.32.1.1.(4)	revision	2012-12-21	Sentence was added
B	9.32.3.1.(1)(c)	erratum	2012-12-21	Clause was added to clarify intent
B	9.32.3.11.(4)	revision	2012-12-21	Sentence was restructured and requirement was added as Clause (b)
B	9.33.1.1.(4)	revision	2012-12-21	Sentence was added
B	Section 9.36.	revision	2012-12-21	Section was added
B	Table 9.37.1.1.	revision	2012-12-21	Attributions were added for new Sentence 9.23.3.1.(2) and new Section 9.36.
B	A-1.1.2.1.(1)	erratum	2012-12-21	Appendix Note was corrected to read "... at the end of Volume 1."
B	Table A-1.3.1.2.(1)	revision	2012-12-21	Standards referenced in new Appendix Notes A-9.36.1.1.(1) to A-9.36.5.15.(8) were added
B	A-5.2.2.1.(2)(c)	revision	2012-12-21	Second paragraph was added

Change History — National Building Code of Canada 2010 (Continued)

Division	Code Reference	Change	Date (Y-M-D)	Description of Change
B	A-9.8.8.6.(2)	erratum	2012-12-21	Offset shown in top guard protrusion in Figure A-9.8.8.6.(2)-B was corrected
B	A-9.10.15.4.(2)	erratum	2012-12-21	In Figure A-9.10.15.4.(2)-C, Table Notes on “required” and “noncombustible” were corrected for limiting distance$_2$ to limiting distance$_3$
B	A-9.10.22.	erratum	2012-12-21	Word “range” was replaced with “cooktop” in title, text and Figure title
B	A-9.19.2.1.(1)	revision	2012-12-21	Appendix Note was added
B	A-9.23.3.1.(2)	revision	2012-12-21	Appendix Note was added
B	A-9.32.3.3.	erratum	2012-12-21	Word “range” was replaced with “cooktop” in third paragraph under section entitled “Indoor Air Exhaust”
B	A-9.32.3.3.(10)	erratum	2012-12-21	Appendix Note was corrected to read “... the use of a cooktop exhaust or hood fan ..."
B	A-9.36.1.1.(1) to A-9.36.5.15.(8)	revisions	2012-12-21	Eighty-four Appendix Notes were added
B	Table C-2	erratum	2012-12-21	Value for S_a(2.0) for Sault Ste. Marie was corrected to read “0.012”
C	2.2.8.	revision	2012-12-21	Subsection was added
C	A-2.2.8.1.(1)	revision	2012-12-21	Appendix Note was added
C	A-2.2.8.3.(2)(c)(i)	revision	2012-12-21	Appendix Note was added
Index	Letter A	erratum	2012-12-21	Entry under “Application of the National Building Code, factory-made buildings” was corrected to read “factory-constructed buildings”
Index	Letter F	erratum	2012-12-21	Entry for “Factory-made buildings” was corrected to read “Factory-constructed buildings” Under entry for “Fans,” "range-top" was corrected to read “cooktop” Entry for “Fire blocks” was added Entry for “Fire stopping” was corrected Entry for “Fire stops” was corrected
n/a	Conversion Factors	editorial update	2012-12-21	Factor to convert kW to Btu/h was added: 3.412

Secondary suite means a self-contained *dwelling unit* with a prescribed *floor area* located in a *building* or portion of a *building* of only *residential occupancy* that contains only one other *dwelling unit* and common spaces, and where both *dwelling units* constitute a single real estate entity. (See Appendix A and Article 9.1.2.1. of Division B.)

Service room means a room provided in a *building* to contain equipment associated with *building* services. (See Appendix A.)

Service space means space provided in a *building* to facilitate or conceal the installation of *building* service facilities such as chutes, ducts, pipes, shafts or wires.

Service water heater means a device for heating water for plumbing services.

Shallow foundation means a *foundation unit* that derives its support from *soil* or *rock* located close to the lowest part of the *building* that it supports.

Smoke alarm means a combined *smoke detector* and audible alarm device designed to sound an alarm within the room or *suite* in which it is located upon the detection of smoke within that room or *suite*.

Smoke detector means a *fire detector* designed to operate when the concentration of airborne combustion products exceeds a predetermined level.

Soil means that portion of the earth's crust that is fragmentary, or such that some individual particles of a dried sample may be readily separated by agitation in water; it includes boulders, cobbles, gravel, sand, silt, clay and organic matter.

Space heater means a *space-heating appliance* for heating the room or space within which it is located, without the use of ducts.

Space-heating appliance means an *appliance* intended for the supplying of heat to a room or space directly, such as a *space heater*, fireplace or *unit heater*, or to rooms or spaces of a *building* through a heating system such as a central *furnace* or *boiler*.

Sprinklered (as applying to a *building* or part thereof) means that the *building* or part thereof is equipped with a system of automatic sprinklers.

Stage means a space that is designed primarily for theatrical performances with provision for quick change scenery and overhead lighting, including environmental control for a wide range of lighting and sound effects and that is traditionally, but not necessarily, separated from the audience by a proscenium wall and curtain opening.

Storage garage means a *building* or part thereof intended for the storage or parking of motor vehicles and containing no provision for the repair or servicing of such vehicles. (See Appendix A.)

Storage-type service water heater means a *service water heater* with an integral hot water storage tank.

Storey means that portion of a *building* that is situated between the top of any floor and the top of the floor next above it, and if there is no floor above it, that portion between the top of such floor and the ceiling above it.

Stove means an *appliance* intended for cooking and space heating.

Street means any highway, road, boulevard, square or other improved thoroughfare 9 m or more in width, that has been dedicated or deeded for public use and is accessible to fire department vehicles and equipment.

Subsurface investigation means the appraisal of the general subsurface conditions at a *building* site by analysis of information gained by such methods as geological surveys, in situ testing, sampling, visual inspection, laboratory testing of samples of the subsurface materials and *groundwater* observations and measurements.

Suite means a single room or series of rooms of complementary use, operated under a single tenancy, and includes *dwelling units*, individual guest rooms in motels, hotels, boarding houses, rooming houses and dormitories as well as individual stores and individual or complementary rooms for *business and personal services occupancies*. (See Appendix A.)

Supply duct means a duct for conveying air from a heating, ventilating or air-conditioning *appliance* to a space to be heated, ventilated or air-conditioned.

Theatre means a place of public assembly intended for the production and viewing of the performing arts or the screening and viewing of motion pictures, and consisting of an auditorium with permanently fixed seats intended solely for a viewing audience.

Treatment means the provision of medical or other health-related intervention to persons, where the administration or lack of administration of these interventions may render them incapable of evacuating to a safe location without the assistance of another person. (See Appendix A.)

Treatment occupancy means the *occupancy* or use of a *building* or part thereof for the provision of *treatment*, and where overnight accommodation is available to facilitate the *treatment*. (See Appendix A.)

Unit heater means a suspended *space heater* with an integral air-circulating fan.

Unprotected opening (as applying to *exposing building face*) means a doorway, window or opening other than one equipped with a *closure* having the required *fire-protection rating*, or any part of a wall forming part of the *exposing building face* that has a *fire-resistance rating* less than that required for the *exposing building face*.

Unsafe condition means any condition that could cause undue hazard to the life, limb or health of any person authorized or expected to be on or about the premises.

Unstable liquid means a liquid, including *flammable liquids* and *combustible liquids*, that is chemically reactive to the extent that it will vigorously react or decompose at or near normal temperature and pressure conditions or that is chemically unstable when subjected to impact.

Vapour barrier means the elements installed to control the diffusion of water vapour.

Vent connector (as applying to heating or cooling systems) means the part of a venting system that conducts the *flue* gases or vent gases from the *flue collar* of a gas *appliance* to the *chimney* or *gas vent*, and may include a draft control device.

Vertical service space means a shaft oriented essentially vertically that is provided in a *building* to facilitate the installation of *building* services including mechanical, electrical and plumbing installations and facilities such as elevators, refuse chutes and linen chutes.

Walkway means a covered or roofed pedestrian thoroughfare used to connect 2 or more *buildings*.

1.4.2. Symbols and Other Abbreviations

1.4.2.1. Symbols and Other Abbreviations

1) The symbols and other abbreviations in this Code shall have the meanings assigned to them in this Article and Article 1.3.2.1. of Division B.

1 in 2	slope of 1 vertical to 2 horizontal
cm	centimetre(s)
°	degree(s)
°C	degree(s) Celsius
dBA	A-weighted sound level
diam	diameter
g	gram(s)
h	hour(s)
HDD	heating degree-day(s)
HVAC	heating, ventilating and air-conditioning
Hz	hertz
Inc.	Incorporated
J	joule(s)

K ..... degree(s) Kelvin
kg ..... kilogram(s)
kN ..... kilonewton(s)
kPa ..... kilopascal(s)
kW ..... kilowatt(s)
L ..... litre(s)
lx ..... lux
m ..... metre(s)
M ..... metric nomenclature for reinforcing bars
max. ..... maximum
mg ..... milligram(s)
min. ..... minimum
min ..... minute(s)
MJ ..... megajoule(s)
mm ..... millimetre(s)
MPa ..... megapascal(s)
N ..... newton
n/a ..... not applicable
ng ..... nanogram(s)
No. ..... number(s)
o.c. ..... on centre
OSB ..... oriented strandboard
PM ..... particulate matter
ppb ..... part(s) per billion
ppm ..... part(s) per million
R ..... thermal resistance value (imperial unit)
RSI ..... thermal resistance value (metric unit)
s ..... second(s)
W ..... watt(s)
% ..... percent
µg ..... microgram(s)
µm ..... micrometre(s)
U-value ..... overall thermal transmittance

Section 1.5. Referenced Documents and Organizations

1.5.1. Referenced Documents

1.5.1.1. Application of Referenced Documents

1) Except as provided in Sentence (2), the provisions of documents referenced in this Code, and of any documents referenced within those documents, apply only to the extent that they relate to

a) *buildings*, and
b) the objectives and functional statements attributed to the applicable acceptable solutions in Division B where the documents are referenced.

(See Appendix A.)

2) Where a provision of the Code references the NFC, NPC or NECB, the applicable objectives and functional statements shall be those found in the referenced Code. (See A-2.1.1.2.(6) in Appendix A.)

1.5.1.2. Conflicting Requirements

1) In case of conflict between the provisions of this Code and those of a referenced document, the provisions of this Code shall govern.

1.5.1.3. Applicable Editions

1) Where documents are referenced in this Code, they shall be the editions designated in Subsection 1.3.1. of Division B.

1.5.2. Organizations

1.5.2.1. Abbreviations of Proper Names

1) The abbreviations of proper names in this Code shall have the meanings assigned to them in Article 1.3.2.1. of Division B.

Part 2
Objectives

Section 2.1. Application

2.1.1. Application

2.1.1.1. Application

1) This Part applies to all *buildings* covered in this Code. (See Article 1.1.1.1.)

2.1.1.2. Application of Objectives

(See A-2.2.1.1.(1) in Appendix A.)

1) Except as provided in Sentences (2) to (6), the objectives described in this Part apply

a) to all *buildings* covered in this Code (see Article 1.1.1.1.), and
b) only to the extent that they relate to compliance with this Code as required in Article 1.2.1.1.

2) Objective OS4, Resistance to Unwanted Entry, applies only to *dwelling units* in *buildings* covered in Part 9 of Division B. (See Article 1.3.3.3.)

3) Objective OH3, Noise Protection, applies only to *dwelling units*.

4) Objective OH5, Hazardous Substances Containment, applies only to the extent defined in

a) the National Plumbing Code of Canada 2010, and
b) the National Fire Code of Canada 2010.

5) Objective OA, Accessibility (including Objectives OA1, Barrier-Free Path of Travel, and OA2, Barrier-Free Facilities), does not apply to

a) detached houses, semi-detached houses, houses with a *secondary suite*, duplexes, triplexes, townhouses, row houses and boarding houses (see A-1.4.1.2.(1), Secondary Suite, in Appendix A),
b) *buildings* of Group F, Division 1 *major occupancy*, and
c) *buildings* that are not intended to be occupied on a daily or full-time basis, including automatic telephone exchanges, pumphouses and substations.

6) Objective OE, Environment (including Objectives OE1, Resources, and OE1.1, Excessive Use of Energy), applies only to

a) *buildings* of *residential occupancy* to which Part 9 of Division B applies,
b) *buildings* containing *business and personal services*, *mercantile* or *low-hazard industrial occupancies* to which Part 9 of Division B applies whose combined total *floor area* does not exceed 300 m^2, and
c) *buildings* containing a mix of the *residential* and non-*residential occupancies* described in Clauses (a) and (b).

(See Appendix A.) (See also Article 1.3.3.3.)

Section 2.2. Objectives

2.2.1. Objectives

2.2.1.1. Objectives

1) The objectives of this Code are as follows (see Appendix A):

OS Safety
An objective of this Code is to limit the probability that, as a result of the design, construction or demolition of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury.

OS1 Fire Safety
An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury due to fire. The risks of injury due to fire addressed in this Code are those caused by—

OS1.1 – fire or explosion occurring
OS1.2 – fire or explosion impacting areas beyond its point of origin
OS1.3 – collapse of physical elements due to a fire or explosion
OS1.4 – fire safety systems failing to function as expected
OS1.5 – persons being delayed in or impeded from moving to a safe place during a fire emergency

OS2 Structural Safety
An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury due to structural failure. The risks of injury due to structural failure addressed in this Code are those caused by—

OS2.1 – loads bearing on the *building* elements that exceed their *loadbearing* capacity
OS2.2 – loads bearing on the *building* that exceed the *loadbearing* properties of the supporting medium
OS2.3 – damage to or deterioration of *building* elements
OS2.4 – vibration or deflection of *building* elements
OS2.5 – instability of the *building* or part thereof
OS2.6 – collapse of the *excavation*

OS3 Safety in Use
An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in or adjacent to the *building* will be exposed to an unacceptable risk of injury due to hazards. The risks of injury due to hazards addressed in this Code are those caused by—

OS3.1 – tripping, slipping, falling, contact, drowning or collision
OS3.2 – contact with hot surfaces or substances
OS3.3 – contact with energized equipment
OS3.4 – exposure to hazardous substances
OS3.5 – exposure to high levels of sound from fire alarm systems
OS3.6 – persons becoming trapped in confined spaces
OS3.7 – persons being delayed in or impeded from moving to a safe place during an emergency (see Appendix A)

OS4 Resistance to Unwanted Entry

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of injury due to the *building's* low level of resistance to unwanted entry (see Sentence 2.1.1.2.(2) for application limitation). The risks of injury due to unwanted entry addressed in this Code are those caused by—

- OS4.1 – intruders being able to force their way through locked doors or windows
- OS4.2 – occupants being unable to identify potential intruders as such

OS5 Safety at Construction and Demolition Sites

An objective of this Code is to limit the probability that, as a result of the construction or demolition of the *building*, the public adjacent to a construction or demolition site will be exposed to an unacceptable risk of injury due to hazards. The risks of injury due to construction and demolition hazards addressed in this Code are those caused by—

- OS5.1 – objects projected onto *public ways*
- OS5.2 – vehicular accidents on *public ways*
- OS5.3 – damage to or obstruction of *public ways*
- OS5.4 – water accumulated in *excavations*
- OS5.5 – entry into the site
- OS5.6 – exposure to hazardous substances and activities
- OS5.7 – loads bearing on a covered way that exceed its *loadbearing* capacity
- OS5.8 – collapse of the *excavation*
- OS5.9 – persons being delayed in or impeded from moving to a safe place during an emergency (see Appendix A)

OH Health

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person will be exposed to an unacceptable risk of illness.

OH1 Indoor Conditions

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of illness due to indoor conditions. The risks of illness due to indoor conditions addressed in this Code are those caused by—

- OH1.1 – inadequate indoor air quality
- OH1.2 – inadequate thermal comfort
- OH1.3 – contact with moisture

OH2 Sanitation

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of illness due to unsanitary conditions. The risks of illness due to unsanitary conditions addressed in this Code are those caused by—

- OH2.1 – exposure to human or domestic waste
- OH2.2 – consumption of contaminated water
- OH2.3 – inadequate facilities for personal hygiene
- OH2.4 – contact with contaminated surfaces
- OH2.5 – contact with vermin and insects

OH3 Noise Protection

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of illness due to high levels of sound originating in adjacent spaces in the *building* (see Sentence 2.1.1.2.(3) for application limitation). The risks of illness due to high levels of sound addressed in this Code are those caused by—

OH3.1 – exposure to airborne sound transmitted through assemblies separating *dwelling units* from adjacent spaces in the *building*

OH4 Vibration and Deflection Limitation

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person in the *building* will be exposed to an unacceptable risk of illness due to high levels of vibration or deflection of *building* elements.

OH5 Hazardous Substances Containment

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, the public will be exposed to an unacceptable risk of illness due to the release of hazardous substances from the *building* (see Sentence 2.1.1.2.(4) for application limitation).

OA Accessibility

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person with a physical or sensory limitation will be unacceptably impeded from accessing or using the *building* or its facilities (see Sentence 2.1.1.2.(5) for application limitations).

OA1 Barrier-Free Path of Travel

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person with a physical or sensory limitation will be unacceptably impeded from accessing the *building* or circulating within it (see Sentence 2.1.1.2.(5) for application limitations).

OA2 Barrier-Free Facilities

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, a person with a physical or sensory limitation will be unacceptably impeded from using the *building's* facilities (see Sentence 2.1.1.2.(5) for application limitations).

OP Fire and Structural Protection of Buildings

An objective of this Code is to limit the probability that, as a result of the design, construction or demolition of the *building*, the *building* or adjacent *buildings* will be exposed to an unacceptable risk of damage due to fire or structural insufficiency, or the *building* or part thereof will be exposed to an unacceptable risk of loss of use also due to structural insufficiency.

OP1 Fire Protection of the Building

An objective of this Code is to limit the probability that, as a result of its design or construction, the *building* will be exposed to an unacceptable risk of damage due to fire. The risks of damage due to fire addressed in this Code are those caused by—

- OP1.1 – fire or explosion occurring
- OP1.2 – fire or explosion impacting areas beyond its point of origin
- OP1.3 – collapse of physical elements due to a fire or explosion
- OP1.4 – fire safety systems failing to function as expected

OP2 Structural Sufficiency of the Building

An objective of this Code is to limit the probability that, as a result of its design or construction, the *building* or part thereof will be exposed to an unacceptable risk of damage or loss of use due to structural failure or lack of structural serviceability. The risks of damage and of loss of use due to structural failure or lack of structural serviceability addressed in this Code are those caused by—

- OP2.1 – loads bearing on the *building* elements that exceed their *loadbearing* capacity
- OP2.2 – loads bearing on the *building* that exceed the *loadbearing* properties of the supporting medium
- OP2.3 – damage to or deterioration of *building* elements
- OP2.4 – vibration or deflection of *building* elements
- OP2.5 – instability of the *building* or part thereof
- OP2.6 – instability or movement of the supporting medium

OP3 Protection of Adjacent Buildings from Fire

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, adjacent *buildings* will be exposed to an unacceptable risk of damage due to fire. The risks of damage to adjacent *buildings* due to fire addressed in this Code are those caused by—

- OP3.1 – fire or explosion impacting areas beyond the *building* of origin

OP4 Protection of Adjacent Buildings from Structural Damage

An objective of this Code is to limit the probability that, as a result of the design, construction or demolition of the *building*, adjacent *buildings* will be exposed to an unacceptable risk of structural damage. The risks of structural damage to adjacent *buildings* addressed in this Code are those caused by—

- OP4.1 – settlement of the medium supporting adjacent *buildings*
- OP4.2 – collapse of the *building* or portion thereof onto adjacent *buildings*
- OP4.3 – impact of the *building* on adjacent *buildings*
- OP4.4 – collapse of the *excavation*

OE Environment

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, the environment will be affected in an unacceptable manner.

OE1 Resources

An objective of this Code is to limit the probability that, as a result of the design or construction of the *building*, resources will be used in a manner that will have an unacceptable effect on the environment. The risks of unacceptable effect on the environment due to use of resources addressed in this Code are those caused by –

OE1.1 – excessive use of energy

Part 3
Functional Statements

Section 3.1. Application

3.1.1. Application

3.1.1.1. Application

1) This Part applies to all *buildings* covered in this Code. (See Article 1.1.1.1.)

3.1.1.2. Application of Functional Statements

1) Except as provided in Sentences (2) to (4), the functional statements described in this Part apply

a) to all *buildings* covered in this Code (see Article 1.1.1.1.), and
b) only to the extent that they relate to compliance with this Code as required in Article 1.2.1.1.

2) Functional Statement F56 applies only to *dwelling units*.

3) Functional Statements F73 and F74 do not apply to

a) detached houses, semi-detached houses, houses with a *secondary suite*, duplexes, triplexes, townhouses, row houses and boarding houses (see A-1.4.1.2.(1), Secondary Suite, in Appendix A),
b) *buildings* of Group F, Division 1 *major occupancy*, and
c) *buildings* that are not intended to be occupied on a daily or full-time basis, including automatic telephone exchanges, pumphouses and substations.

4) Functional Statements F90 to F93, F95, F96 and F98 to F100 apply only to

a) *buildings* of *residential occupancy* to which Part 9 of Division B applies,
b) *buildings* containing *business and personal services*, *mercantile* or *low-hazard industrial occupancies* to which Part 9 of Division B applies whose combined total *floor area* does not exceed 300 m^2, and
c) *buildings* containing a mix of the *residential* and non-*residential occupancies* described in Clauses (a) and (b).

(See also Article 1.3.3.3.)

Section 3.2. Functional Statements

3.2.1. Functional Statements

3.2.1.1. Functional Statements

1) The objectives of this Code are achieved by measures, such as those described in the acceptable solutions in Division B, that are intended to allow the *building* or its elements to perform the following functions (see Appendix A):

F01 To minimize the risk of accidental ignition.

F02 To limit the severity and effects of fire or explosions.

F03 To retard the effects of fire on areas beyond its point of origin.

F04 To retard failure or collapse due to the effects of fire.

F05 To retard the effects of fire on emergency egress facilities.

F06 To retard the effects of fire on facilities for notification, suppression and emergency response.

F10 To facilitate the timely movement of persons to a safe place in an emergency.

F11 To notify persons, in a timely manner, of the need to take action in an emergency.

F12 To facilitate emergency response.

F13 To notify emergency responders, in a timely manner, of the need to take action in an emergency.

F20 To support and withstand expected loads and forces.

F21 To limit or accommodate dimensional change.

F22 To limit movement under expected loads and forces.

F23 To maintain equipment in place during structural movement.

F30 To minimize the risk of injury to persons as a result of tripping, slipping, falling, contact, drowning or collision.

F31 To minimize the risk of injury to persons as a result of contact with hot surfaces or substances.

F32 To minimize the risk of injury to persons as a result of contact with energized equipment.

F33 To limit the level of sound of a fire alarm system.

F34 To resist or discourage unwanted access or entry.

F35 To facilitate the identification of potential intruders.

F36 To minimize the risk that persons will be trapped in confined spaces.

F40 To limit the level of contaminants.

F41 To minimize the risk of generation of contaminants.

F42 To resist the entry of vermin and insects.

F43 To minimize the risk of release of hazardous substances.

F44 To limit the spread of hazardous substances beyond their point of release.

F46 To minimize the risk of contamination of potable water.

F50 To provide air suitable for breathing.

F51 To maintain appropriate air and surface temperatures.

F52 To maintain appropriate relative humidity.

F53 To maintain appropriate indoor/outdoor air pressure differences.

F54 To limit drafts.

F55 To resist the transfer of air through environmental separators.

F56 To limit the transmission of airborne sound into a *dwelling unit* from spaces elsewhere in the *building* (see Sentence 3.1.1.2.(2) for application limitation).

F60 To control the accumulation and pressure of water on and in the ground.

F61 To resist the ingress of precipitation, water or moisture from the exterior or from the ground.

F62 To facilitate the dissipation of water and moisture from the *building*.

F63 To limit moisture condensation.

F70 To provide potable water.

F71 To provide facilities for personal hygiene.

F72 To provide facilities for the sanitary disposal of human and domestic wastes.

F73 To facilitate access to and circulation in the *building* and its facilities by persons with physical or sensory limitations (see Sentence 3.1.1.2.(3) for application limitation).

F74 To facilitate the use of the *building*'s facilities by persons with physical or sensory limitations (see Sentence 3.1.1.2.(3) for application limitation).

F80 To resist deterioration resulting from expected service conditions.

F81 To minimize the risk of malfunction, interference, damage, tampering, lack of use or misuse.

F82 To minimize the risk of inadequate performance due to improper maintenance or lack of maintenance.

F90 To limit the amount of uncontrolled air leakage through the *building* envelope.

F91 To limit the amount of uncontrolled air leakage through system components.

F92 To limit the amount of uncontrolled thermal transfer through the *building* envelope.

F93 To limit the amount of uncontrolled thermal transfer through system components.

F95 To limit the unnecessary demand and/or consumption of energy for heating and cooling.

F96 To limit the unnecessary demand and/or consumption of energy for service water heating.

F98 To limit the inefficiency of equipment.

F99 To limit the inefficiency of systems.

F100 To limit the unnecessary rejection of reusable waste energy.

A-1.5.1.1.(1) Application of Referenced Documents. Documents referenced in the NBC may contain provisions covering a wide range of issues, including issues that are unrelated to the objectives and functional statements stated in Parts 2 and 3 of Division A respectively; e.g. aesthetic issues such as colour-fastness or uniformity. Sentence 1.5.1.1.(1) is intended to make it clear that, whereas referencing a document in the NBC generally has the effect of making the provisions of that document part of the Code, provisions that are unrelated to buildings or to the objectives and functional statements attributed to the provisions in Division B where the document is referenced are excluded.

Furthermore, many documents referenced in the NBC contain references to other documents, which may also, in turn, refer to other documents. These secondary and tertiary referenced documents may contain provisions that are unrelated to buildings or to the objectives and functional statements of the NBC: such provisions—no matter how far down the chain of references they occur—are not included in the intent of Sentence 1.5.1.1.(1) of Division A.

A-2.1.1.2.(6) Application of Environment Objective. Objective OE, Environment (including its sub-objectives), is attributed to the requirements in Section 9.36. of Division B, which address energy efficiency for small residential buildings and certain small non-residential and mixed-use buildings (see Article 9.36.1.3. of Division B). The objectives, functional statements and energy efficiency requirements for larger Part 9 residential buildings as well as for non-residential buildings whose combined total floor area exceeds 300 m^2 and some mixed-use buildings are addressed in the National Energy Code for Buildings.

A-2.2.1.1.(1) Objectives.

Listing of objectives

Any gaps in the numbering sequence of the objectives are due to the fact that there is a master list of objectives covering the four principal National Code Documents—the National Building Code, the National Fire Code, the National Plumbing Code and the National Energy Code for Buildings—but not all objectives are pertinent to all Codes.

The building

Where the term "the building" is used in the wording of the objectives, it refers to the building for which compliance with the National Building Code is being assessed.

Emergency

The term "emergency"—in the context of safety in buildings—is often equated to the term "fire emergency;" however, the wording of objectives OS3.7 and OS5.9 makes it clear that the Code addresses any type of emergency that would require the rapid evacuation of the building, such as a bomb threat or the presence of intruders.

A-3.2.1.1.(1) Functional Statements.

Listing of functional statements

The numbered functional statements are grouped according to functions that deal with closely related subjects. For example, the first group deals with fire risks, the second group deals with emergency egress and response, etc. There may be gaps in the numbering sequence for the following reasons:

- Each group has unused numbers which allows for the possible future creation of additional functional statements within any one group.
- There is a master list of functional statements covering the four principal National Code Documents—the National Building Code, the National Fire Code, the National Plumbing Code and the National Energy Code for Buildings—but not all functional statements are pertinent to all Codes.

b) the factored bearing pressures on the *soil* or *rock*, the factored loads when applicable and the design loads applied to *foundation units*, and
c) the earth pressures and other loads applied to the supporting structures of supported *excavations*.

2) When required, evidence that justifies the information on the drawings shall be submitted with the application to excavate or build.

2.2.4.7. Altered Conditions

1) Where conditions as described under Sentences 4.2.2.4.(1) and (2) of Division B are encountered, or where *foundation units* or their locations are altered, this information shall be recorded on appropriate drawings or new "as constructed" drawings.

2.2.5. Drawings and Specifications for Environmental Separators and Other Assemblies Exposed to the Exterior

2.2.5.1. Application

1) This Subsection applies to *building* materials, components and assemblies to which Part 5 of Division B applies. (See Article 1.3.3.2. of Division A.)

2.2.5.2. Information Required on Drawings and Specifications

1) Information shown on drawings and in specifications shall be clear and legible, and shall contain sufficient details to demonstrate conformance with this Code. (See A-2.2.6.2.(1) in Appendix A.)

2.2.6. Heating, Ventilating and Air-conditioning Drawings and Specifications

2.2.6.1. Application

1) This Subsection applies only to *buildings* covered in Part 6 of Division B. (See Article 1.3.3.2. of Division A.)

2.2.6.2. Information Required on Drawings

1) The information shown on architectural drawings and on drawings for heating, ventilating and air-conditioning systems shall be clear and legible and shall contain all necessary details to demonstrate conformance with this Code. (See Appendix A.)

2.2.7. Review of Work

2.2.7.1. Application

1) This Subsection applies only to *buildings* covered in Part 4 of Division B (see Article 1.3.3.2. of Division A), except that Article 2.2.7.5. applies to all *buildings* covered in this Code. (See Article 1.1.1.1. of Division A.)

2.2.7.2. Review of Construction

1) The *designer* or another suitably qualified person shall review the construction of any *building* or part thereof to determine conformance with the design.

2.2.7.3. Review of Shop Drawings

1) The *designer* or another suitably qualified person shall review all shop drawings and other related documents relevant to the design to determine conformance with the design.

2.2.7.4. Review of Workmanship and Materials

1) Workmanship, materials and all reports of material tests shall be reviewed by the *designer* or another suitably qualified person during the process of construction.

2.2.7.5. Off-Site Review

1) Where a *building* or component of a *building* is assembled off the *building* site in such a manner that it cannot be reviewed on site, off-site reviews shall be provided to determine compliance with this Code.

2.2.8. Drawings, Specifications and Calculations for Energy Performance Compliance

2.2.8.1. Application

1) This Subsection applies only to houses with or without a *secondary suite* and to *buildings* containing only *dwelling units* and common spaces whose total *floor area* does not exceed 20% of the total *floor area* of the *building* that are modeled in accordance with Subsection 9.36.5. of Division B to demonstrate compliance with the energy efficiency objectives of Subsections 9.36.2. to 9.36.4. of Division B. (See Appendix A.) (See also Sentence 9.36.1.2.(1) of Division B and A-9.36.1.3.(3) in Appendix A of Division B.)

2.2.8.2. Information Required on Drawings and Specifications

1) Except as provided in Sentences (2), (3) and (4), the drawings and specifications for the proposed house shall include

a) the effective thermal resistance values and respective areas of all opaque *building* envelope assemblies, including all above-ground and below-ground roof/ceiling, wall, and floor assemblies,
b) the overall thermal transmittance (U-value), solar heat gain coefficient and respective areas of all fenestration and door components,
c) the ratio of total vertical fenestration and door area to gross wall area,
d) the performance rating, energy source, and types of all equipment required for space-heating and -cooling and service water heating,
e) the design basis for the ventilation rates,
f) where a test is used to determine the airtightness of a house, the measured airtightness of the *building* envelope in air changes per hour, and
g) any additional features used in the energy model calculations that account for a significant difference in house energy performance.

2) The effective thermal resistance values and respective areas of opaque *building* envelope assemblies that cover less than 2% of the total area of their respective assembly type need not be provided in the drawings and specifications required in Sentence (1).

3) Where part-load characteristics are used in the modeling of the HVAC equipment, they need not be provided in the drawings and specifications required in Sentence (1).

4) The features of the proposed house that differ from those of the reference house shall be detailed in the specifications required in Sentence (1).

2.2.8.3. House Performance Compliance Calculation Report

1) A house performance compliance calculation report shall be provided in accordance with Sentence (2) for each proposed house design.

2) In addition to the drawings and specifications required in Article 2.2.8.2., the house performance compliance calculation report shall include

a) a project information section containing
   i) the name or identifier of the project,
   ii) a description of the project,
   iii) the address of the project,
   iv) the name and version of the calculation tool,
   v) the geographic region in which the proposed house is to be built, and
   vi) the identifier for the climatic data set used for analysis,
b) a summary of the characteristics of the *building* envelope, HVAC system and service water heating system reflecting the information provided in Article 2.2.8.2.,

c) an energy performance data summary containing
   i) the annual energy consumption of all energy sources calculated for the proposed house (see Appendix A), and
   ii) the house energy target of all energy sources calculated for the reference house,
d) where a software program is used to determine compliance,
   i) the name of the software program(s), and
   ii) a list of any adaptations made by the user to the software relating to input or output values, and
e) a statement that the calculation was performed in compliance with Subsection 9.36.5. of Division B.

Section 2.3. Alternative Solutions

2.3.1. Documentation of Alternative Solutions

(See Appendix A.)

2.3.1.1. Documentation

1) Documentation conforming to this Subsection shall be provided by the person requesting the use of an alternative solution to demonstrate that the proposed alternative solution complies with this Code.

2) The documentation referred to in Sentence (1) shall include
a) a Code analysis outlining the analytical methods and rationales used to determine that a proposed alternative solution will achieve at least the level of performance required by Clause 1.2.1.1.(1)(b) of Division A, and
b) information concerning any special maintenance or operational requirements, including any *building* component commissioning requirements, that are necessary for the alternative solution to achieve compliance with the Code after the *building* is constructed.

3) The Code analysis referred to in Clause (2)(a) shall identify the applicable objectives, functional statements and acceptable solutions, and any assumptions, limiting or restricting factors, testing procedures, engineering studies or *building* performance parameters that will support a Code compliance assessment.

4) The Code analysis referred to in Clause (2)(a) shall include information about the qualifications, experience and background of the person or persons taking responsibility for the design.

5) The information provided under Sentence (3) shall be in sufficient detail to convey the design intent and to support the validity, accuracy, relevance and precision of the Code analysis.

6) Where the design of a *building* includes proposed alternative solutions that involve more than one person taking responsibility for different aspects of the design, the applicant for the permit shall identify a single person to co-ordinate the preparation of the design, Code analysis and documentation referred to in this Subsection.

Appendix A
Explanatory Material

A-2.2.1.2.(1) Structural Design. Part 4 of Division B is written on the assumption that structural design will be carried out by a professional who is qualified to perform such design. Sentence 2.2.1.2.(1) is not intended to imply that a professional may not also be required in the application of requirements in other Parts of the NBC.

A-2.2.6.2.(1) Information Required on Drawings and Specifications. Examples of information that should be shown on architectural drawings and drawings for heating, ventilating and air-conditioning systems are:

(a) the name, type and location of the building,
(b) the name of the owner,
(c) the name of the architect,
(d) the name of the engineer or designer,
(e) the north point,
(f) the dimensions and height of all rooms,
(g) the intended use of all rooms,
(h) the details or description of the wall, roof, ceiling and floor construction, including insulation,
(i) the details or description of the windows and outside doors, including the size, weatherstripping, storm sashes, sills and storm doors,
(j) the size and continuity of all pipes, ducts, shafts, flues and fire dampers,
(k) the location, size, capacity and type of all principal units of equipment,
(l) the size, shape and height of all chimneys and gas vents,
(m) the size and location of all combustion air and ventilation openings, and
(n) the location and fire-resistance rating of required fire separations.

A-2.2.8.1.(1) Use of Terms "Building" and "House". Although the word "house" is used in the terms "proposed house," "reference house" and "house performance compliance calculation report" in Subsection 2.2.8., it is intended to include other types of residential buildings also addressed by Subsection 9.36.5. of Division B. The terms "proposed building," "reference building" and "building performance compliance calculation report" used in the NECB apply to other types of buildings.

A-2.2.8.3.(2)(c)(i) Annual Energy Consumption. The performance compliance calculation method detailed in Subsection 9.36.5. of Division B uses a number of assumptions regarding environmental values and operating conditions in order to standardize the calculations and neutralize the impact of occupant behaviour or to exclude issues that are not addressed in the requirements. Note that the result of the energy model calculations is not a prediction of the actual energy consumption of the proposed house.

A-2.3.1. Documentation of Alternative Solutions. Beyond the purposes of demonstrating compliance and acquiring a building permit, there are other important reasons for requiring that the proponent of an alternative solution submit project documentation (i.e. a compliance report) to the authority having jurisdiction and for the authority having jurisdiction to retain that documentation for a substantial period following the construction of a building:

- Most jurisdictions require that a building be maintained in compliance with the codes under which it was built. Alternative solutions made possible by objective-based codes may have special maintenance requirements, which would be described in the documentation.
- Documentation helps consultants perform code compliance assessments of existing buildings before they are sold and informs current owners or prospective buyers of existing buildings of any limitations pertaining to their future use or development.

This Appendix is included for explanatory purposes only and does not form part of the requirements. The numbers that introduce each Appendix Note correspond to the applicable requirements in this Division.

- Documentation provides design professionals with the basic information necessary to design changes to an existing building.
- An alternative solution could be invalidated by a proposed alteration to a building. Designers and regulators must therefore know the details of the particular alternative solutions that were integral to the original design. Complete documentation should provide insight as to why one alternative solution was chosen over another.
- Documentation is the "paper trail" of the alternative solution negotiated between the designer and the regulator and should demonstrate that a rational process led to the acceptance of the alternative solution as an equivalency.
- It is possible that over time a particular alternative solution may be shown to be inadequate. It would be advantageous for a jurisdiction to know which buildings included that alternative solution as part of their design: documentation will facilitate this type of analysis.
- Project documentation provides important information to a forensic team that is called to investigate an accident or why a design failed to provide the level of performance expected.

This subject is discussed in further detail in "Recommended Documentation Requirements for Projects Using Alternative Solutions in the Context of Objective-Based Codes," which was prepared for the CCBFC Task Group on Implementation of Objective-Based Codes and is available at www.nationalcodes.ca.

Table 9.37.1.1. (Continued)

Functional Statements and Objectives[1]	
9.22.9.2. Metal Exposed to the Interior	
(1)	[F01-OS1.1]
	[F01-OP1.1]
9.22.9.3. Clearance to Combustible Framing	
(1)	[F01-OS1.1]
	[F01-OP1.1]
(2)	[F01-OS1.1]
	[F01-OP1.1]
9.22.9.4. Heat-Circulating Duct Outlets	
(1)	(a),(b) [F01-OS1.1]
	(a),(b) [F01-OP1.1]
9.22.10.1. Appliance Standard	
(1)	[F44-OH1.1]
	[F01-OS1.1]
	[F44-OS3.4]
	[F01-OP1.1]
9.22.10.2. Installation	
(1)	[F01-OS1.1]
	[F44-OH1.1]
	[F01-OP1.1]
	[F44-OS3.4]

Table 9.37.1.1. (Continued)

Functional Statements and Objectives[1]	
9.23.2.1. Strength and Rigidity	
(1)	[F20-OS2.1] [F20,F22-OS2.5] [F20,F22-OS2.3] Applies to elements that support or are part of an environmental separator.
	[F20-OP2.1] [F20,F22-OP2.4,OP2.5] [F20,F22-OP2.3] Applies to elements that support or are part of an environmental separator.
	[F22-OH4] Applies to floors and elements that support floors.
	[F20,F22-OS1.2] Applies to assemblies required to provide fire resistance.
	[F22-OS3.1] Applies to floors and elements that support floors. [F22-OS3.7] Applies to walls, and elements that support walls, that contain doors or windows required for emergency egress.
	[F20,F22-OH1.1,OH1.2,OH1.3] Applies to elements that support or are part of an environmental separator.
9.23.2.2. Protection from Decay	
(1)	[F80-OS2.3]
	[F80-OP2.3,OP2.4]
	[F80-OH1.1,OH1.2,OH1.3] Applies to elements that support or are part of an environmental separator.
	[F80-OS1.2] Applies to assemblies required to provide fire resistance.
	[F80-OH4] Applies to floors and elements that support floors.
	[F80-OS3.1] Applies to floors and elements that support floors. [F80-OS3.7] Applies to walls, and elements that support walls, that contain doors or windows required for emergency egress.
(2)	[F81-OS2.3]
	[F81-OP2.3]
	[F81-OH1.1,OH1.2,OH1.3] Applies to elements that support or are part of an environmental separator.
	[F81-OS1.2] Applies to assemblies required to provide fire resistance.
	[F81-OH4] Applies to floors and elements that support floors.
	[F81-OS3.1] Applies to floors and elements that support floors.
9.23.2.3. Protection from Dampness	
(1)	[F80-OS2.1,OS2.3]
	[F80-OP2.1,OP2.3,OP2.4]
	[F80-OH1.1,OH1.2,OH1.3] Applies to elements that support or are part of an environmental separator.
	[F80-OS1.2] Applies to assemblies required to provide fire resistance.
	[F80-OH4] Applies to floors and elements that support floors.
	[F80-OS3.1] Applies to floors and elements that support floors.

Table 9.37.1.1. (Continued)

Functional Statements and Objectives[1]	
9.23.3.1. Standards for Nails and Screws	
(1)	[F20-OS2.1] [F20,F22-OS2.5] [F20,F22-OS2.3] Applies to elements that support or are part of an environmental separator.
	[F20-OP2.1] [F20,F22-OP2.4,OP2.5] [F20,F22-OP2.3] Applies to elements that support or are part of an environmental separator.
	[F20,F22-OS1.2] Applies to assemblies required to provide fire resistance.
	[F20,F22-OH1.1,OH1.2,OH1.3] Applies to elements that support or are part of an environmental separator.
	[F22-OH4] Applies to floors and elements that support floors.
	[F22-OS3.1] Applies to floors and elements that support floors. [F22-OS3.7] Applies to walls, and elements that support walls, that contain doors or windows required for emergency egress.
(2)	[F20-OS2.1] [F20,F22-OS2.5] [F20,F22-OS2.3] Applies to elements that support or are part of an environmental separator.
	[F20-OP2.1] [F20,F22-OP2.4,OP2.5] [F20,F22-OP2.3] Applies to elements that support or are part of an environmental separator.
	[F20,F22-OS1.2] Applies to assemblies required to provide fire resistance.
	[F20,F22-OH1.1,OH1.2,OH1.3] Applies to elements that support or are part of an environmental separator.
	[F22-OH4] Applies to floors and elements that support floors.
	[F22-OS3.1] Applies to floors and elements that support floors. [F22-OS3.7] Applies to walls, and elements that support walls, that contain doors or windows required for emergency egress.
(3)	[F20-OS2.1] [F20,F22-OS2.5] [F20,F22-OS2.3] Applies to elements that support or are part of an environmental separator.
	[F20-OP2.1,OP2.5] [F22-OP2.4,OP2.5] [F20,F22-OP2.3] Applies to elements that support or are part of an environmental separator.
	[F20,F22-OH1.1,OH1.2,OH1.3] Applies to elements that support or are part of an environmental separator.
	[F20,F22-OS1.2] Applies to assemblies required to provide fire resistance.
	[F22-OH4] Applies to floors and elements that support floors.
	[F22-OS3.1] Applies to floors and elements that support floors. [F22-OS3.7] Applies to walls, and elements that support walls, that contain doors or windows required for emergency egress.TT

Table 9.37.1.1. (Continued)

Acceptable Solutions	Functional Statements and Objectives(1)
9.33.10.2. Factory-Built Chimneys	
(1)	[F01-OS1.1]
	[F44-OS3.4]
	[F44,F41-OH1.1]
	[F01-OP1.1]
9.34.1.1. Standard for Electrical Installations	
(1)	[F32-OS3.3]
	[F01-OS1.1]
	[F01-OP1.1]
9.34.1.3. Location of Equipment in Public Areas	
(1)	[F10-OS3.1] [F32-OS3.3]
9.34.1.4. Recessed Lighting Fixtures	
(1)	[F01-OS1.1]
9.34.1.5. Wiring and Cables	
(1)	[F02-OS1.2]
	[F02-OP1.2]
9.34.2.1. Lighting of Entrances	
(1)	[F30-OS3.1]
	[F34-OS4.2]
9.34.2.2. Outlets in Dwelling Units	
(1)	[F30-OS3.1]
(2)	[F30-OS3.1]
9.34.2.3. Stairways	
(1)	[F30-OS3.1]
(2)	[F30-OS3.1]
9.34.2.4. Basements	
(1)	[F30-OS3.1]
(2)	[F30-OS3.1]
9.34.2.5. Storage Rooms	
(1)	[F30-OS3.1]
9.34.2.6. Garages and Carports	
(1)	[F30-OS3.1]
(2)	[F30-OS3.1]
(3)	[F30-OS3.1]
9.34.2.7. Public and Service Areas	
(1)	[F30-OS3.1]
(2)	[F30-OS3.1]
(3)	[F30-OS3.1]
9.35.2.2. Garage Floor	
(1)	[F40-OS1.1]

Table 9.37.1.1. (Continued)

Functional Statements and Objectives[1]	
9.35.3.2. Protection from Damage due to Soil Movement	
(1)	[F21-OS2.3]
	[F21-OH1.1,OH1.2,OH1.3]
	[F21-OP2.3,OP2.4]
	[F21-OH4] Applies to floors and elements that support floors.
	[F21-OS3.1] Applies to floors and elements that support floors.
(2)	[F21-OS2.3]
	[F21-OH1.1,OH1.2,OH1.3]
	[F21-OP2.3,OP2.4]
	[F21-OH4] Applies to floors and elements that support floors.
	[F21-OS3.1] Applies to floors and elements that support floors.
9.35.3.4. Column Piers	
(1)	[F80-OS2.3]
	[F80-OP2.3]
(2)	[F20-OS2.1,OS2.2]
	[F20-OP2.1,OP2.2]
9.35.4.2. Columns	
(1)	[F20-OS2.1]
	[F20-OP2.1]
9.35.4.3. Anchorage	
(1)	[F22-OS2.4,OS2.5]
	[F22-OP2.4,OP2.5]
9.36.2.2. Determination of Thermal Characteristics of Materials, Components and Assemblies	
(1)	[F92-OE1.1]

Table 9.37.1.1. (Continued)

Functional Statements and Objectives[1]	
(2)	[F92-OE1.1]
(3)	[F92-OE1.1]
(4)	[F92-OE1.1]
9.36.2.4. Calculation of Effective Thermal Resistance of Assemblies	
(1)	[F92-OE1.1]
(3)	[F92-OE1.1]
9.36.2.5. Continuity of Insulation	
(1)	[F92-OE1.1]
(2)	[F92-OE1.1]
(4)	[F92-OE1.1]
(5)	[F92-OE1.1]
(6)	[F92-OE1.1]
(7)	[F92-OE1.1]
(8)	[F92-OE1.1]
9.36.2.6. Thermal Characteristics of Above-ground Opaque Building Assemblies	
(1)	[F92-OE1.1]
(2)	[F92-OE1.1]
(3)	[F92-OE1.1]
(4)	[F92-OE1.1]
9.36.2.7. Thermal Characteristics of Fenestration, Doors and Skylights	
(1)	[F92-OE1.1]
(2)	[F92-OE1.1]
(3)	[F92-OE1.1]
(4)	[F92-OE1.1]
(5)	[F92-OE1.1]
(7)	[F92-OE1.1]
(8)	[F92-OE1.1]
9.36.2.8. Thermal Characteristics of Building Assemblies Below-Grade or in Contact with the Ground	
(1)	[F92-OE1.1]
(2)	[F92-OE1.1]
(3)	[F92-OE1.1]
(4)	[F92-OE1.1]
(5)	[F92-OE1.1]
(6)	[F92-OE1.1]
(7)	[F92-OE1.1]
(8)	[F92-OE1.1]
(9)	[F92-OE1.1]
9.36.2.9. Airtightness	
(1)	[F90-OE1.1]
(2)	[F90-OE1.1]

Table 9.37.1.1. (Continued)

Functional Statements and Objectives[1]	
(3)	[F90-OE1.1]
(4)	[F90-OE1.1]
(5)	[F90-OE1.1]
(6)	[F90-OE1.1]
9.36.2.10. Construction of Air Barrier Details	
(1)	[F90-OE1.1]
(2)	[F90-OE1.1]
(3)	[F90-OE1.1]
(4)	[F90-OE1.1]
(5)	[F90-OE1.1]
(6)	[F90-OE1.1]
(17)	[F90-OE1.1]
9.36.2.11. Trade-off Options for Above-ground Building Envelope Components and Assemblies	
(2)	[F92-OE1.1]
(3)	[F92-OE1.1]
(4)	[F92-OE1.1]
(5)	[F92-OE1.1]
(6)	[F92-OE1.1]
(7)	[F92-OE1.1]
(8)	[F92-OE1.1]
9.36.3.2. Equipment and Ducts	
(1)	[F95-OE1.1]
(3)	[F91,F93-OE1.1]
(4)	[F91,F93-OE1.1]
(5)	[F91,F93-OE1.1]
9.36.3.3. Air Intake and Outlet Dampers	
(1)	[F91,F95-OE1.1]
(2)	[F91,F95-OE1.1]
9.36.3.4. Piping for Heating and Cooling Systems	
(2)	[F93-OE1.1]
9.36.3.5. Equipment for Heating and Air-conditioning Systems	
(1)	[F98-OE1.1]
9.36.3.6. Temperature Controls	
(1)	[F92-OE1.1]
(2)	[F95,F98-OE1.1]
(3)	[F95-OE1.1]
(4)	[F95-OE1.1]
(5)	[F95-OE1.1]
(6)	[F95-OE1.1]
(7)	[F95-OE1.1]
9.36.3.7. Humidification	
(1)	[F95-OE1.1]

Table 9.37.1.1. (Continued)

Functional Statements and Objectives[1]	
9.36.3.8. Heat Recovery from Dehumidification in Spaces with an Indoor Pool or Hot Tub	
(1)	[F95,F100-OE1.1]
(3)	[F95-OE1.1]
(4)	[F98,F100-OE1.1]
(5)	[F98,F100-OE1.1]
9.36.3.9. Heat Recovery from Ventilation Systems	
(2)	[F95,F100-OE1.1]
(3)	[F95,F100-OE1.1]
(4)	[F95,F98,F100-OE1.1]
9.36.3.10. Equipment Efficiency	
(1)	[F95,F98,F99-OE1.1]
9.36.3.11. Solar Thermal Systems	
(1)	[F95,F98,F99-OE1.1]
(3)	[F93,F96-OE1.1]
9.36.4.2. Equipment Efficiency	
(1)	[F96,F98-OE1.1]
(2)	[F93,F96-OE1.1]
(3)	[F98-OE1.1]
9.36.4.3. Solar Domestic Hot Water Systems	
(1)	[F96,F98-OE1.1]
(3)	[F93,F96-OE1.1]
9.36.4.4. Piping	
(1)	[F93,F96-OE1.1]
(2)	[F93,F96-OE1.1]
(3)	[F93,F96-OE1.1]
9.36.4.5. Controls	
(1)	[F96-OE1.1]
9.36.4.6. Indoor Swimming Pool Equipment Controls	
(1)	[F96-OE1.1]
(2)	[F96-OE1.1]
9.36.5.3. Compliance	
(1)	[F99-OE1.1]
(2)	[F92,F93,F95,F96,F98,F99,F100-OE1.1]
(3)	[F92,F93,F95,F96,F98,F99,F100-OE1.1]
(4)	[F92,F93,F95,F96,F98,F99,F100-OE1.1]
(5)	[F92,F93,F95,F96,F98,F99,F100-OE1.1]
(6)	[F99-OE1.1]
9.36.5.4. Calculation Methods	
(1)	[F99-OE1.1]
(3)	[F99-OE1.1]
(4)	[F99-OE1.1]
(5)	[F95,F99-OE1.1]

Table 9.37.1.1. (Continued)

Functional Statements and Objectives[1]	
(6)	[F95,F99-OE1.1]
(7)	[F95,F99-OE1.1]
(8)	[F99-OE1.1]
(9)	[F99-OE1.1]
(10)	[F90,F99-OE1.1]
(11)	[F90,F99-OE1.1]
9.36.5.5. Climatic Data	
(1)	[F99-OE1.1]
(2)	[F99-OE1.1]
(3)	[F99-OE1.1]
9.36.5.6. Building Envelope Calculations	
(1)	[F92,F99-OE1.1]
(2)	[F92,F99-OE1.1]
(3)	[F92,F99-OE1.1]
(4)	[F92,F99-OE1.1]
(5)	[F92,F99-OE1.1]
(6)	[F92,F99-OE1.1]
(7)	[F92,F93,F95,F96,F99-OE1.1]
(8)	[F92,F99-OE1.1]
(9)	[F92,F99-OE1.1]
(10)	[F92,F99-OE1.1]
(11)	[F92,F99-OE1.1]
9.36.5.7. HVAC System Calculations	
(1)	[F95,F99-OE1.1]
(2)	[F95,F99-OE1.1]
(3)	[F95,F99-OE1.1]
(4)	[F95,F99-OE1.1]
(5)	[F95,F99-OE1.1]
(6)	[F95,F99-OE1.1]
(7)	[F95,F99-OE1.1]
(8)	[F95,F99-OE1.1]
(9)	[F95,F99-OE1.1]
9.36.5.8. Service Water Heating System Calculations	
(1)	[F96,F99-OE1.1]
(2)	[F96,F99-OE1.1]
(3)	[F96,F99-OE1.1]
(4)	[F96,F99-OE1.1]
(5)	[F96,F99-OE1.1]
(6)	[F96,F99-OE1.1]
9.36.5.9. General Requirements for Modeling the Proposed House	
(1)	[F99-OE1.1]

Table 9.37.1.1. (Continued)

Functional Statements and Objectives[1]	
9.36.5.10. Modeling Building Envelope of Proposed House	
(1)	[F92,F95,F99-OE1.1]
(4)	[F92,F95,F99-OE1.1]
(5)	[F92,F95,F99-OE1.1]
(6)	[F92,F95,F99-OE1.1]
(7)	[F92,F95,F99-OE1.1]
(9)	[F90,F91,F92,F95,F99-OE1.1]
(10)	[F90,F99-OE1.1]
(11)	[F90,F99-OE1.1]
(12)	[F90,F99-OE1.1]
(13)	[F90,F99-OE1.1]
9.36.5.11. Modeling HVAC System of Proposed House	
(1)	[F95,F99-OE1.1]
(2)	[F95,F99-OE1.1]
(3)	[F92,F95,F99-OE1.1]
(4)	[F95,F99,F100-OE1.1]
(5)	[F95,F99-OE1.1]
(6)	[F95,F99-OE1.1]
(7)	[F99-OE1.1]
(8)	[F95,F99-OE1.1]
(9)	[F95,F99-OE1.1]
(10)	[F95,F99,F100-OE1.1]
(11)	[F95,F99-OE1.1]
(12)	[F95,F99,F100-OE1.1]
(13)	[F95,F99-OE1.1]
(14)	[F95,F99,F100-OE1.1]
(15)	[F95,F99-OE1.1]
(16)	[F95,F99-OE1.1]
(17)	[F95,F99-OE1.1]
(18)	[F95,F99-OE1.1]
(19)	[F95,F99-OE1.1]
(20)	[F95,F99-OE1.1]
9.36.5.12. Modeling Service Water Heating System of Proposed House	
(1)	[F96,F99-OE1.1]
(2)	[F99-OE1.1]
9.36.5.13. General Requirements for Modeling the Reference House	
(1)	[F99-OE1.1]
(2)	[F99-OE1.1]
9.36.5.14. Modeling Building Envelope of Reference House	
(1)	[F92,F95,F99-OE1.1]
(2)	[F90,F91,F92,F95,F99-OE1.1]
(3)	[F92,F95,F99-OE1.1]

Table 9.37.1.1. (Continued)

Functional Statements and Objectives[1]	
(4)	[F92,F95,F99-OE1.1]
(5)	[F92,F99-OE1.1]
(6)	[F92,F95,F99-OE1.1]
(7)	[F92,F99-OE1.1]
(8)	[F92,F99-OE1.1]
(9)	[F92,F95,F99-OE1.1]
(10)	[F92,F99-OE1.1]
9.36.5.15. Modeling HVAC System of Reference House	
(1)	[F95,F99-OE1.1]
(2)	[F95,F99-OE1.1]
(3)	[F95,F99,F100-OE1.1]
(4)	[F95,F99-OE1.1]
(5)	[F95,F99-OE1.1]
(6)	[F95,F99-OE1.1]
(7)	[F95,F99-OE1.1]
(8)	[F95,F99,F100-OE1.1]
(9)	[F95,F99-OE1.1]
(10)	[F95,F99-OE1.1]
(11)	[F95,F99-OE1.1]
(12)	[F95,F99,F100-OE1.1]
(13)	[F95,F99,F100-OE1.1]
(14)	[F95,F99-OE1.1]
(15)	[F95,F99-OE1.1]
(16)	[F95,F99-OE1.1]
9.36.5.16. Modeling Service Water Heating System of Reference House	
(1)	[F95,F99-OE1.1]
(2)	[F95,F99-OE1.1]
(3)	[F95,F99-OE1.1]

Notes to Table 9.37.1.1.:

(1) See Parts 2 and 3 of Division A.

Part 1
General

Section 1.1. General

1.1.1. Application

1.1.1.1. Application

1) This Part applies to all *buildings* covered in this Code. (See Article 1.1.1.1. of Division A.)

1.1.2. Objectives and Functional Statements

1.1.2.1. Attributions to Acceptable Solutions

1) For the purpose of compliance with this Code as required in Clause 1.2.1.1.(1)(b) of Division A, the objectives and functional statements attributed to the acceptable solutions in Division B shall be the objectives and functional statements identified in Sections 3.9., 4.5., 5.11., 6.4., 7.2., 8.3. and 9.37. (See Appendix A.)

1.1.3. Climatic and Seismic Data

1.1.3.1. Climatic and Seismic Values

1) The climatic and seismic values required for the design of *buildings* under this Code shall be in conformance with the values established by the *authority having jurisdiction* or, in the absence of such data, with Sentence (2) and the climatic and seismic values in Appendix C. (See Appendix A.)

2) The outside winter design temperatures determined from Appendix C shall be those listed for the January 2.5% values. (See Appendix A.)

1.1.3.2. Depth of Frost Penetration

1) Depth of frost penetration shall be established on the basis of local experience.

1.1.4. Fire Safety Plan

1.1.4.1. Fire Safety Plan

1) Where a fire safety plan is required, it shall conform to Section 2.8. of Division B of the NFC.

Section 1.2. Terms and Abbreviations

1.2.1. Definitions of Words and Phrases

1.2.1.1. Non-defined Terms

1) Words and phrases used in Division B that are not included in the list of definitions in Article 1.4.1.2. of Division A shall have the meanings that are commonly assigned to them in the context in which they are used, taking into account the

specialized use of terms by the various trades and professions to which the terminology applies.

2) Where objectives and functional statements are referred to in Division B, they shall be the objectives and functional statements described in Parts 2 and 3 of Division A.

3) Where acceptable solutions are referred to in Division B, they shall be the provisions stated in Parts 3 to 9.

1.2.1.2. Defined Terms

1) The words and terms in italics in Division B shall have the meanings assigned to them in Article 1.4.1.2. of Division A.

1.2.2. Symbols and Other Abbreviations

1.2.2.1. Symbols and Other Abbreviations

1) The symbols and other abbreviations in Division B shall have the meanings assigned to them in Article 1.4.2.1. of Division A and Article 1.3.2.1.

Section 1.3. Referenced Documents and Organizations

1.3.1. Referenced Documents

1.3.1.1. Effective Date

1) Unless otherwise specified herein, the documents referenced in this Code shall include all amendments, revisions, reaffirmations, reapprovals, addenda and supplements effective to 30 September 2009.

1.3.1.2. Applicable Editions

1) Where documents are referenced in this Code, they shall be the editions designated in Table 1.3.1.2. (See Appendix A.)

Table 1.3.1.2.
Documents Referenced in the National Building Code of Canada 2010
Forming Part of Sentence 1.3.1.2.(1)

Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
AHAM	ANSI/AHAM RAC-1-1982	Room Air Conditioners	Table 9.36.3.10.
AHRI	ANSI/AHRI 210/240-2008	Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment	Table 9.36.3.10.
AHRI	ANSI/AHRI 1060-2005	Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation	9.36.3.8.(4)
AHRI	BTS-2000	Efficiency of Commercial Space Heating Boilers	Table 9.36.3.10.
AISI	S201-07	North American Standard for Cold-Formed Steel Framing - Product Data	9.24.1.2.(1)
ANSI	A208.1-2009	Particleboard	Table 5.10.1.1. 9.23.15.2.(3) 9.29.9.1.(1) 9.30.2.2.(1)
ANSI/CSA	ANSI Z21.10.3-2004/CSA 4.3-04	Gas Water Heaters – Volume III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous	Table 9.36.4.2.
ANSI/CSA	ANSI Z21.56-2006/CSA 4.7-2006	Gas-Fired Pool Heaters	Table 9.36.4.2.

Table 1.3.1.2. (Continued)

Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
ANSI/CSA	ANSI Z83.8-2006/CSA 2.6-2006	Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters and Gas-Fired Duct Furnaces	Table 9.36.3.10.
ASHRAE	ANSI/ASHRAE 62-2001	Ventilation for Acceptable Indoor Air Quality (except Addendum n)	6.2.2.1.(2)
ASHRAE	ANSI/ASHRAE 103-2007	Annual Fuel Utilization Efficiency of Residential Central Furnaces and Boilers	Table 9.36.3.10.
ASHRAE	ANSI/ASHRAE 140-2007	Evaluation of Building Energy Analysis Computer Programs	9.36.5.4.(8)
ASME	B18.6.1-1981	Wood Screws (Inch Series)	Table 5.10.1.1. 9.23.3.1.(3)
ASME/CSA	ASME A17.1-2007/CSA B44-07	Safety Code for Elevators and Escalators	3.2.6.7.(2) 3.5.2.1.(1) 3.5.2.1.(2) 3.5.2.1.(3) 3.5.4.2.(1) Table 4.1.5.11.
ASTM	A 123/A 123M-08	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products	Table 5.10.1.1. Table 9.20.16.1.
ASTM	A 153/A 153M-05	Zinc Coating (Hot-Dip) on Iron and Steel Hardware	Table 5.10.1.1. Table 9.20.16.1.
ASTM	A 252-98	Welded and Seamless Steel Pipe Piles	4.2.3.8.(1)
ASTM	A 283/A 283M-03	Low and Intermediate Tensile Strength Carbon Steel Plates	4.2.3.8.(1)
ASTM	A 653/A 653M-08	Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process	Table 5.10.1.1. 9.3.3.2.(1)
ASTM	A 792/A 792M-08	Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process	9.3.3.2.(1)
ASTM	A 1008/A 1008M-09	Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable	4.2.3.8.(1)
ASTM	A 1011/A 1011M-09a	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength	4.2.3.8.(1)
ASTM	C 4-04e1	Clay Drain Tile and Perforated Clay Drain Tile	Table 5.10.1.1. 9.14.3.1.(1)
ASTM	C 27-98	Classification of Fireclay and High-Alumina Refractory Brick	9.21.3.4.(1)
ASTM	C 73-05	Calcium Silicate Brick (Sand-Lime Brick)	Table 5.10.1.1. 9.20.2.1.(1)
ASTM	C 126-99	Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units	Table 5.10.1.1. 9.20.2.1.(1)
ASTM	C 177-10	Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus	9.36.2.2.(1)
ASTM	C 212-00	Structural Clay Facing Tile	Table 5.10.1.1. 9.20.2.1.(1)
ASTM	C 260-06	Air-Entraining Admixtures for Concrete	9.3.1.8.(1)
ASTM	C 411-05	Hot-Surface Performance of High-Temperature Thermal Insulation	3.6.5.4.(4) 3.6.5.5.(1) 9.33.6.4.(4) 9.33.8.2.(2)
ASTM	C 412M-05a	Concrete Drain Tile (Metric)	Table 5.10.1.1. 9.14.3.1.(1)
ASTM	C 444M-03	Perforated Concrete Pipe (Metric)	Table 5.10.1.1. 9.14.3.1.(1)
ASTM	C 494/C 494M-08a	Chemical Admixtures for Concrete	9.3.1.8.(1)

Table 1.3.1.2. (Continued)

Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
ASTM	C 518-10	Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus	9.36.2.2.(1)
ASTM	C 553-02	Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications	Table 5.10.1.1.
ASTM	C 612-04	Mineral Fiber Block and Board Thermal Insulation	Table 5.10.1.1.
ASTM	C 700-07a	Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated	Table 5.10.1.1. 9.14.3.1.(1)
ASTM	C 834-05	Latex Sealants	Table 5.10.1.1. 9.27.4.2.(2)
ASTM	C 920-05	Elastomeric Joint Sealants	Table 5.10.1.1. 9.27.4.2.(2)
ASTM	C 954-07	Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness	9.24.1.4.(1)
ASTM	C 991-03	Flexible Fibrous Glass Insulation for Metal Buildings	Table 5.10.1.1.
ASTM	C 1002-07	Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs	Table 5.10.1.1. 9.24.1.4.(1) 9.29.5.7.(1)
ASTM	C 1177/C 1177M-08	Glass Mat Gypsum Substrate for Use as Sheathing	Table 5.10.1.1. Table 9.23.17.2.A.
ASTM	C 1178/C 1178M-08	Coated Glass Mat Water-Resistant Gypsum Backing Panel	Table 5.10.1.1. 9.29.5.2.(1)
ASTM	C 1184-05	Structural Silicone Sealants	Table 5.10.1.1. 9.27.4.2.(2)
ASTM	C 1311-02	Solvent Release Sealants	Table 5.10.1.1. 9.27.4.2.(2)
ASTM	C 1330-02	Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants	Table 5.10.1.1. 9.27.4.2.(3)
ASTM	C 1363-05	Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus	9.36.2.2.(4)
ASTM	C 1396/C 1396M-06a	Gypsum Board	3.1.5.12.(4) Table 5.10.1.1. Table 9.23.17.2.A. 9.29.5.2.(1) Table 9.29.5.3.
ASTM	D 323-08	Vapor Pressure of Petroleum Products (Reid Method)	1.4.1.2.(1)[4]
ASTM	D 2178-04	Asphalt Glass Felt Used in Roofing and Waterproofing	Table 5.10.1.1.
ASTM	D 2898-08	Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing	3.1.5.5.(5) 3.1.5.21.(1) 3.2.3.7.(4) 9.10.14.5.(3) 9.10.15.5.(3)
ASTM	E 90-04	Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements	5.9.1.1.(1) 9.11.1.1.(1)
ASTM	E 96/E 96M-05	Water Vapor Transmission of Materials	5.5.1.2.(3) 9.25.4.2.(1) 9.25.5.1.(1) 9.30.1.2.(1)
ASTM	E 336-05	Measurement of Airborne Sound Attenuation between Rooms in Buildings	5.9.1.1.(1) 9.11.1.1.(1)
ASTM	E 413-04	Classification for Rating Sound Insulation	5.9.1.1.(1) 9.11.1.1.(1)

Table 1.3.1.2. (Continued)

Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
ASTM	E 2190-08	Insulating Glass Unit Performance and Evaluation	Table 5.10.1.1. 9.6.1.2.(1)
ASTM	E 2357-11	Determining Air Leakage of Air Barrier Assemblies	9.36.2.9.(1)
ASTM	F 476-84	Security of Swinging Door Assemblies	9.7.5.2.(2)
ASTM	F 1667-05	Driven Fasteners: Nails, Spikes, and Staples	9.23.3.1.(1) 9.26.2.2.(1) 9.29.5.6.(1)
AWPA	M4-08	Care of Preservative-Treated Wood Products	4.2.3.2.(2) Table 5.10.1.1.
BNQ	NQ 3624-115/2007	Polyethylene (PE) Pipe and Fittings – Flexible Corrugated Pipes for Drainage – Characteristics and Test Methods	Table 5.10.1.1. 9.14.3.1.(1)
CCBFC	NRCC 54435	National Energy Code of Canada for Buildings 2011	9.36.1.3.(1) 9.36.1.3.(4) 9.36.3.1.(2) 9.36.4.1.(2)
CCBFC	NRCC 38732	National Farm Building Code of Canada 1995	1.1.1.1.(3)[4]
CCBFC	NRCC 53303	National Fire Code of Canada 2010	1.1.4.1.(1) 1.4.1.2.(1)[4] 2.1.1.2.(4)[4] 3.1.13.1.(1) 3.2.3.21.(1) 3.2.4.6.(1) 3.2.5.16.(1) 3.3.1.2.(1) 3.3.1.10.(1) 3.3.2.3.(1) 3.3.2.15.(1) 3.3.4.3.(4) 3.3.5.2.(1) 3.3.6.1.(1) 3.3.6.3.(1) 3.3.6.3.(2) 3.3.6.4.(1) 3.3.6.4.(2) 3.3.6.6.(1) 6.2.2.6.(1) 6.2.12.2.(3) 6.2.12.3.(1) 6.2.12.4.(1) 8.1.1.1.(3) 8.1.1.3.(1) 9.10.1.2.(1) 9.10.20.4.(1) 9.10.21.8.(1)
CCBFC	NRCC 53302	National Plumbing Code of Canada 2010	2.1.1.2.(4)[4] 5.6.2.2.(2) 7.1.2.1.(1) 9.31.6.2.(1)
CGSB	CAN/CGSB-1.501-M89	Method for Permeance of Coated Wallboard	5.5.1.2.(2) 9.25.4.2.(5)
CGSB	CAN/CGSB-7.2-94	Adjustable Steel Columns	9.17.3.4.(1)
CGSB	CAN/CGSB-10.3-92	Air Setting Refractory Mortar	9.21.3.4.(2) 9.21.3.9.(1) 9.22.2.2.(2)

Table 1.3.1.2. (Continued)

Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
CGSB	CAN/CGSB-11.3-M87	Hardboard	Table 5.10.1.1. 9.27.9.1.(2) 9.29.7.1.(1) 9.30.2.2.(1)
CGSB	CAN/CGSB-11.5-M87	Hardboard, Precoated, Factory Finished, for Exterior Cladding	Table 5.10.1.1. 9.27.9.1.(1)
CGSB	CAN/CGSB-12.1-M90	Tempered or Laminated Safety Glass	3.3.1.19.(2) 3.4.6.15.(1) 3.4.6.15.(3) Table 5.10.1.1. 9.6.1.2.(1) 9.6.1.4.(1) 9.8.8.7.(1)
CGSB	CAN/CGSB-12.2-M91	Flat, Clear Sheet Glass	Table 5.10.1.1. 9.6.1.2.(1)
CGSB	CAN/CGSB-12.3-M91	Flat, Clear Float Glass	Table 5.10.1.1. 9.6.1.2.(1)
CGSB	CAN/CGSB-12.4-M91	Heat Absorbing Glass	Table 5.10.1.1. 9.6.1.2.(1)
CGSB	CAN/CGSB-12.8-97	Insulating Glass Units	Table 5.10.1.1. 9.6.1.2.(1)
CGSB	CAN/CGSB-12.10-M76	Glass, Light and Heat Reflecting	Table 5.10.1.1. 9.6.1.2.(1)
CGSB	CAN/CGSB-12.11-M90	Wired Safety Glass	3.3.1.19.(2) 3.4.6.15.(1) 3.4.6.15.(3) Table 5.10.1.1. 9.6.1.2.(1) 9.6.1.4.(1) 9.8.8.7.(1)
CGSB	CAN/CGSB-12.20-M89	Structural Design of Glass for Buildings	4.3.6.1.(1) 9.6.1.3.(1)
CGSB	CAN/CGSB-19.22-M89	Mildew-Resistant Sealing Compound for Tubs and Tiles	9.29.10.5.(1)
CGSB	CAN/CGSB-34.22-94	Asbestos-Cement Drain Pipe	Table 5.10.1.1. 9.14.3.1.(1)
CGSB	CAN/CGSB-37.1-M89	Chemical Emulsifier Type, Emulsified Asphalt for Dampproofing	Table 5.10.1.1. 9.13.2.2.(1)
CGSB	CAN/CGSB-37.2-M88	Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings	Table 5.10.1.1. 9.13.2.2.(1) 9.13.3.2.(1)
CGSB	CAN/CGSB-37.3-M89	Application of Emulsified Asphalts for Dampproofing or Waterproofing	5.8.2.3.(1) Table 5.10.1.1. 9.13.2.3.(1) 9.13.3.3.(1)
CGSB	CAN/CGSB-37.4-M89	Fibrated, Cutback Asphalt, Lap Cement for Asphalt Roofing	Table 5.10.1.1. 9.26.2.1.(1)
CGSB	CAN/CGSB-37.5-M89	Cutback Asphalt Plastic, Cement	Table 5.10.1.1. 9.26.2.1.(1)
CGSB	37-GP-6Ma-1983	Asphalt, Cutback, Unfilled, for Dampproofing	5.8.2.2.(6) 5.8.2.2.(7) Table 5.10.1.1. 9.13.2.2.(1)
CGSB	CAN/CGSB-37.8-M88	Asphalt, Cutback, Filled, for Roof Coating	Table 5.10.1.1. 9.26.2.1.(1)

Table 1.3.1.2. (Continued)

Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
CGSB	37-GP-9Ma-1983	Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing	Table 5.10.1.1. 9.26.2.1.(1)
CGSB	37-GP-12Ma-1984	Application of Unfilled Cutback Asphalt for Dampproofing	5.8.2.3.(2) Table 5.10.1.1. 9.13.2.3.(1)
CGSB	CAN/CGSB-37.16-M89	Filled, Cutback Asphalt for Dampproofing and Waterproofing	Table 5.10.1.1. 9.13.2.2.(1) 9.13.3.2.(1)
CGSB	37-GP-18Ma-1985	Tar, Cutback, Unfilled, for Dampproofing	5.8.2.2.(6) 5.8.2.2.(7) Table 5.10.1.1. 9.13.2.2.(1)
CGSB	37-GP-21M-1985	Tar, Cutback, Fibrated, for Roof Coating	Table 5.10.1.1. 9.26.2.1.(1)
CGSB	CAN/CGSB-37.22-M89	Application of Unfilled, Cutback Tar Foundation Coating for Dampproofing	5.8.2.3.(2) Table 5.10.1.1. 9.13.2.3.(1)
CGSB	37-GP-36M-1976	Application of Filled Cutback Asphalts for Dampproofing and Waterproofing	5.8.2.3.(1) Table 5.10.1.1.
CGSB	37-GP-37M-1977	Application of Hot Asphalt for Dampproofing or Waterproofing	5.8.2.3.(1) Table 5.10.1.1.
CGSB	CAN/CGSB-37.50-M89	Hot-Applied, Rubberized Asphalt for Roofing and Waterproofing	Table 5.10.1.1. 9.26.2.1.(1)
CGSB	CAN/CGSB-37.51-M90	Application for Hot-Applied Rubberized Asphalt for Roofing and Waterproofing	5.6.1.2.(1) 5.8.2.3.(1) Table 5.10.1.1. 9.26.15.1.(1)
CGSB	37-GP-52M-1984	Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric	Table 5.10.1.1. 9.26.2.1.(1)
CGSB	CAN/CGSB-37.54-95	Polyvinyl Chloride Roofing and Waterproofing Membrane	Table 5.10.1.1. 9.26.2.1.(1)
CGSB	37-GP-55M-1979	Application of Sheet Applied Flexible Polyvinyl Chloride Roofing Membrane	5.6.1.2.(1) Table 5.10.1.1. 9.26.16.1.(1)
CGSB	37-GP-56M-1985	Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing	Table 5.10.1.1. 9.26.2.1.(1)
CGSB	37-GP-64M-1977	Mat Reinforcing, Fibrous Glass, for Membrane Waterproofing Systems and Built-Up Roofing	Table 5.10.1.1.
CGSB	41-GP-6M-1983	Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced	Table 5.10.1.1. 9.26.2.1.(1)
CGSB	CAN/CGSB-41.24-95	Rigid Vinyl Siding, Soffits and Fascia	Table 5.10.1.1. 9.27.12.1.(1)
CGSB	CAN/CGSB-51.25-M87	Thermal Insulation, Phenolic, Faced	Table 9.23.17.2.A. 9.25.2.2.(1)
CGSB	51-GP-27M-1979	Thermal Insulation, Polystyrene, Loose Fill	9.25.2.2.(1)
CGSB	CAN/CGSB-51.32-M77	Sheathing, Membrane, Breather Type	Table 5.10.1.1. 9.20.13.9.(1) 9.26.2.1.(1) 9.27.3.2.(1)
CGSB	CAN/CGSB-51.33-M89	Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction	Table 5.10.1.1. 9.25.4.2.(4)

Table 1.3.1.2. (Continued)

Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
CGSB	CAN/CGSB-51.34-M86	Vapour Barrier, Polyethylene Sheet for Use in Building Construction	Table 5.10.1.1. 9.13.2.2.(1) 9.18.6.2.(1) 9.25.3.2.(2) 9.25.3.6.(1) 9.25.4.2.(3)
CGSB	CAN/CGSB-51.71-95	The Spillage Test: Method to Determine the Potential for Pressure-Induced Spillage from Vented, Fuel-Fired, Space Heating Applicances, Water Heaters and Fireplaces	9.32.3.8.(7)
CGSB	CAN/CGSB-82.6-M86	Doors, Mirrored Glass, Sliding or Folding, Wardrobe	9.6.1.2.(2)
CGSB	CAN/CGSB-93.1-M85	Sheet, Aluminum Alloy, Prefinished, Residential	Table 5.10.1.1. 9.27.11.1.(4)
CGSB	CAN/CGSB-93.2-M91	Prefinished Aluminum Siding, Soffits, and Fascia, for Residential Use	3.2.3.6.(4) Table 5.10.1.1. 9.10.14.5.(8) 9.10.14.5.(11) 9.10.15.5.(7) 9.10.15.5.(10) 9.27.11.1.(3)
CGSB	CAN/CGSB-93.3-M91	Prefinished Galvanized and Aluminum-Zinc Alloy Steel Sheet for Residential Use	Table 5.10.1.1. 9.27.11.1.(2)
CGSB	CAN/CGSB-93.4-92	Galvanized Steel and Aluminum-Zinc Alloy Coated Steel Siding, Soffits and Fascia, Prefinished, Residential	Table 5.10.1.1. 9.27.11.1.(1)
CGSB	CAN/CGSB-149.10-M86	Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method	9.36.5.10.(11)
CSA	CAN/CSA-6.19-01	Residential Carbon Monoxide Alarming Devices	6.2.4.1.(2) 9.32.3.9.(2) 9.32.3.9.(3)
CSA	A23.1-09	Concrete Materials and Methods of Concrete Construction	4.2.3.6.(1) 4.2.3.9.(1) Table 5.10.1.1. 9.3.1.1.(1) 9.3.1.1.(4) 9.3.1.3.(1) 9.3.1.4.(1)
CSA	CAN/CSA-A23.3-04	Design of Concrete Structures	Table 4.1.8.9. 4.3.3.1.(1)
CSA	CAN/CSA-A82.1-M87	Burned Clay Brick (Solid Masonry Units Made from Clay or Shale)	Table 5.10.1.1. 9.20.2.1.(1)
CSA	A82.4-M1978	Structural Clay Load-Bearing Wall Tile	Table 5.10.1.1. 9.20.2.1.(1)
CSA	A82.5-M1978	Structural Clay Non-Load-Bearing Tile	Table 5.10.1.1. 9.20.2.1.(1)
CSA	CAN3-A82.8-M78	Hollow Clay Brick	Table 5.10.1.1. 9.20.2.1.(1)
CSA	CAN/CSA-A82.27-M91	Gypsum Board	3.1.5.12.(4) Table 5.10.1.1. Table 9.23.17.2.A. 9.29.5.2.(1)
CSA	A82.30-M1980	Interior Furring, Lathing and Gypsum Plastering	Table 5.10.1.1. 9.29.4.1.(1)

Table 1.3.1.2. (Continued)

Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
CSA	A82.31-M1980	Gypsum Board Application	3.2.3.6.(4) Table 5.10.1.1. 9.10.9.2.(4) 9.10.12.4.(3) 9.10.14.5.(8) 9.10.14.5.(11) 9.10.15.5.(7) 9.10.15.5.(10) 9.29.5.1.(2)
CSA	CAN3-A93-M82	Natural Airflow Ventilators for Buildings	Table 5.10.1.1. 9.19.1.2.(5)
CSA	A123.1-05/A123.5-05	Asphalt Shingles Made From Organic Felt and Surfaced with Mineral Granules/Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules	Table 5.10.1.1. 9.26.2.1.(1)
CSA	CAN/CSA-A123.2-03	Asphalt-Coated Roofing Sheets	Table 5.10.1.1. 9.26.2.1.(1)
CSA	A123.3-05	Asphalt Saturated Organic Roofing Felt	Table 5.10.1.1. 9.26.2.1.(1)
CSA	CAN/CSA-A123.4-04	Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems	Table 5.10.1.1. 9.13.2.2.(1) 9.13.3.2.(1) 9.26.2.1.(1)
CSA	A123.17-05	Asphalt Glass Felt Used in Roofing and Waterproofing	Table 5.10.1.1. 9.26.2.1.(1)
CSA	CAN3-A123.51-M85	Asphalt Shingle Application on Roof Slopes 1:3 and Steeper	5.6.1.2.(1) Table 5.10.1.1. 9.26.1.2.(1)
CSA	CAN3-A123.52-M85	Asphalt Shingle Application on Roof Slopes 1:6 to Less Than 1:3	5.6.1.2.(1) Table 5.10.1.1. 9.26.1.2.(1)
CSA	CAN/CSA-A165.1-04	Concrete Block Masonry Units	Table 5.10.1.1. 9.15.2.2.(1) 9.17.5.1.(1) 9.20.2.1.(1) 9.20.2.6.(1)
CSA	CAN/CSA-A165.2-04	Concrete Brick Masonry Units	Table 5.10.1.1. 9.20.2.1.(1)
CSA	CAN/CSA-A165.3-04	Prefaced Concrete Masonry Units	Table 5.10.1.1. 9.20.2.1.(1)
CSA	CAN3-A165.4-M85	Autoclaved Cellular Units	Table 5.10.1.1. 9.20.2.1.(1)
CSA	CAN/CSA-A179-04	Mortar and Grout for Unit Masonry	Table 5.10.1.1. 9.15.2.2.(3) 9.20.3.1.(1)
CSA	CAN/CSA-A220.0-06	Performance of Concrete Roof Tiles	Table 5.10.1.1. 9.26.2.1.(1)
CSA	CAN/CSA-A220.1-06	Installation of Concrete Roof Tiles	Table 5.10.1.1. 9.26.17.1.(1)
CSA	CAN/CSA-A324-M88	Clay Flue Liners	9.21.3.3.(1)
CSA	CAN/CSA-A371-04	Masonry Construction for Buildings	5.6.1.2.(2) Table 5.10.1.1. 9.15.2.2.(3) 9.20.3.2.(7) 9.20.15.2.(1)

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Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
CSA	CAN/CSA-A405-M87	Design and Construction of Masonry Chimneys and Fireplaces	9.21.3.5.(1) 9.22.1.4.(1) 9.22.5.2.(2)
CSA	AAMA/WDMA/CSA 101/I.S.2/A440-08	NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights	5.10.2.2.(1) 5.10.2.2.(3) Table 9.7.3.3. 9.7.4.1.(1) 9.7.4.2.(1) 9.7.4.3.(2) 9.7.5.1.(1) 9.7.5.3.(1) 9.36.2.9.(3)
CSA	A440.2-09/A440.3-09	Fenestration Energy Performance/User Guide to CSA A440.2-09, Fenestration Energy Performance	Table 9.7.3.3. 9.36.2.2.(3)
CSA	CAN/CSA-A440.4-07	Window, Door, and Skylight Installation	9.7.6.1.(1)
CSA	A440S1-09	Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights	5.10.2.2.(1) 9.7.4.2.(1) 9.36.2.9.(3)
CSA	CAN/CSA-A660-04	Certification of Manufacturers of Steel Building Systems	4.3.4.3.(1)
CSA	CAN/CSA-A3001-08	Cementitious Materials for Use in Concrete	Table 5.10.1.1. 9.3.1.2.(1) 9.28.2.1.(1)
CSA	B51-09	Boiler, Pressure Vessel, and Pressure Piping Code	6.2.1.4.(1) 9.31.6.2.(2) 9.33.5.2.(1)
CSA	B52-05	Mechanical Refrigeration Code	6.2.1.4.(1) 9.33.5.2.(1)
CSA	CAN/CSA-B72-M87	Installation Code for Lightning Protection Systems	6.3.1.4.(1)
CSA	B111-1974	Wire Nails, Spikes and Staples	9.23.3.1.(1) 9.26.2.2.(1) 9.29.5.6.(1)
CSA	B139-04	Installation Code for Oil-Burning Equipment	6.2.1.4.(1) 9.31.6.2.(2) 9.33.5.2.(1)
CSA	B140.12-03	Oil-Burning Equipment: Service Water Heaters for Domestic Hot Water, Space Heating, and Swimming Pools	Table 9.36.4.2.
CSA	CAN/CSA-B149.1-05	Natural Gas and Propane Installation Code	6.2.1.4.(1) 9.10.22.1.(1) 9.31.6.2.(2) 9.33.5.2.(1)
CSA	CAN/CSA-B182.1-06	Plastic Drain and Sewer Pipe and Pipe Fittings	Table 5.10.1.1. 9.14.3.1.(1)
CSA	CAN/CSA-B211-00	Energy Efficiency of Oil-Fired Storage Tank Water Heaters	Table 9.36.4.2.
CSA	B212-00	Energy Utilization Efficiencies of Oil-Fired Furnaces and Boilers	9.36.3.10.
CSA	CAN/CSA-B214-07	Installation Code for Hydronic Heating Systems	6.2.1.1.(1) 9.33.4.2.(1)
CSA	CAN/CSA-B355-00	Lifts for Persons with Physical Disabilities	3.8.3.5.(1)
CSA	CAN/CSA-B365-01	Installation Code for Solid-Fuel-Burning Appliances and Equipment	6.2.1.4.(1) 9.22.10.2.(1) 9.31.6.2.(2) 9.33.5.3.(1)
CSA	B415.1-10	Solid-Fuel-Burning Heating Appliances	Table 9.36.3.10.

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Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
CSA	C22.1-09	Canadian Electrical Code, Part I	3.3.6.2.(4) 3.6.1.2.(1) 3.6.2.1.(6) 3.6.2.7.(1) 6.2.1.4.(1) 9.31.6.2.(2) 9.33.5.2.(1) 9.34.1.1.(1)
CSA	C22.2 No. 0.3-01	Test Methods for Electrical Wires and Cables	3.1.4.3.(1) 3.1.4.3.(2) 3.1.5.18.(1) 3.1.5.18.(3) 9.34.1.5.(1)
CSA	C22.2 No. 113-M1984	Fans and Ventilators	9.32.3.10.(7)
CSA	C22.2 No. 141-10	Emergency Lighting Equipment	3.2.7.4.(2) 3.4.5.1.(3) 9.9.11.3.(3) 9.9.12.3.(7)
CSA	C22.2 No. 211.0-03	General Requirements and Methods of Testing for Nonmetallic Conduit	3.1.5.20.(1)
CSA	CAN/CSA-C22.2 No. 262-04	Optical Fiber Cable and Communication Cable Raceway Systems	3.1.5.20.(1)
CSA	CAN/CSA-C191-04	Electric Storage Tank Water Heaters for Domestic Hot Water Service	Table 9.36.4.2.
CSA	CAN/CSA-C260-M90	Rating the Performance of Residential Mechanical Ventilating Equipment	9.32.3.10.(1) 9.32.3.10.(2) Table 9.32.3.10.B.
CSA	CAN/CSA-C282-05	Emergency Electrical Power Supply for Buildings	3.2.7.5.(1)
CSA	CAN/CSA-C368.1-M90	Room Air Conditioners	9.36.3.10.
CSA	CAN/CSA-C439-00	Rating the Performance of Heat/Energy-Recovery Ventilators	9.32.3.10.(4) 9.32.3.10.(5) 9.36.3.8.(4) 9.36.3.9.(3)
CSA	CAN/CSA-C448 Series-02	Design and Installation of Earth Energy Systems	9.33.5.2.(1)
CSA	CAN/CSA-C656-05	Split-System and Single-Package Central Air Conditioners and Heat Pumps	Table 9.36.3.10.
CSA	CAN/CSA-C745-03	Energy Efficiency of Electric Storage Tank Water Heaters and Heat Pump Water Heaters	Table 9.36.4.2.
CSA	CAN/CSA-C746-06	Rating Large and Single Packaged Vertical Air Conditioners and Heat Pumps	Table 9.36.3.10.
CSA	C748-94	Direct-Expansion (DX) Ground-Source Heat Pumps	Table 9.36.3.10.
CSA	CAN/CSA-C749-07	Performance of Dehumidifiers	Table 9.36.3.10.
CSA	CAN/CSA-C828-06	Thermostats Used with Individual Room Electric Space Heating Devices	9.36.3.6.(3)
CSA	CAN/CSA-C13256-1-01	Water-Source Heat Pumps - Testing and Rating for Performance - Part 1: Water-to-Air and Brine-to-Air Heat Pumps (Adopted ISO 13256-1:1998, with Canadian Deviations)	Table 9.36.3.10.
CSA	CAN/CSA-C13256-2-01	Water-Source Heat Pumps - Testing and Rating for Performance - Part 2: Water-to-Water and Brine-to-Water Heat Pumps (Adopted ISO 13256-2: 1998, with Canadian Deviations)	Table 9.36.3.10.
CSA	CAN/CSA-F280-M90	Determining the Required Capacity of Residential Space Heating and Cooling Appliances	9.33.5.1.(1)
CSA	CAN/CSA-F326-M91	Residential Mechanical Ventilation Systems	9.32.3.1.(1)
CSA	CAN/CSA-G30.18-M92	Billet-Steel Bars for Concrete Reinforcement	9.3.1.1.(4)

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CSA	CAN/CSA-G40.21-04	General Requirements for Rolled or Welded Structural Quality Steel	4.2.3.8.(1) Table 5.10.1.1. 9.23.4.3.(2)
CSA	CAN/CSA-G401-07	Corrugated Steel Pipe Products	Table 5.10.1.1. 9.14.3.1.(1)
CSA	CAN/CSA-O80 Series-08	Wood Preservation	3.1.4.5.(1) 4.2.3.2.(1) 4.2.3.2.(2) Table 5.10.1.1.
CSA	CAN/CSA-O80.1-08	Specification of Treated Wood	9.3.2.9.(5)
CSA	CAN/CSA-O80.2-08	Processing and Treatment	4.2.3.2.(1)
CSA	CAN/CSA-O80.3-08	Preservative Formulations	4.2.3.2.(1)
CSA	O80.15-97	Preservative Treatment of Wood for Building Foundation Systems, Basements, and Crawl Spaces by Pressure Processes	4.2.3.2.(1)
CSA	O86-09	Engineering Design in Wood	Table 4.1.8.9. 4.3.1.1.(1)
CSA	O115-M1982	Hardwood and Decorative Plywood	Table 5.10.1.1. 9.27.8.1.(1) 9.30.2.2.(1)
CSA	O118.1-08	Western Red Cedar Shakes and Shingles	Table 5.10.1.1. 9.26.2.1.(1) 9.27.7.1.(1)
CSA	O118.2-08	Eastern White Cedar Shingles	Table 5.10.1.1. 9.26.2.1.(1) 9.27.7.1.(1)
CSA	O121-08	Douglas Fir Plywood	Table 5.10.1.1. 9.23.15.2.(1) 9.23.16.2.(1) Table 9.23.17.2.A. 9.27.8.1.(1) 9.30.2.2.(1) Table A-13 Table A-14 Table A-15
CSA	CAN/CSA-O122-06	Structural Glued-Laminated Timber	Table A-11 Table A-16
CSA	CAN/CSA-O132.2 Series-90	Wood Flush Doors	9.7.4.3.(4)
CSA	O141-05	Softwood Lumber	Table 5.10.1.1. 9.3.2.6.(1)
CSA	O151-09	Canadian Softwood Plywood	Table 5.10.1.1. 9.23.15.2.(1) 9.23.16.2.(1) Table 9.23.17.2.A. 9.27.8.1.(1) 9.30.2.2.(1) Table A-13 Table A-14 Table A-15
CSA	O153-M1980	Poplar Plywood	Table 5.10.1.1. 9.23.15.2.(1) 9.23.16.2.(1) Table 9.23.17.2.A. 9.27.8.1.(1) 9.30.2.2.(1)

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Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
CSA	O177-06	Qualification Code for Manufacturers of Structural Glued-Laminated Timber	4.3.1.2.(1) Table A-11 Table A-16
CSA	CAN/CSA-O325-07	Construction Sheathing	Table 5.10.1.1. Table 9.23.13.6. 9.23.15.2.(1) 9.23.15.4.(2) Table 9.23.15.5.B. 9.23.16.2.(1) 9.23.16.3.(2) Table 9.23.16.7.B. Table 9.23.17.2.B. 9.29.9.1.(2) 9.29.9.2.(5) Table A-13 Table A-14 Table A-15
CSA	O437.0-93	OSB and Waferboard	Table 5.10.1.1. 9.23.15.2.(1) 9.23.15.4.(2) 9.23.16.2.(1) 9.23.16.3.(2) Table 9.23.17.2.A. 9.27.10.1.(1) 9.29.9.1.(2) 9.30.2.2.(1) Table A-13 Table A-14 Table A-15
CSA	CAN/CSA-P.2-07	Measuring the Annual Fuel Utilization Efficiency of Residential Gas-Fired Furnaces and Boilers	Table 9.36.3.10.
CSA	CAN/CSA-P.3-04	Measuring Energy Consumption and Determining Efficiencies of Gas-Fired Storage Water Heaters	Table 9.36.4.2.
CSA	P.6-09	Measuring Thermal Efficiency of Gas-Fired Pool Heaters	Table 9.36.4.2.
CSA	CAN/CSA-P.7-10	Measuring Energy Loss of Gas-Fired Instantaneous Water Heaters	Table 9.36.4.2.
CSA	CAN/CSA-P.8-09	Thermal Efficiencies of Industrial and Commercial Gas-Fired Package Furnaces	Table 9.36.3.10.
CSA	CAN/CSA-P.9-11	Performance of Combined Space and Water Heating Systems (Combos)	Table 9.36.3.10. 9.36.3.10.(3) Table 9.36.4.2. Table 9.36.5.15.C.
CSA	P.10-07	Performance of Integrated Mechanical Systems for Residential Heating and Ventilation	9.36.3.9.(2) Table 9.36.3.10. Table 9.36.4.2. Table 9.36.5.15.C.
CSA	CAN/CSA-P.11-07	Measuring Efficiency and Energy Consumption of Gas-Fired Unit Heaters	Table 9.36.3.10.
CSA	S16-09	Design of Steel Structures	Table 4.1.8.9. 4.3.4.1.(1)
CSA	CAN/CSA-S136-07	North American Specification for the Design of Cold-Formed Steel Structural Members (using the Appendix B provisions applicable to Canada)	Table 4.1.8.9. 4.3.4.2.(1)
CSA	CAN/CSA-S157-05/S157.1-05	Strength Design in Aluminum/Commentary on CSA S157-05, Strength Design in Aluminum	4.3.5.1.(1)
CSA	S269.1-1975	Falsework for Construction Purposes	4.1.1.3.(4)
CSA	CAN/CSA-S269.2-M87	Access Scaffolding for Construction Purposes	4.1.1.3.(4)

Table 1.3.1.2. (Continued)

Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
CSA	CAN/CSA-S269.3-M92	Concrete Formwork	4.1.1.3.(4)
CSA	S304.1-04	Design of Masonry Structures	Table 4.1.8.9. 4.3.2.1.(1)
CSA	S307-M1980	Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings	9.23.14.11.(5)
CSA	S367-09	Air-, Cable-, and Frame-Membrane Supported Structures	4.4.1.1.(1)
CSA	CAN/CSA-S406-92	Construction of Preserved Wood Foundations	9.15.2.4.(1) 9.16.5.1.(1)
CSA	S413-07	Parking Structures	4.4.2.1.(1)
CSA	Z32-04	Electrical Safety and Essential Electrical Systems in Health Care Facilities	3.2.7.3.(4) 3.2.7.6.(1)
CSA	Z240.2.1-09	Structural Requirements for Manufactured Homes	9.12.2.2.(6) 9.15.1.3.(1)
CSA	Z240.10.1-08	Site Preparation, Foundation, and Anchorage of Manufactured Homes	9.15.1.3.(1) 9.23.6.3.(1)
CSA	CAN/CSA-Z317.2-01	Special Requirements for Heating, Ventilation, and Air Conditioning (HVAC) Systems in Health Care Facilities	6.2.1.1.(1)
CSA	Z662-07	Oil and Gas Pipeline Systems	3.2.3.22.(1)
CSA	Z7396.1-06	Medical Gas Pipeline Systems – Part 1: Pipelines for Medical Gases and Vacuum	3.7.3.1.(1)
CTI	201(04)	Certification of Water-Cooling Tower Thermal Performance	Table 9.36.3.10.
CWC	2009	Engineering Guide for Wood Frame Construction	9.4.1.1.(1) 9.23.13.1.(2) 9.23.13.2.(2) 9.23.13.3.(2)
DOE	10 CFR, Part 430-2011	Energy, Energy Conservation Program for Consumer Products	Table 9.36.4.2.
DOE	10 CFR, Part 431-2011	Energy, Energy Efficiency Program for Certain Commercial and Industrial Equipment	Table 9.36.4.2.
EC	CEPA 1988	Canadian Environmental Protection Act, Section 8, Part 1	6.2.1.7.(2)
EPA	625/R-92/016 (1994)	Radon Prevention in the Design and Construction of Schools and Other Large Buildings	6.2.1.1.(1)
EPA	40 CFR, Part 60-2008	Protection of Environment, Standards of Performance for New Stationary Sources	Table 9.36.3.10.
HVI	HVI 915	Procedure for Loudness Rating of Residential Fan Products	9.32.3.10.(2) Table 9.32.3.10.B.
HVI	HVI 916	Airflow Test Standard	9.32.3.10.(1)
ICC	400-2007	Design and Construction of Log Structures	9.36.2.2.(5)
ISO	3864-1:2002	Graphical symbols – Safety colours and safety signs – Part 1: Design principles for safety signs in workplaces and public areas	3.4.5.1.(2) 9.9.11.3.(2)
ISO	7010:2003	Graphical symbols – Safety colours and safety signs – Safety signs used in workplaces and public areas	3.4.5.1.(2) 9.9.11.3.(2)
ISO	8201:1987(E)	Acoustics – Audible emergency evacuation signal	3.2.4.19.(2)
NFPA	13-2007	Installation of Sprinkler Systems	3.1.9.1.(4) 3.2.4.9.(2) 3.2.4.16.(1) 3.2.5.12.(1) 3.3.2.13.(3) 9.10.9.6.(11)

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Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
NFPA	13D-2007	Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes	3.2.4.1.(2) 3.2.5.12.(3) 9.10.18.2.(3)
NFPA	13R-2007	Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height	3.2.5.12.(2)
NFPA	14-2007	Installation of Standpipe and Hose Systems	3.2.5.9.(1) 3.2.5.10.(1)
NFPA	20-2007	Installation of Stationary Pumps for Fire Protection	3.2.4.10.(4) 3.2.5.18.(1)
NFPA	68-2007	Explosion Protection by Deflagration Venting	3.3.6.4.(2)
NFPA	80-2007	Fire Doors and Other Opening Protectives	3.1.8.5.(2) 3.1.8.10.(2) 3.1.8.14.(1) 3.1.9.1.(5) 9.10.9.6.(13) 9.10.13.1.(1)
NFPA	82-2009	Incinerators and Waste and Linen Handling Systems and Equipment	6.2.6.1.(1) 9.10.10.5.(2)
NFPA	91-2004	Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids	6.2.12.3.(1)
NFPA	96-2008	Ventilation Control and Fire Protection of Commercial Cooking Operations	3.2.4.9.(2) 6.2.2.7.(1)
NFPA	101-2009	Life Safety Code	3.3.2.1.(2) 3.3.2.1.(3)
NFPA	211-2006	Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances	6.3.1.2.(2) 6.3.1.3.(1)
NFPA	214-2005	Water-Cooling Towers	6.2.3.14.(3)
NFRC	100-2010	Determining Fenestration Product U-factors	9.36.2.2.(3)
NFRC	200-2010	Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence	9.36.2.2.(3)
NLGA	2007	Standard Grading Rules for Canadian Lumber	9.3.2.1.(1)
SMACNA	ANSI/SMACNA 006-2006	HVAC Duct Construction Standards – Metal and Flexible	9.33.6.5.(2)
TC		Canadian Aviation Regulations – Part III	4.1.5.13.(1)
TPIC	2007	Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses	9.23.14.11.(6)
UL	ANSI/UL 300-2005	Fire Testing of Fire Extinguishing Systems for Protection of Commercial Cooking Equipment	6.2.2.7.(2)
UL	731-1995	Oil-Fired Unit Heaters	Table 9.36.3.10.
ULC	CAN/ULC-S101-07	Fire Endurance Tests of Building Construction and Materials	3.1.5.12.(3) 3.1.5.12.(4) 3.1.5.12.(6) 3.1.7.1.(1) 3.1.11.7.(1) 3.2.3.8.(1) 3.2.6.5.(6) 9.10.16.3.(1)
ULC	CAN/ULC-S102-07	Test for Surface Burning Characteristics of Building Materials and Assemblies	3.1.5.21.(1) 3.1.12.1.(1)
ULC	CAN/ULC-S102.2-07	Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies	3.1.12.1.(2) 3.1.13.4.(1)
ULC	CAN/ULC-S102.3-07	Fire Test of Light Diffusers and Lenses	3.1.13.4.(1)

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Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
ULC	CAN/ULC-S102.4-07	Fire and Smoke Characteristics of Electrical Wiring and Cables	3.1.5.18.(2) 3.1.5.20.(2)
ULC	CAN4-S104-M80	Fire Tests of Door Assemblies	3.1.8.4.(1) 3.2.6.5.(3)
ULC	CAN4-S105-M85	Fire Door Frames Meeting the Performance Required by CAN4-S104	9.10.13.6.(1)
ULC	CAN4-S106-M80	Fire Tests of Window and Glass Block Assemblies	3.1.8.4.(1)
ULC	CAN/ULC-S107-03	Fire Tests of Roof Coverings	3.1.15.1.(1)
ULC	CAN/ULC-S109-03	Flame Tests of Flame-Resistant Fabrics and Films	3.1.6.5.(1) 3.1.16.1.(1) 3.6.5.2.(2) 3.6.5.3.(1) 9.33.6.3.(1)
ULC	CAN/ULC-S110-07	Test for Air Ducts	3.6.5.1.(2) 3.6.5.1.(5) 9.33.6.2.(2) 9.33.6.2.(4)
ULC	ULC-S111-07	Fire Tests for Air Filter Units	6.2.3.13.(1) 9.33.6.14.(1)
ULC	CAN/ULC-S112-M90	Fire Test of Fire-Damper Assemblies	3.1.8.4.(1)
ULC	CAN/ULC-S112.1-M90	Leakage Rated Dampers for Use in Smoke Control Systems	6.2.3.9.(3)
ULC	CAN/ULC-S113-07	Wood Core Doors Meeting the Performance Required by CAN/ULC-S104 for Twenty Minute Fire Rated Closure Assemblies	9.10.13.2.(1)
ULC	CAN/ULC-S114-05	Test for Determination of Non-Combustibility in Building Materials	1.4.1.2.(1)[4]
ULC	CAN/ULC-S115-05	Fire Tests of Firestop Systems	3.1.5.16.(3) 3.1.9.1.(1) 3.1.9.1.(2) 3.1.9.1.(3) 3.1.9.4.(4) 9.10.9.6.(2) 9.10.9.7.(3)
ULC	CAN/ULC-S124-06	Test for the Evaluation of Protective Coverings for Foamed Plastic	3.1.5.12.(2)
ULC	CAN/ULC-S126-06	Test for Fire Spread Under Roof-Deck Assemblies	3.1.14.1.(1) 3.1.14.2.(1)
ULC	CAN/ULC-S134-92	Fire Test of Exterior Wall Assemblies	3.1.5.5.(1) 3.2.3.7.(3) 9.10.14.5.(2) 9.10.15.5.(2) 9.10.15.5.(3)
ULC	ULC-S135-04	Test Method for the Determination of Combustibility Parameters of Building Materials Using an Oxygen Consumption Calorimeter (Cone Calorimeter)	3.1.5.1.(2)
ULC	CAN/ULC-S138-06	Test for Fire Growth of Insulated Building Panels in a Full-Scale Room Configuration	3.1.5.12.(7)
ULC	ULC-S139-00	Fire Test for Evaluation of Integrity of Electrical Cables	3.2.7.10.(2) 3.2.7.10.(3)
ULC	CAN/ULC-S143-09	Fire Tests for Non-Metallic Electrical and Optical Fibre Cable Raceway Systems	3.1.5.20.(1)
ULC	ULC-S505-1974	Fusible Links for Fire Protection Service	3.1.8.9.(1)

Table 1.3.1.2. (Continued)

Issuing Agency	Document Number[1][2]	Title of Document[3]	Code Reference
ULC	CAN/ULC-S524-06	Installation of Fire Alarm Systems	3.1.8.12.(2) 3.1.8.12.(3) 3.2.4.5.(1) 3.2.4.21.(7) 3.2.4.21.(12) 9.10.19.4.(3) 9.10.19.6.(2)
ULC	CAN/ULC-S531-02	Smoke-Alarms	3.2.4.21.(1) 9.10.19.1.(1)
ULC	CAN/ULC-S537-04	Verification of Fire Alarm Systems	3.2.4.5.(2)
ULC	CAN/ULC-S553-02	Installation of Smoke-Alarms	3.2.4.21.(10) 9.10.19.3.(2)
ULC	CAN/ULC-S561-03	Installation and Services for Fire Signal Receiving Centres and Systems	3.2.4.8.(4)
ULC	CAN/ULC-S572-10	Photoluminescent and Self-Luminous Signs and Path Marking Systems	3.4.5.1.(3) 3.4.5.1.(4) 9.9.11.3.(3) 9.9.11.3.(4)
ULC	CAN/ULC-S610-M87	Factory-Built Fireplaces	9.22.8.1.(1)
ULC	ULC-S628-93	Fireplace Inserts	9.22.10.1.(1)
ULC	CAN/ULC-S629-M87	650°C Factory-Built Chimneys	9.33.10.2.(1)
ULC	CAN/ULC-S639-M87	Steel Liner Assemblies for Solid-Fuel Burning Masonry Fireplaces	9.22.2.3.(1)
ULC	CAN/ULC-S701-05	Thermal Insulation, Polystyrene, Boards and Pipe Covering	Table 5.10.1.1. 9.15.4.1.(1) Table 9.23.17.2.A. 9.25.2.2.(1)
ULC	CAN/ULC-S702-09	Mineral Fibre Thermal Insulation for Buildings	Table 5.10.1.1. Table 9.23.17.2.A. 9.25.2.2.(1)
ULC	CAN/ULC-S703-01	Cellulose Fibre Insulation (CFI) for Buildings	Table 5.10.1.1. 9.25.2.2.(1)
ULC	CAN/ULC-S704-03	Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced	Table 5.10.1.1. Table 9.23.17.2.A. 9.25.2.2.(1)
ULC	CAN/ULC-S705.1-01	Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Material - Specification	Table 5.10.1.1. 9.25.2.2.(1)
ULC	CAN/ULC-S705.2-05	Thermal Insulation – Spray-Applied Rigid Polyurethane Foam, Medium Density — Application	5.3.1.3.(3) Table 5.10.1.1. 9.25.2.5.(1)
ULC	CAN/ULC-S706-02	Wood Fibre Thermal Insulation for Buildings	Table 5.10.1.1. 9.23.16.7.(3) Table 9.23.17.2.A. 9.25.2.2.(1) 9.29.8.1.(1)
ULC	CAN/ULC-S710.1-05	Thermal Insulation – Bead-Applied One Component Polyurethane Air Sealant Foam, Part 1: Material Specification	9.36.2.10.(6)
ULC	CAN/ULC-S711.1-05	Thermal Insulation – Bead-Applied Two Component Polyurethane Air Sealant Foam, Part 1: Material Specification	9.36.2.10.(6)
ULC	CAN/ULC-S741-08	Air Barrier Materials – Specification	5.4.1.2.(1) 9.36.2.10.(1)
ULC	CAN/ULC-S742-11	Air Barrier Assemblies – Specification	9.36.2.9.(1)
ULC	ULC/ORD-C199P-2002	Combustible Piping for Sprinkler Systems	3.2.5.13.(2) 3.2.5.13.(5)

Table 1.3.1.2. (Continued)

Issuing Agency	Document Number(1)(2)	Title of Document(3)	Code Reference
ULC	ULC/ORD-C1254.6-1995	Fire Testing of Restaurant Cooking Area Fire Extinguishing System Units	6.2.2.7.(2)
US Congress		National Appliance Energy Conservation Act of 1987	Table 9.36.4.2. Table 9.36.5.16.

Notes to Table 1.3.1.2.:

(1) Some documents may have been reaffirmed or reapproved. Check with the applicable issuing agency for up-to-date information.

(2) Some documents referenced in the energy efficiency provisions in Section 9.36. were published after the date specified in Sentence 1.3.1.1.(1).

(3) Some titles have been abridged to omit superfluous wording.

(4) Code reference is in Division A.

1.3.2. Organizations

1.3.2.1. Abbreviations of Proper Names

1) The abbreviations of proper names in this Code shall have the meanings assigned to them in this Article (the appropriate addresses of the organizations are shown in brackets).

ACGIH ..... American Conference of Governmental Industrial Hygienists (1330 Kemper Meadow Drive, Cincinnati, Ohio 45240-1634 U.S.A.; www.acgih.org)

AHAM ..... Association of Home Appliance Manufacturers (111 19th Street, NW, Suite 402, Washington, D.C. 20036 U.S.A.; www.aham.org)

AHRI ..... Air-Conditioning, Heating and Refrigeration Institute (2111 Wilson Boulevard, Suite 500, Arlington, Virginia 22201 U.S.A.; www.ahrinet.org)

AISI ..... American Iron and Steel Institute (1140 Connecticut Avenue, NW, Suite 705, Washington, D.C. 20036 U.S.A.; www.steel.org)

ANSI ..... American National Standards Institute (25 West 43rd Street, 4th Floor, New York, New York 10036 U.S.A.; www.ansi.org)

ASCE ..... American Society of Civil Engineers (1801 Alexander Bell Drive, Reston, Virginia 20191 U.S.A.; www.asce.org)

ASHRAE ..... American Society of Heating, Refrigerating and Air-Conditioning Engineers (1791 Tullie Circle, N.E., Atlanta, Georgia 30329 U.S.A.; www.ashrae.org)

ASME ..... American Society of Mechanical Engineers (Three Park Avenue, New York, New York 10016-5990 U.S.A.; www.asme.org)

ASTM ..... American Society for Testing and Materials International (100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428-2959 U.S.A.; www.astm.org)

AWPA ..... American Wood Protection Association (P.O. Box 361784, Birmingham, Alabama 35236-1784 U.S.A.; www.awpa.com)

BIA ..... Brick Industry Association (1850 Centennial Park Drive, Suite 301, Reston, Virginia 20191 U.S.A.; www.bia.org)

BNQ ..... Bureau de normalisation du Québec (333, rue Franquet, Québec (Québec) G1P 4C7; www.bnq.qc.ca)

CAN ..... National Standard of Canada designation. (The number or name following the CAN designation represents the agency under whose auspices the standard is issued.
CAN3 designates CSA, and
CAN4 designates ULC.)

CCBFC ..... Canadian Commission on Building and Fire Codes (National Research Council of Canada, Ottawa, Ontario K1A 0R6; www.nationalcodes.ca)

CGSB ..... Canadian General Standards Board (Place du Portage, Phase III, 6B1, 11 Laurier Street, Gatineau, Quebec K1A 1G6; www.pwgsc.gc.ca/cgsb)

CHC ..... Canadian Hydronics Council (295 The West Mall, Suite 330, Toronto, Ontario M9C 4Z4; www.ciph.com)

CISC ..... Canadian Institute of Steel Construction (3760 14th Avenue, Suite 200, Markham, Ontario L3R 3T7; www.cisc.ca)

CMHC ..... Canada Mortgage and Housing Corporation (700 Montreal Road, Ottawa, Ontario K1A 0P7; www.cmhc.ca)

CRCA ..... Canadian Roofing Contractors' Association (2430 Don Reid Drive, Suite 100, Ottawa, Ontario K1H 1E1; www.roofingcanada.com)

CSA ..... Canadian Standards Association (5060 Spectrum Way, Suite 100, Mississauga, Ontario L4W 5N6; www.csa.ca)

CTI ..... Cooling Technology Institute (P.O. Box 73383, Houston, Texas 77273-3383 U.S.A.; www.cti.org)

CWC ..... Canadian Wood Council (99 Bank Street, Suite 400, Ottawa, Ontario K1P 6B9; www.cwc.ca)

DOE ..... Department of Energy (1000 Independence Avenue, SW, Washington, D.C. 20585 U.S.A.; http://energy.gov)

EC ..... Environment Canada (351 St. Joseph Boulevard, Vincent Massey Place, 8th Floor, Gatineau, Quebec K1A 0H3; www.ec.gc.ca)

EPA ..... Environmental Protection Agency (1200 Pennsylvania Avenue NW, Washington, D.C. 20460 U.S.A.; www.epa.gov)

FPI ..... FPInnovations – Wood Products (formerly FCC – Forintek Canada Corporation) (319, rue Franquet, Québec (Québec) G1P 4R4; www.forintek.ca)

HC ..... Health Canada (Address Locator 0900C2, Ottawa, Ontario K1A 0K9; www.hc-sc.gc.ca)

HI ..... Hydronics Institute (35 Russo Place, Berkley Heights, New Jersey 07922 U.S.A.; www.gamanet.org)

HRAI ..... Heating, Refrigeration and Air Conditioning Institute of Canada (2800 Skymark Avenue, Building 1, Suite 201, Mississauga, Ontario L4W 5A6; www.hrai.ca)

HVI ..... Home Ventilating Institute (1000 N. Rand Road, Suite 214, Wauconda, Illinois 60084 U.S.A.; www.hvi.org)

ICC ..... International Code Council (500 New Jersey Avenue, NW, 6th Floor, Washington, D.C. 20001 U.S.A.; www.iccsafe.org)

ISO ..... International Organization for Standardization (Standards Council of Canada, 270 Albert Street, Suite 200, Ottawa, Ontario K1P 6N7; www.iso.org)

NBC ..... National Building Code of Canada 2010 (see CCBFC)

NCMA ..... National Concrete Masonry Association (13750 Sunrise Valley Drive, Herndon, Virginia 20171-4662 U.S.A.; www.ncma.org)

NECB ..... National Energy Code of Canada for Buildings 2011 (see CCBFC)

NFC ..... National Fire Code of Canada 2010 (see CCBFC)

NFPA ..... National Fire Protection Association (1 Batterymarch Park, Quincy, Massachusetts 02169-7471 U.S.A.; www.nfpa.org)

NFRC ..... National Fenestration Rating Council (6305 Ivy Lane, Suite 140, Greenbelt, Maryland 20770 U.S.A.; www.nfrc.org)

NLGA ..... National Lumber Grades Authority (#302-960 Quayside Drive, New Westminster, British Columbia V3M 6G2; www.nlga.org)

NRC ..... National Research Council of Canada (Ottawa, Ontario K1A 0R6; www.nrc-cnrc.gc.ca)

NRCA ..... National Roofing Contractors Association (10255 W. Higgins Road, Suite 600, Rosemont, Illinois 60018-5607 U.S.A.; www.nrca.net)

NRC-IRC ..... Institute for Research in Construction (National Research Council of Canada, Ottawa, Ontario K1A 0R6; irc.nrc-cnrc.gc.ca)

NYCDH ..... New York City Department of Health and Mental Hygiene (Environmental and Occupational Disease Epidemiology, 253 Broadway, Suite 402, CN-34C, New York, New York 10007-2333 U.S.A.; www.nyc.gov/html/doh)

OMMAH ..... Ontario Ministry of Municipal Affairs and Housing (777 Bay Street, 2nd Floor, Toronto, Ontario M5G 2E5; www.ontario.ca/buildingcode)

SMACNA .... Sheet Metal and Air Conditioning Contractors' National Association (4201 Lafayette Center Drive, Chantilly, Virginia 20151-1219 U.S.A.; www.smacna.org)

TC ..... Transport Canada (330 Sparks Street, Ottawa, Ontario K1A 0N5; www.tc.gc.ca)

TPIC ..... Truss Plate Institute of Canada (c/o MiTek Canada Inc., 100 Industrial Road, Bradford, Ontario L3Z 3G7; www.tpic.ca)

TWC ..... Tarion Warranty Corporation (formerly Ontario New Home Warranty Program) (5150 Yonge Street, Concourse Level, Toronto, Ontario M2N 6L8; www.tarion.com)

UL ..... Underwriters Laboratories Inc. (333 Pfingsten Road, Northbrook, Illinois 60062-2096 U.S.A.; www.ul.com)

ULC ..... Underwriters' Laboratories of Canada (7 Underwriters Road, Toronto, Ontario M1R 3B4; www.ulc.ca)

WCLIB ..... West Coast Lumber Inspection Bureau (P.O. Box 23145, Portland, Oregon 97281 U.S.A.; www.wclib.org)

WWPA ..... Western Wood Products Association (522 SW Fifth Avenue, Suite 500, Portland, Oregon 97204-2122 U.S.A.; www.wwpa.org)

6.2.1.8. Installation – General

1) Equipment requiring periodic maintenance and forming part of a heating, ventilating or air-conditioning system shall be installed with provision for access for inspection, maintenance, repair and cleaning. (See Appendix A.)

2) Mechanical equipment shall be provided with guards so as to prevent injury.

3) Heating, ventilating or air-conditioning systems shall be protected from freezing if they may be adversely affected by freezing temperatures.

6.2.1.9. Expansion, Contraction and System Pressure

1) Heating and cooling systems shall be designed to allow for expansion and contraction of the heat transfer fluid and to maintain the system pressure within the rated working pressure limits of all components of the system.

6.2.1.10. Asbestos

1) Asbestos shall not be used in air distribution systems or equipment in a form or in a location where asbestos fibres could enter the air supply or return systems.

6.2.1.11. Access Openings

1) Any covering of an access opening through which a person could enter shall be openable from the inside without the use of keys where there is a possibility of the opening being accidentally closed while the system or equipment is being serviced.

6.2.2. Ventilation

6.2.2.1. Required Ventilation

1) Except as provided in Sentence (3), all *buildings* shall be ventilated in accordance with this Part.

2) Except in *storage garages* covered by Article 6.2.2.3., the rates at which outdoor air is supplied in *buildings* by ventilation systems shall be not less than the rates required by ASHRAE ANSI/ASHRAE 62, "Ventilation for Acceptable Indoor Air Quality" (except Addendum n).

3) Self-contained mechanical ventilation systems serving only one *dwelling unit* shall comply with

a) this Part, or
b) Subsection 9.32.3.

6.2.2.2. Natural Ventilation

1) Except as permitted by Sentence (2), the ventilation required by Article 6.2.2.1. shall be provided by mechanical ventilation, except that it can be provided by natural ventilation or a combination of natural and mechanical ventilation in

a) *buildings* of other than *residential occupancy* having an *occupant load* of not more than one person per 40 m^2 during normal use,
b) *buildings* of *industrial occupancy* where the nature of the processes contained therein permits or requires the use of large openings in the *building* envelope even during the winter, and
c) seasonal *buildings* not intended to be occupied during the winter.

2) Where climatic conditions permit, *buildings* containing *occupancies* other than *residential occupancies* may be ventilated by natural ventilation methods in lieu of mechanical ventilation where engineering data demonstrates that such a method will provide the required ventilation for the type of *occupancy*.

6.2.2.3. Ventilation of Storage Garages

1) Except as provided in Sentences (4) and (6), an enclosed *storage garage* shall have a mechanical ventilation system designed to

a) limit the concentration of carbon monoxide to not more than 100 parts per million parts of air,
b) limit the concentration of nitrogen dioxide to not more than 3 parts per million parts of air, where the majority of the vehicles stored are powered by diesel-fuelled engines, or
c) provide, during operating hours, a continuous supply of outdoor air at a rate of not less than 3.9 L/s for each square metre of *floor area* (see Article 3.3.1.20.).

(See also Sentence 3.3.5.4.(4).)

2) Mechanical ventilation systems provided in accordance with Clause (1)(a) shall be controlled by carbon monoxide monitoring devices, and systems provided in accordance with Clause (1)(b) shall be controlled by nitrogen dioxide or other acceptable monitoring devices. (See Appendix A.)

3) Mechanical ventilation systems provided in accordance with Sentence (1) shall be designed such that the pressure in the *storage garage* is less than the pressure in adjoining *buildings* of other *occupancy*, or in adjacent portions of the same *building* having a different *occupancy*.

4) In *storage garages* subject to the requirements of Sentences (1) and (2), where motor vehicles are parked by mechanical means, the ventilation requirements may be reduced by one half.

5) Except as provided in Sentence (6), ticket and attendant booths of *storage garages* shall be pressurized with a supply of uncontaminated air.

6) The requirements of Sentences (1) to (5) shall not apply to *open-air storeys* in a *storage garage*.

6.2.2.4. Cleaning Devices

1) Where outdoor air quality conditions do not meet the requirements of Sentence 6.2.1.7.(2), ventilation required by Sentence 6.2.2.1.(1) shall be provided by a ventilation system designed to include devices that reduce particles and gases to the maximum acceptable levels described in Sentence 6.2.1.7.(2) prior to the introduction of outdoor air to indoor occupied spaces.

6.2.2.5. Air Contaminants

1) Air contaminants released within *buildings* shall be removed insofar as possible at their points of origin and shall not be permitted to accumulate in concentrations greater than permitted in the Industrial Ventilation Manual published by the American Conference of Governmental Industrial Hygienists.

2) Systems serving spaces that contain sources of contamination and systems serving other occupied parts of the *building* but located in or running through spaces that contain sources of contamination shall be designed in such a manner as to prevent spreading of such contamination to other occupied parts of the *building*.

3) Heating, ventilating and air-conditioning systems shall be designed to minimize the growth of micro-organisms. (See Appendix A.)

6.2.2.6. Hazardous Gases, Dusts or Liquids

1) Systems serving spaces that contain hazardous gases, dusts or liquids shall be designed, constructed and installed to conform to the requirements of the applicable provincial or territorial regulations or municipal bylaws or, in the absence of such regulations or bylaws, to good engineering practice such as that described in the publications of the National Fire Protection Association and in the NFC. (See Appendix A.)

b) CAN/CGSB-12.2-M, "Flat, Clear Sheet Glass,"
c) CAN/CGSB-12.3-M, "Flat, Clear Float Glass,"
d) CAN/CGSB-12.4-M, "Heat Absorbing Glass,"
e) CAN/CGSB-12.8, "Insulating Glass Units,"
f) CAN/CGSB-12.10-M, "Glass, Light and Heat Reflecting,"
g) CAN/CGSB-12.11-M, "Wired Safety Glass," or
h) ASTM E 2190, "Insulating Glass Unit Performance and Evaluation."

2) Mirrored glass doors may be used only at the entrance to clothes closets and shall conform to the requirements of CAN/CGSB-82.6-M, "Doors, Mirrored Glass, Sliding or Folding, Wardrobe." (See Appendix A.)

9.6.1.3. Structural Sufficiency of Glass

1) Glass shall be designed in conformance with CAN/CGSB-12.20-M, "Structural Design of Glass for Buildings." (See Appendix A.)

2) The maximum area of individual panes of glass for doors shall conform to Table 9.6.1.3.

Table 9.6.1.3.
Glass Area for Doors
Forming Part of Sentence 9.6.1.3.(2)

Glass Thickness, mm	Maximum Glass Area, m^2[1]						
	Type of Glass						
	Annealed	Annealed, Multiple-Glazed, Factory-Sealed Units	Laminated	Wired	Heat-Strengthened	Fully Tempered	Fully Tempered, Multiple-Glazed, Factory-Sealed
3	0.50	0.70	[2]	[2]	1.00	1.00	2.00
4	1.00	1.50	[2]	[2]	1.50	4.00	4.00
5	1.50	1.50	[2]	[2]	1.50	No limit	No limit
6	1.50	1.50	1.20	1.00	1.50	No limit	No limit

Notes to Table 9.6.1.3.:
[1] See Appendix A.
[2] Not generally available.

9.6.1.4. Types of Glass and Protection of Glass

1) Glass sidelights greater than 500 mm wide that could be mistaken for doors, glass in storm doors and glass in sliding doors within or at every entrance to a *dwelling unit* and in public areas shall be

a) safety glass of the tempered or laminated type conforming to CAN/CGSB-12.1-M, "Tempered or Laminated Safety Glass," or
b) wired glass conforming to CAN/CGSB-12.11-M, "Wired Safety Glass."

2) Except as provided in Sentence (4), glass in entrance doors to *dwelling units* and in public areas, other than the entrance doors described in Sentence (1), shall be safety glass or wired glass of the type described in Sentence (1) where the glass area exceeds 0.5 m^2 and extends to less than 900 mm from the bottom of the door.

3) Except as provided in Sentence (4), transparent panels that could be mistaken as a *means of egress* shall be protected by barriers or railings.

4) Sliding glass *partitions* that separate a *public corridor* from an adjacent *occupancy* and that are open during normal working hours need not conform to Sentences (2), (3) and (5), except that such *partitions* shall be suitably marked to indicate their existence and position.

5) Except as provided in Sentence (4), every glass or transparent door accessible to the public shall be equipped with hardware, bars or other permanent fixtures designed so that the existence and position of such doors is readily apparent.

6) Glass other than safety glass shall not be used for a shower or bathtub enclosure.

Section 9.7. Windows, Doors and Skylights

9.7.1. General

9.7.1.1. Application

1) This Section applies to
a) windows, doors and skylights separating *conditioned space* from unconditioned space or the exterior, and
b) main entrance doors.

2) For the purpose of this Section, the term "skylight" refers to unit skylights, roof windows and tubular daylighting devices.

3) For the purpose of this Section, the term "doors" includes glazing in doors and sidelights for doors.

9.7.2. Required Windows, Doors and Skylights

9.7.2.1. Entrance Doors

1) A door shall be provided at each entrance to a *dwelling unit*.

2) Main entrance doors to *dwelling units* shall be provided with
a) a door viewer or transparent glazing in the door, or
b) a sidelight.

9.7.2.2. Other Requirements for Windows, Doors and Skylights

1) Minimum sizes of doorways and doors within a *barrier-free* path of travel shall conform to Section 9.5.

2) The protection of window and door openings to protect persons from falling through them shall conform to Article 9.8.8.1.

3) Properties of windows and doors within *exits* shall conform to Section 9.9.

4) Windows and doors installed to provide the required *means of egress* from bedrooms shall conform to Subsection 9.9.10.

5) The location and protection of windows, doors and skylights in order to control the spread of fire shall conform to Subsection 9.10.12.

6) Doors between *dwelling units* and attached garages shall conform to Article 9.10.13.15.

7) The surface *flame-spread rating* for doors and skylights shall conform to Article 9.10.17.1.

8) Windows and doors installed to provide the required access to a *building* for firefighting purposes shall conform to Subsection 9.10.20.

9) Windows and skylights installed to provide required non-heating season ventilation shall conform to Article 9.32.2.2.

10) Windows, doors and skylights shall conform to the energy efficiency requirements in Section 9.36.

2) The ground cover required in Sentence (1) shall have its joints lapped not less than 300 mm, and

a) be sealed and evenly weighted down, or
b) be covered with concrete not less than 50 mm thick.

3) The perimeter of the ground cover required in Sentence (1) shall be sealed to the *foundation* wall. (See A-9.13.4., A-9.25.3.4. and 9.25.3.6., and A-9.25.3.6.(2) and (3) in Appendix A.)

4) All penetrations of the ground cover required in Sentence (1) shall be sealed against air leakage. (See Subsection 9.25.3.)

9.18.7. Fire Protection

9.18.7.1. Crawl Spaces as Warm Air Plenums

1) Only crawl spaces under 1-*storey* portions of *dwelling units* shall be used as warm-air *plenums*.

2) Enclosing material in crawl spaces described in Sentence (1), including insulation, shall have a surface *flame-spread rating* not greater than 150.

3) *Combustible* ground cover in crawl spaces described in Sentence (1) shall be protected beneath each register opening with *noncombustible* material.

4) The *noncombustible* register protection described in Sentence (3) shall

a) extend not less than 300 mm beyond the projection of the register opening, and
b) have up-turned edges.

(See Appendix A.)

Section 9.19. Roof Spaces

9.19.1. Venting

9.19.1.1. Required Venting

1) Except where it can be shown to be unnecessary, where insulation is installed between a ceiling and the underside of the roof sheathing, a space shall be provided between the insulation and the sheathing, and vents shall be installed to permit the transfer of moisture from the space to the exterior. (See Appendix A.)

9.19.1.2. Vent Requirements

1) Except as provided in Sentence (2), the unobstructed vent area shall be not less than 1/300 of the insulated ceiling area.

2) Where the roof slope is less than 1 in 6 or in roofs that are constructed with roof joists, the unobstructed vent area shall be not less than 1/150 of the insulated ceiling area.

3) Required vents may be roof type, eave type, gable-end type or any combination thereof, and shall be distributed

a) uniformly on opposite sides of the *building*,
b) with not less than 25% of the required openings located at the top of the space, and
c) with not less than 25% of the required openings located at the bottom of the space.

4) Except where each joist space is separately vented, roof joist spaces shall be interconnected by installing purlins not less than 38 mm by 38 mm on the top of the roof joists.

5) Vents shall comply with CAN3-A93-M, "Natural Airflow Ventilators for Buildings."

9.19.1.3. Clearances

1) Except as provided in Sentence (2), not less than 63 mm of space shall be provided between the top of the insulation and the underside of the roof sheathing.

2) At the junction of sloped roofs and exterior walls, where preformed baffles are used to contain the insulation, the baffles shall

a) provide an unobstructed air space, between the insulation and the underside of the roof sheathing, that is
   i) not less than 25 mm in dimension, and
   ii) of sufficient cross area to meet the *attic or roof space* venting requirements of Article 9.19.1.2., and
b) extend vertically not less than 50 mm above the top of the insulation.

3) Ceiling insulation shall be installed in a manner that will not restrict the free flow of air through roof vents or through any portion of the *attic or roof space*.

9.19.1.4. Mansard or Gambrel Roof

1) The lower portion of a mansard or gambrel style roof need not be ventilated.

2) The upper portion of roofs described in Sentence (1) shall be ventilated in conformance with Articles 9.19.1.1. to 9.19.1.3.

9.19.2. Access

9.19.2.1. Access

1) Every *attic or roof space* shall be provided with an access hatch where the open space in the *attic or roof space* measures

a) 3 m^2 or more in area,
b) 1 m or more in length or width, and
c) 600 mm or more in height over at least the area described in Clauses (a) and (b).

(See Appendix A.)

2) The hatch required in Sentence (1) shall be not less than 550 mm by 900 mm except that, where the hatch serves not more than one *dwelling unit*, the hatch may be reduced to 0.32 m^2 in area with no dimension less than 500 mm.

3) Hatchways to *attic or roof spaces* shall be fitted with doors or covers.

Section 9.20. Masonry and Insulating Concrete Form Walls Not In Contact with the Ground

9.20.1. Application

9.20.1.1. General

1) Except as provided in Article 9.20.1.2., this Section applies to

a) unreinforced masonry and masonry veneer walls not in contact with the ground, where
   i) the height of the walls constructed on the *foundation* walls does not exceed 11 m, and
   ii) the roof or floor assembly above the *first storey* is not of concrete construction, and
b) flat insulating concrete form walls not in contact with the ground that (see A-9.15.1.1.(1)(c) and 9.20.1.1.(1)(b) in Appendix A)
   i) have a maximum floor-to-floor height of 3 m,
   ii) are erected in *buildings* not more than 2 *storeys* in *building height* and containing only a single *dwelling unit*, and
   iii) are erected in locations where the seismic spectral response acceleration, $S_a(0.2)$, is not greater than 0.4 (see A-9.20.1.2. in Appendix A).

9.22.10. Fireplace Inserts and Hearth-Mounted Stoves

9.22.10.1. Appliance Standard

1) Fireplace inserts and hearth-mounted *stoves* vented through the throat of a fireplace shall conform to ULC-S628, "Fireplace Inserts."

9.22.10.2. Installation

1) The installation of fireplace inserts and hearth-mounted *stoves* vented through the throat of a fireplace shall conform to CAN/CSA-B365, "Installation Code for Solid-Fuel-Burning Appliances and Equipment."

Section 9.23. Wood-Frame Construction

9.23.1. Application

9.23.1.1. Limitations

(See Appendix A.)

1) This Section applies to constructions where wall, floor and roof planes are generally comprised of lumber frames of small repetitive structural members, or engineered components, and where

a) roof and wall planes are clad, sheathed or braced on at least one side,
b) the small repetitive structural members are spaced not more than 600 mm o.c.,
c) the constructions do not serve as *foundations*,
d) the specified *live load* on supported subfloors and floor framing does not exceed 2.4 kPa, and
e) the span of any structural member does not exceed 12.20 m.

(See Appendix A.)

2) Where the conditions in Sentence (1) are exceeded for wood constructions, the design of the framing and fastening shall conform to Subsection 4.3.1.

9.23.2. General

9.23.2.1. Strength and Rigidity

1) All members shall be so framed, anchored, fastened, tied and braced to provide the necessary strength and rigidity.

9.23.2.2. Protection from Decay

1) Ends of wood joists, beams and other members framing into masonry or concrete shall be treated to prevent decay where the bottom of the member is at or below ground level, or a 12 mm air space shall be provided at the end and sides of the member.

2) Air spaces required in Sentence (1) shall not be blocked by insulation, *vapour barriers* or airtight materials.

9.23.2.3. Protection from Dampness

1) Except as permitted in Sentence (2), wood framing members that are not pressure-treated with a wood preservative and that are supported on concrete in contact with the ground or *fill* shall be separated from the concrete by not less than 0.05 mm polyethylene film or Type S roll roofing.

2) Dampproofing material referred to in Sentence (1) is not required where the wood member is at least 150 mm above the ground.

9.23.2.4. Lumber

1) Lumber shall conform to Subsection 9.3.2.

9.23.3. Fasteners

9.23.3.1. Standards for Nails and Screws

1) Except as provided in Sentence (2) and unless otherwise indicated, nails specified in this Section shall be common steel wire nails or common spiral nails conforming to

a) ASTM F 1667, "Driven Fasteners: Nails, Spikes, and Staples," or
b) CSA B111, "Wire Nails, Spikes and Staples."

2) Nails used to comply with Table 9.23.3.4. shall have a diameter not less than that stated in Table 9.23.3.1. (See Appendix A.)

Table 9.23.3.1.
Diameter of Nails
Forming Part of Sentence 9.23.3.1.(2)

Minimum Length of Nails, mm	Diameter of Nails, mm
57	2.87
63	3.25
76	3.66
82	3.66
101 or greater	4.88

3) Wood screws specified in this Section shall conform to ASME B18.6.1, "Wood Screws (Inch Series)." (See Appendix A.)

9.23.3.2. Length of Nails

1) All nails shall be long enough so that not less than half their required length penetrates into the second member.

9.23.3.3. Prevention of Splitting

1) Splitting of wood members shall be minimized by staggering the nails in the direction of the grain and by keeping nails well in from the edges. (See Appendix A.)

9.23.3.4. Nailing of Framing

1) Except as provided in Sentence (2), nailing of framing shall conform to Table 9.23.3.4.

2) Where the bottom wall plate or sole plate of an exterior wall is not nailed to floor joists, *rim joists* or blocking in conformance with Table 9.23.3.4., the exterior wall is permitted to be fastened to the floor framing by

a) having plywood, OSB or waferboard sheathing extend down over floor framing and fastened to the floor framing by nails or staples conforming to Article 9.23.3.5., or
b) tying the wall framing to the floor framing by galvanized-metal strips
   i) 50 mm wide,
   ii) not less than 0.41 mm thick,
   iii) spaced not more than 1.2 m apart, and
   iv) fastened at each end with at least two 63 mm nails.

Table 9.23.3.4.
Nailing for Framing
Forming Part of Sentence 9.23.3.4.(1)

Construction Detail	Minimum Length of Nails, mm	Minimum Number or Maximum Spacing of Nails
Floor joist or blocking perpendicular to sill plate or top wall plate below – toe nail	82	2 per floor joist or blocking
Rim joist, trimmer joist or blocking – supporting walls with required *braced wall panels* – to sill plate or top wall plate – toe nail	82	150 mm (o.c.)
Wood or metal strapping to underside of floor joists	57	2
Cross bridging to joists	57	2 at each end
Double header or trimmer joists	76	300 mm (o.c.)
Floor joist to stud (balloon construction)	76	2
Ledger strip to wood beam	82	2 per joist
Joist to joist splice (see also Table 9.23.14.8.)	76	2 at each end
Tail joist to adjacent header joist	82	5
(end nailed) around openings	101	3
Each header joist to adjacent trimmer joist	82	5

2) Studs described in Sentence (1) shall be fastened together by screws, crimping or welding to act as a single structural unit in resisting transverse loads.

9.24.3.6. Attachment of Studs to Runners

1) Studs shall be attached to runners by screws, crimping or welding around wall openings and elsewhere where necessary to keep the studs in alignment during construction.

2) Where clearance for expansion is required in Article 9.24.3.2., attachment required in Sentence (1) shall be applied between studs and bottom runners only.

9.24.3.7. Openings for Fire Dampers

1) Openings for *fire dampers* in non-*loadbearing fire separations* required to have a *fire-resistance rating* shall be framed with double studs on each side of the opening.

2) The sill and header for openings described in Sentence (1) shall consist of a runner track with right angle bends made on each end so as to extend 300 mm above the header or below the sill and fastened to the studs.

3) The openings described in Sentence (1) shall be lined with a layer of gypsum board not less than 12.7 mm thick fastened to stud and runner webs.

Section 9.25. Heat Transfer, Air Leakage and Condensation Control

9.25.1. General

9.25.1.1. Scope and Application

1) This Section is concerned with heat, air and water vapour transfer and measures to control condensation.

2) All walls, ceilings and floors separating *conditioned space* from unconditioned space, the exterior air or the ground shall be

a) provided with
   i) thermal insulation conforming to Subsection 9.25.2. and Section 9.36.,
   ii) an air barrier conforming to Subsection 9.25.3. and Section 9.36., and
   iii) a vapour barrier conforming to Subsection 9.25.4., and
b) constructed in such a way that the properties and relative position of all materials conform to Subsection 9.25.5.

3) Insulation and sealing of heating and ventilating ducts shall conform to Sections 9.32., 9.33. and 9.36.

9.25.2. Thermal Insulation

9.25.2.1. Required Insulation

1) All walls, ceilings and floors separating heated space from unheated space, the exterior air or the exterior *soil* shall be provided with sufficient thermal insulation to prevent moisture condensation on their room side during the winter and to ensure comfortable conditions for the occupants. (See A-9.1.1.1.(1) in Appendix A.)

9.25.2.2. Insulation Materials

1) Except as required in Sentence (2), thermal insulation shall conform to the requirements of

a) CAN/CGSB-51.25-M, "Thermal Insulation, Phenolic, Faced,"
b) CGSB 51-GP-27M, "Thermal Insulation, Polystyrene, Loose Fill,"

c) CAN/ULC-S701, "Thermal Insulation, Polystyrene, Boards and Pipe Covering,"
d) CAN/ULC-S702, "Mineral Fibre Thermal Insulation for Buildings,"
e) CAN/ULC-S703, "Cellulose Fibre Insulation (CFI) for Buildings,"
f) CAN/ULC-S704, "Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced,"
g) CAN/ULC-S705.1, "Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Material - Specification," or
h) CAN/ULC-S706, "Wood Fibre Thermal Insulation for Buildings."

2) The *flame-spread ratings* requirements contained in the standards listed in Sentence (1) shall not apply. (See Appendix A.)

3) Insulation in contact with the ground shall be inert to the action of *soil* and water and shall be such that its insulative properties are not significantly reduced by moisture.

9.25.2.3. Installation of Thermal Insulation

1) Insulation shall be installed so that there is a reasonably uniform insulating value over the entire face of the insulated area.

2) Insulation shall be applied to the full width and length of the space between furring or framing.

3) Except where the insulation provides the principal resistance to air leakage, thermal insulation shall be installed so that at least one face is in full and continuous contact with an element with low air permeance. (See Appendix A.)

4) Insulation on the interior of *foundation* walls enclosing a crawl space shall be applied so that there is not less than 50 mm clearance above the crawl space floor, if the insulation is of a type that may be damaged by water.

5) Insulation around concrete slabs-on-ground shall be located so that heat from the *building* is not restricted from reaching the ground beneath the perimeter, where exterior walls are not supported by footings extending below frost level.

6) Where insulation is exposed to the weather and subject to mechanical damage, it shall be protected with not less than
a) 6 mm asbestos-cement board,
b) 6 mm preservative-treated plywood, or
c) 12 mm cement parging on wire lath applied to the exposed face and edge.

7) Insulation located in areas where it may be subject to mechanical damage shall be protected by a covering such as gypsum board, plywood, particleboard, OSB, waferboard or hardboard.

8) Insulation in factory-built *buildings* shall be installed so that it will not become dislodged during transportation.

9.25.2.4. Installation of Loose-Fill Insulation

1) Except as provided in Sentences (2) to (6), loose-fill insulation shall be used on horizontal surfaces only.

2) Where loose-fill insulation is installed in an unconfined sloped space, such as an attic space over a sloped ceiling, the supporting slope shall not be more than
a) 4.5 in 12 for mineral fibre or cellulose fibre insulation, and
b) 2.5 in 12 for other types of insulation.

3) Loose-fill insulation is permitted to be used in wood-frame walls of existing *buildings*. (See Appendix A.)

4) Where blown-in insulation is installed in above-ground or below-ground wood-frame walls of new *buildings*,
a) the density of the installed insulation shall be sufficient to preclude settlement,
b) the insulation shall be installed behind a membrane that will permit visual inspection prior to the installation of the interior finish,

9.26.2. Roofing Materials

9.26.2.1. Material Standards

1) Roofing materials shall conform to

a) CAN/CGSB-37.4-M, "Fibrated, Cutback Asphalt, Lap Cement for Asphalt Roofing,"
b) CAN/CGSB-37.5-M, "Cutback Asphalt Plastic, Cement,"
c) CAN/CGSB-37.8-M, "Asphalt, Cutback, Filled, for Roof Coating,"
d) CGSB 37-GP-9Ma, "Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing,"
e) CGSB 37-GP-21M, "Tar, Cutback, Fibrated, for Roof Coating,"
f) CAN/CGSB-37.50-M, "Hot-Applied, Rubberized Asphalt for Roofing and Waterproofing,"
g) CGSB 37-GP-52M, "Roofing and Waterproofing Membrane, Sheet Applied, Elastomeric,"
h) CAN/CGSB-37.54, "Polyvinyl Chloride Roofing and Waterproofing Membrane,"
i) CGSB 37-GP-56M, "Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing,"
j) CGSB 41-GP-6M, "Sheets, Thermosetting Polyester Plastics, Glass Fiber Reinforced,"
k) CAN/CGSB-51.32-M, "Sheathing, Membrane, Breather Type,"
l) CSA A123.1/A123.5, "Asphalt Shingles Made From Organic Felt and Surfaced with Mineral Granules/Asphalt Shingles Made From Glass Felt and Surfaced with Mineral Granules,"
m) CAN/CSA-A123.2, "Asphalt-Coated Roofing Sheets,"
n) CSA A123.3, "Asphalt Saturated Organic Roofing Felt,"
o) CAN/CSA-A123.4, "Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems,"
p) CSA A123.17, "Asphalt Glass Felt Used in Roofing and Waterproofing,"
q) CAN/CSA-A220.0, "Performance of Concrete Roof Tiles,"
r) CSA O118.1, "Western Red Cedar Shakes and Shingles," or
s) CSA O118.2, "Eastern White Cedar Shingles."

9.26.2.2. Nails

1) Nails used for roofing shall be corrosion-resistant roofing or shingle nails conforming to

a) ASTM F 1667, "Driven Fasteners: Nails, Spikes, and Staples," or
b) CSA B111, "Wire Nails, Spikes and Staples."

2) Nails shall have sufficient length to penetrate through, or 12 mm into, roof sheathing.

3) Nails used with asphalt roofing shall have a head diameter of not less than 9.5 mm and a shank thickness of not less than 2.95 mm.

4) Nails used with wood shingles or shakes shall have a head diameter of not less than 4.8 mm and a shank thickness of not less than 2.0 mm and shall be stainless steel, aluminum or hot-dipped galvanized. (See Appendix A.)

9.26.2.3. Staples

1) Staples used to apply asphalt or wood shingles shall be corrosion-resistant and shall be driven with the crown parallel to the eaves.

2) Staples used with asphalt shingles shall be not less than 19 mm long, 1.6 mm diam or thickness, with not less than a 25 mm crown, except that an 11 mm crown may be used as provided in Sentence 9.26.7.4.(2).

3) Staples used with wood shingles shall be not less than 29 mm long, 1.6 mm diam or thickness, with not less than a 9.5 mm crown and shall be stainless steel or aluminum. (See A-9.26.2.2.(4) in Appendix A.)

9.26.3. Slope of Roofed Surfaces

9.26.3.1. Slope

1) Except as provided in Sentences (2) and (3), the slopes on which roof coverings may be applied shall conform to Table 9.26.3.1.

2) Asphalt and gravel or coal tar and gravel roofs may be constructed with lower slopes than required in Sentence (1) when effective drainage is provided by roof drains located at the lowest points on the roofs.

3) Profiled metal roof cladding systems specifically designed for low-slope applications are permitted to be installed with lower slopes than required by Sentence (1), provided they are installed in conformance with the manufacturer's written recommendations.

4) Except where back-slope will not adversely affect adjacent supported or supporting constructions due to water ingress, roofs and constructions that effectively serve as roofs shall be constructed with sufficient slope away from

a) exterior walls, and
b) *guards* that are connected to the roof, or to a construction that effectively serves as a roof, by more than pickets or posts.

(See A-9.26.1.1.(2), A-9.26.4.1. and A-9.27.3.8.(4) in Appendix A.)

5) The slope required by Sentence (4) shall be sufficient to maintain a positive slope

a) after expected shrinkage of the *building* frame, where these surfaces are supported by exterior walls and exterior columns (see A-9.27.3.8.(4) in Appendix A), and
b) once design loading is taken into consideration, where these surfaces are cantilevered from exterior walls.

Table 9.29.5.5.
Fastener Penetration into Wood Supports
Forming Part of Sentence 9.29.5.5.(1)

Required *Fire-Resistance Rating* of Assembly	Minimum Penetration, mm			
	Walls		Ceilings	
	Nails	Screws	Nails	Screws
Not required	20	15	20	15
45 min	20	20	30	30
1 h	20	20	45	45
1.5 h	20	20	60	60

9.29.5.6. Nails

1) Nails for fastening gypsum board to wood supports shall conform to
a) ASTM F 1667, "Driven Fasteners: Nails, Spikes, and Staples," or
b) CSA B111, "Wire Nails, Spikes and Staples."

9.29.5.7. Screws

1) Screws for fastening gypsum board to wood supports shall conform to ASTM C 1002, "Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs."

9.29.5.8. Spacing of Nails

1) For single-layer application on a ceiling, nails shall be spaced
a) not more than 180 mm o.c. on ceiling supports, or
b) every 300 mm o.c. along ceiling supports, in pairs about 50 mm apart.

2) Where the ceiling sheets are supported by the wall sheets around the perimeter of the ceiling, this support may be considered as equivalent to nailing at this location.

3) Except as required by Sentence (4), for single-layer application on walls, nails shall be spaced
a) not more than 200 mm o.c. on vertical wall supports, or
b) every 300 mm o.c. along vertical wall supports, in pairs about 50 mm apart.

4) For single-layer application on walls, where gypsum board provides required bracing in *braced wall panels*, lateral support for studs, or fire protection, nails shall be spaced not more than 200 mm o.c. on
a) vertical wall supports, and
b) top and bottom plates.
(See Article 9.23.10.2. and Section 9.10.)

5) The uppermost nails on vertical wall supports shall be not more than 200 mm below the ceiling.

6) Nails shall be located not less than 10 mm from the side or edge of the board.

7) Nails shall be driven so that the heads do not puncture the paper.

9.29.5.9. Spacing of Screws

1) For single-layer application on a ceiling, screws shall be spaced not more than 300 mm o.c. on ceiling supports.

2) Where the ceiling sheets are supported by the wall sheets around the perimeter of the ceiling, this support may be considered as equivalent to screwing at this location.

3) Except as required by Sentence (4), for single-layer application on walls, screws shall be spaced

a) not more than 300 mm o.c. on vertical wall supports where the supports are more than 400 mm o.c., or

b) not more than 400 mm o.c. on vertical wall supports where the supports are not more than 400 mm o.c.

4) Except as provided in Sentence (5), for single-layer application on walls, where gypsum board provides required bracing in *braced wall panels*, lateral support for studs, or fire protection, screws shall be spaced not more than 300 mm o.c. on

a) vertical wall supports, and

b) top and bottom plates.

(See Article 9.23.10.2. and Section 9.10.)

5) Where a *fire-resistance rating* is determined based on Table A-9.10.3.1.A. in Appendix A, Sentence (4) need not apply for the purpose of fire protection.

6) Screws shall be located not less than 10 mm from the edge of the board.

7) Screws shall be driven so that the heads do not puncture the paper.

9.29.5.10. Low Temperature Conditions

1) In cold weather, heat shall be provided to maintain a temperature not below 10°C for 48 h prior to taping and finishing and maintained for not less than 48 h thereafter.

9.29.6. Plywood Finish

9.29.6.1. Thickness

1) Except as provided in Sentences (2) and (3), the minimum thickness of plywood interior finish shall conform to Table 9.29.6.1.

Table 9.29.6.1.
Thickness of Plywood Interior Finish
Forming Part of Articles 9.29.6.1. and 9.29.6.2.

Maximum Spacing of Supports, mm o.c.	Minimum Thickness, mm[1]	
	On Supports with no Horizontal Blocking	On Supports with Blocking at Vertical Intervals not Exceeding 1.2 m
400	4.7	4.0
600	8.0	4.7

Notes to Table 9.29.6.1.:

(1) Thickness limits shall apply to the net effective thickness (NET) of grooved, striated, textured and/or embossed panels and to the actual thickness of flat panels.

2) A manufacturing tolerance of –0.4 mm may be applied to the thicknesses listed in Table 9.29.6.1.

3) No minimum thickness is required where plywood is applied over continuous backing.

9.29.6.2. Grooved Plywood

1) Except as permitted in Sentence (2), where plywood for interior finish is grooved, the grooves shall not extend through the face ply and into the plies below the face ply unless the groove is supported by framing or furring.

2) If the grain of the face ply is at right angles to the supporting members, the groove is permitted to extend into plies below the face ply provided the thickness of the plywood exceeds the value shown in Table 9.29.6.1. by an amount equal to not less than the depth of penetration of the grooves into the plies below the face ply.

9.30.3.2. Strip Direction and End Joints

1) Wood strip flooring shall not be laid parallel to lumber subflooring unless a separate underlay is provided.

2) If wood strip flooring is applied without a subfloor, it shall be laid at right angles to the joists so that the end joints are staggered and occur over supports or are end matched.

3) If the flooring is end matched, it shall be laid so that no 2 adjoining strips break joints in the same space between supports and each strip bears on no fewer than 2 supports.

9.30.3.3. Nailing

1) When nails are used, wood strip flooring shall be toe nailed or face nailed with not less than one nail per strip at the spacings shown in Table 9.30.3.3., except that face nailed strips more than 25 mm in width shall have at least 2 nails per strip.

Table 9.30.3.3.
Nailing of Wood Strip Flooring
Forming Part of Sentence 9.30.3.3.(1)

Finish Floor Thickness, mm	Minimum Length of Flooring Nails, mm	Maximum Spacing of Flooring Nails, mm
7.9	38(1)	200
11.1	51	300
19.0	57	400
25.4	63	400
31.7	70	600
38.1	83	600

Notes to Table 9.30.3.3.:
(1) See Article 9.30.3.4.

2) Face nails shall be countersunk.

9.30.3.4. Staples

1) Staples are permitted to be used to fasten wood strip flooring not more than 7.9 mm in thickness provided the staples are not less than 29 mm long with a shank diameter of 1.19 mm and with 4.7 mm crowns.

9.30.4. Parquet Flooring

9.30.4.1. Adhesive

1) Adhesive used to attach parquet block flooring shall be suitable for bonding wood to the applicable subfloor material.

9.30.5. Resilient Flooring

9.30.5.1. Materials

1) Resilient flooring used on concrete slabs supported on ground shall consist of asphalt, rubber, vinyl-asbestos, unbacked vinyl or vinyl with an inorganic type backing.

2) Flooring described in Sentence (1) shall be attached to the base with a suitable waterproof and alkali-resistant adhesive.

9.30.6. Ceramic Tile

9.30.6.1. Substrate

1) Ceramic tile shall be set in a mortar bed or applied to a sound smooth base with a suitable adhesive.

2) Panel-type subfloor to which ceramic tile is to be applied with adhesive shall have its edges supported according to Article 9.23.15.3.

Section 9.31. Plumbing Facilities

9.31.1. Scope

9.31.1.1. Application

1) This Section applies to the plumbing facilities and *plumbing systems* within *dwelling units*.

2) In *occupancies* other than *dwelling units*, plumbing facilities, grab bars, floor drains, and floor and wall finishes around urinals shall conform to Subsection 3.7.2. (See also Section 3.8. regarding *barrier-free* plumbing facilities.)

3) Medical gas piping systems shall conform to Subsection 3.7.3.

4) Systems used for service water heating shall conform to the energy efficiency requirements in Section 9.36.

9.31.2. General

9.31.2.1. General

1) The construction, extension, *alteration*, renewal or repair of *plumbing systems* and sewage disposal systems shall conform to Part 7.

9.31.2.2. Corrosion Protection

1) Metal pipes in contact with cinders or other corrosive material shall be protected by a heavy coating of bitumen or other corrosion protection.

9.31.2.3. Grab Bars

1) When provided, grab bars shall be capable of resisting a load of not less than 1.3 kN applied vertically or horizontally.

9.31.3. Water Supply and Distribution

9.31.3.1. Required Water Supply

1) Every *dwelling unit* shall be supplied with potable water.

9.31.3.2. Required Connections

1) Where a piped water supply is available, piping for hot and cold water shall be connected to every kitchen sink, lavatory, bathtub, shower, slop sink and laundry area.

2) Piping for cold water shall be run to every water closet.

9.31.4. Required Facilities

9.31.4.1. Required Fixtures

1) A kitchen sink, lavatory, bathtub or shower, and water closet shall be provided for every *dwelling unit* where a piped water supply is available.

9.31.4.2. Hot Water Supply

1) Where a piped water supply is available a hot water supply shall be provided in every *dwelling unit*.

9.31.4.3. Floor Drains

1) Where gravity drainage to a sewer, drainage ditch or dry well is possible, a floor drain shall be installed in a *basement* forming part of a *dwelling unit*.

2) A floor drain shall be provided in a garbage room, incinerator room or *boiler* room serving more than one *dwelling unit*.

9.31.5. Sewage Disposal

9.31.5.1. Building Sewer

1) Wastes from every plumbing fixture shall be piped to the *building* sewer.

9.31.5.2. Discharge of Sewage

1) *Building* sewers shall discharge into a public sewage system where such system is available.

2) Where a public sewage system is not available, the *building* sewer shall discharge into a *private sewage disposal system*.

9.31.6. Service Water Heating Facilities

9.31.6.1. Hot Water Supply

1) Where hot water is required to be supplied in accordance with Article 9.31.4.2., equipment shall

a) provide an adequate supply of hot water, and
b) be installed in conformance with Part 7.

9.31.6.2. Equipment and Installation

1) *Service water heaters* shall conform to appropriate provincial or territorial requirements or, in the absence of such requirements, to the National Plumbing Code of Canada 2010.

2) The installation of *service water heaters*, including provisions for mounting, clearances and air supply, shall conform to appropriate provincial or territorial requirements or, in the absence of such requirements, to

a) CSA B51, "Boiler, Pressure Vessel, and Pressure Piping Code,"
b) CSA B139, "Installation Code for Oil-Burning Equipment,"
c) CAN/CSA-B149.1, "Natural Gas and Propane Installation Code,"
d) CAN/CSA-B365, "Installation Code for Solid-Fuel-Burning Appliances and Equipment," or
e) CSA C22.1, "Canadian Electrical Code, Part I."

3) Where the *building* is in a location where the spectral response acceleration, $S_a(0.2)$, is greater than 0.55, *service water heaters* shall be secured to the structure to prevent overturning. (See Appendix A.)

9.31.6.3. Corrosion-Resistant Coating

1) Where storage tanks for *service water heaters* are of steel, they shall be coated with zinc, vitreous enamel (glass lined), hydraulic cement or other corrosion-resistant material.

9.31.6.4. Fuel-Burning Heaters

1) Fuel-burning *service water heaters* shall be connected to a *chimney flue* conforming to Section 9.21.

9.31.6.5. Heating Coils

1) Heating coils of *service water heaters* shall not be installed in a *flue* or in the combustion chamber of a *boiler* or *furnace* heating a *building*.

Section 9.32. Ventilation

9.32.1. General

9.32.1.1. Application

1) This Section applies to the ventilation of rooms and spaces in *residential occupancies*.

2) Ventilation of all other *occupancies* shall comply with Part 6.

3) A *storage garage* for up to 4 motor vehicles that serves a *residential occupancy* may be considered to be part of that *occupancy*.

4) Systems used for ventilation shall conform to the energy efficiency requirements in Section 9.36.

9.32.1.2. Required Ventilation

1) Every *residential occupancy* shall incorporate
a) provisions for non-heating-season ventilation in accordance with Subsection 9.32.2., and
b) except as required by Sentences (2) and (3), if supplied with electrical power and a heating system, provisions for heating-season ventilation in accordance with Part 6.

2) A self-contained heating-season ventilation system serving a single *dwelling unit* shall comply with Subsection 9.32.3. (See Appendix A.)

3) In houses that contain a *secondary suite*, heating-season ventilation need not be provided for
a) *exits*,
b) *public corridors*, and
c) ancillary spaces that are not within a *dwelling unit*, except as provided in Sentence (4).

(See A-9.32.1.2.(2) in Appendix A.)

4) Where ancillary spaces described in Clause (3)(c) contain exhaust devices, these spaces shall be provided with make-up air in accordance with Article 9.32.3.8.

9.32.2. Non-Heating-Season Ventilation

9.32.2.1. Required Ventilation

1) The non-heating-season ventilation required by Clause 9.32.1.2.(1)(a) shall be supplied by
a) natural ventilation in accordance with Article 9.32.2.2., or
b) a mechanical ventilation system in accordance with Article 9.32.2.3.

9.32.2.2. Non-Heating-Season Natural Ventilation

1) The unobstructed openable ventilation area to the outdoors for rooms and spaces in residential *buildings* ventilated by natural means shall conform to Table 9.32.2.2.

Table 9.32.2.2.
Natural Ventilation Area
Forming Part of Sentence 9.32.2.2.(1)

Location		Minimum Unobstructed Area
Within a *dwelling unit*	Bathrooms or water-closet rooms	0.09 m^2
	Unfinished *basement* space	0.2% of the *floor area*
	Dining rooms, living rooms, bedrooms, kitchens, combined rooms, dens, recreation rooms and all other finished rooms	0.28 m^2 per room or combination of rooms
Other than within a *dwelling unit*	Bathrooms or water-closet rooms	0.09 m^2 per water closet
	Sleeping areas	0.14 m^2 per occupant
	Laundry rooms, kitchens, recreation rooms	4% of the *floor area*
	Corridors, storage rooms and other similar public rooms or spaces	2% of the *floor area*
	Unfinished *basement* space not used on a shared basis	0.2% of the *floor area*

2) Where a vestibule opens directly off a living or dining room within a *dwelling unit*, ventilation to the outdoors for such rooms may be through the vestibule.

3) Openings for natural ventilation other than windows shall provide protection from the weather and insects.

4) Screening shall be of corrosion-resistant material.

9.32.2.3. Non-Heating-Season Mechanical Ventilation

1) Where a habitable room or space is not provided with natural ventilation as described in Article 9.32.2.2. and is mechanically cooled, its non-heating-season mechanical ventilation system shall

a) have the capacity to exhaust air from inside the room or space, or to introduce outdoor air into that room or space, at a rate conforming with Table 9.32.2.3., or
b) comply with Subsection 9.32.3.

2) In applying Clause (1)(a),

a) at least one bedroom in each *dwelling unit* shall be designated as the master bedroom,
b) air change rates for any combined living/dining or family/dining space shall be determined as if the spaces were individual rooms,
c) where a *basement* incorporates rooms of the types designated in Table 9.32.2.3., the assigned air change rate for each room shall be as specified for those types of rooms,
d) *basement* areas used for other purposes that exceed 2/3 of the total *basement floor area* shall be assigned an air change rate of 10 L/s,
e) *basement* areas used for other purposes that are 2/3 of the total *basement floor area* or less shall be assigned an air change rate of 5 L/s, and
f) other habitable rooms, other than spaces intended solely for access, egress, storage, or service equipment, shall be assigned an air change rate of 5 L/s.

Table 9.32.2.3.
Air Change Rate
Forming Part of Clause 9.32.2.3.(1)(a)

Room or Space	Rate, L/s
Master bedroom	10
Other bedrooms	5
Living room	5
Dining room	5
Family room	5
Recreation room	5
Basement	10
Kitchen	5
Bathroom or water-closet room	5
Laundry room	5
Utility room	5
Other habitable rooms	5

3) Where a habitable room or space is not provided with natural ventilation as described in Article 9.32.2.2. and is not mechanically cooled, the non-heating-season mechanical ventilation system shall have the capacity to exhaust indoor air from the room or space or to introduce outdoor air to that room or space at a rate of one air change per hour.

4) A non-heating-season mechanical ventilation system shall be designed and installed in conformance with good practice such as that described in the ASHRAE Handbooks and Standards, the HRAI Digest, the Hydronics Institute Manuals and the SMACNA manuals.

9.32.3. Heating-Season Mechanical Ventilation

(See Appendix A.)

9.32.3.1. Required Ventilation

1) The heating-season ventilation required by Clause 9.32.1.2.(1)(b) shall be provided by a mechanical ventilation system complying with

a) good practice such as that described in CAN/CSA-F326-M, "Residential Mechanical Ventilation Systems,"
b) for *dwelling units* with 5 or fewer bedrooms, the balance of this Subsection, or
c) Part 6.

(See Appendix A.)

2) Mechanical ventilation systems complying with the balance of this Subsection shall incorporate at least the following components:

a) a principal ventilation system complying with Article 9.32.3.3.,
b) supplemental exhaust fans complying with Article 9.32.3.7., and
c) protection against depressurization in accordance with Article 9.32.3.8.

9.32.3.2. Design and Installation

1) Aspects of mechanical ventilation systems not specifically described in this Subsection shall be designed, constructed and installed in accordance with good practice such as that described in the ASHRAE Handbooks and Standards, the HRAI Digest, the HRAI Residential Mechanical Ventilation Manual, the Hydronics Institute Manuals and the SMACNA manuals.

2) Ventilation system equipment installed to meet the requirements of this Section shall be installed in accordance with the manufacturers' instructions and recommendations except that, where such instructions and recommendations are in

4) Where a fuel-burning *appliance* is installed in a *suite* of *residential occupancy*, a CO alarm shall be installed

a) inside each bedroom, or
b) outside each bedroom, within 5 m of each bedroom door, measured following corridors and doorways.

5) Where a fuel-burning *appliance* is installed in a *service room* that is not in a *suite* of *residential occupancy*, a CO alarm shall be installed

a) either inside each bedroom, or if outside, within 5 m of each bedroom door, measured following corridors and doorways, in every *suite* of *residential occupancy* that shares a wall or floor/ceiling assembly with the *service room*, and
b) in the *service room*.

6) For each *suite* of *residential occupancy* that shares a wall or floor/ceiling assembly with a *storage garage* or that is adjacent to an attic or crawl space to which the *storage garage* is also adjacent, a CO alarm shall be installed

a) inside each bedroom, or
b) outside each bedroom, within 5 m of each bedroom door, measured following corridors and doorways.

7) Where CO alarms are installed in a house with a *secondary suite* including their common spaces, the CO alarms shall be wired so that the activation of any one CO alarm causes all CO alarms within the house with a *secondary suite* including their common spaces to sound.

9.32.3.10. Fans

(See Appendix A.)

1) Except as provided in Sentence (4), capacity ratings for required fans shall be determined in accordance with

a) CAN/CSA-C260-M, "Rating the Performance of Residential Mechanical Ventilating Equipment," or
b) HVI 916, "Airflow Test Standard."

2) Sound ratings for fans shall be determined in accordance with

a) CAN/CSA-C260-M, "Rating the Performance of Residential Mechanical Ventilating Equipment," or
b) HVI 915, "Procedure for Loudness Rating of Residential Fan Products."

3) Capacity ratings for fans shall be measured at the external static pressure differentials shown in Table 9.32.3.10.A.

4) Fans in heat recovery ventilators used to provide one or more required fans shall have their airflow at normal temperature rated in accordance with CAN/CSA-C439, "Rating the Performance of Heat/Energy-Recovery Ventilators."

Table 9.32.3.10.A.
Minimum External Static Pressure Differential for Rating of Fans
Forming Part of Sentence 9.32.3.10.(3)

Fan Configuration or Application	Minimum External Static Pressure Differential to be Used in Determining Rated Capacity
Fans installed with ducts connected on both sides, any application	100 Pa (0.4 inch water column)
Fans installed with ducts on one side only, used as the principal ventilation fan in exhaust-only systems permitted by Article 9.32.3.6.	62 Pa (0.25 inch water column)
Other required fans	25 Pa (0.1 inch water column)

5) Where a heat recovery ventilator is used to provide one or more required fans, it shall have a low-temperature ventilation reduction factor of not less than 50% when tested in accordance with CAN/CSA-C439, "Rating the Performance of Heat/Energy-Recovery Ventilators," at an outdoor temperature at least as low as the

outdoor design temperature for the location where the ventilation system is to be installed, but the outdoor design temperature need not be lower than -25°C.

6) Fans, including makeup air supply fans, installed to satisfy Articles 9.32.3.3. to 9.32.3.8. with less than 1 m of duct between themselves and the visible interior surfaces of rooms other than unfinished *basements*, furnace rooms, utility rooms and attics, shall have a sound rating complying with Table 9.32.3.10.B. when operating at the required flow rate.

Table 9.32.3.10.B.
Maximum Sound Rating for Fans
Forming Part of Sentence 9.32.3.10.(6)

Fan Application	Maximum Sound Rating, sones	
	Rated according to CAN/CSA-C260-M	Rated according to HVI 915
Principal ventilation fan	2.0	2.5
Supplemental fans installed in bathrooms and their makeup air fans	2.5	3.5
Supplemental fans installed in kitchens and their makeup air fans	No rating required	No rating required

7) Mechanical ventilation devices shall conform to CSA C22.2 No. 113-M, "Fans and Ventilators."

9.32.3.11. Ducts

(See Appendix A.)

1) Except as provided in Sentence (6), ventilation ducts and their fittings shall conform to the requirements of Article 9.33.6.2., except that *exhaust ducts* serving only a bathroom or water-closet room are permitted to be of *combustible* material, provided they are reasonably airtight and constructed of a material impervious to water.

2) *Exhaust ducts* shall not discharge into heated or unheated enclosed spaces.

3) Where an *exhaust duct* passes through an unheated space or is not separated from an unheated space by an insulated *building* assembly, the duct shall be insulated to not less than RSI 0.5.

4) Where a duct carrying outdoor air that is not tempered and not mixed with indoor air passes through heated space, it shall be

a) insulated to not less than RSI 0.5, and
b) provided with a *vapour barrier*.

5) All exhaust intakes located within 3 m horizontally of a *cooktop* shall be equipped with a grease filter at the intake end.

6) Ductwork for cooking *appliance* exhaust fans shall

a) be of *noncombustible*, corrosion-resistant material,
b) lead directly to the outdoors with no connections to other exhaust fans or ducts, and
c) be equipped with a grease filter at the intake end.

7) All ductwork shall be installed to avoid crushing and shall be permanently supported to prevent sagging.

8) Joints in all ventilation system ducting shall be sealed with mastic, metal foil duct tape or the manufacturers' specified sealants.

9) Except where the size of a duct can be determined using Table 9.32.3.11.A. or Table 9.32.3.11.B., duct sizes shall be determined according to Subsection 9.33.4.

2) The distance from the bottom of an air intake opening to finished ground or to any nearer and lower permanent horizontal surface shall be not less than 450 mm or the depth of expected snow accumulation, whichever is greater.

3) The distance separating air intakes from *building* envelope penetrations that are potential sources of contaminants, such as *gas vents* or oil fill pipes, shall be not less than 900 mm.

4) Air intakes shall be clearly labeled as such for identification from locations outside the *dwelling unit*.

5) The distance from the bottom of an exhaust outlet to finished ground or to any nearer and lower permanent horizontal surface shall be not less than 100 mm.

6) Where air intake and exhaust openings are in exposed locations, provision shall be made to protect them from the entry of precipitation by the use of louvres, weather cowls or other suitable protection.

7) Air intake openings shall incorporate screens or grilles to protect against the entry of animals and insects.

8) Except for exhaust outlets serving heat recovery ventilators, exhaust outlets shall incorporate backdraft dampers.

9) An exhaust outlet that does not incorporate a backdraft damper located at the *building* envelope shall incorporate a screen located at the *building* envelope to protect against the entry of animals.

10) Screens, grilles and filters installed in air intake and exhaust openings shall be easily removable for cleaning purposes, without the need for special tools.

11) Where screens or grilles are installed in air intake and exhaust openings, the net free area of the air intake or exhaust opening shall be equal to or greater than the required cross-sectional area of the duct served or such openings shall comply with Table 9.32.3.13.

12) Screens and grilles shall be of corrosion-resistant material.

Table 9.32.3.13.
Area of Openings with Screens or Grilles
Forming Part of Sentence 9.32.3.13.(11)

Mesh Size of Screen or Grille, mm	Area of Opening
Less than 4	3 times required area of duct served
4 to 6	2 times required area of duct served
Larger than 6	Required area of duct served

Section 9.33. Heating and Air-conditioning

9.33.1. General

9.33.1.1. Application

1) This Section applies to the design and installation of
a) heating systems, including requirements for combustion air, and air-conditioning systems serving only one *dwelling unit*, and
b) radiant heating systems in houses with a *secondary suite* including their common spaces.

2) The design and installation of heating systems, including requirements for combustion air, and air-conditioning systems other than those described in Sentence (1) shall conform to Part 6. (See Appendix A and Subsection 9.10.10.)

3) Air duct distribution systems serving one of the *dwelling units* in a house with a *secondary suite* shall not be directly interconnected with other parts of the house.

4) Systems used for heating and air-conditioning shall conform to the energy efficiency requirements in Section 9.36.

9.33.2. Required Heating Systems

9.33.2.1. Required Heating Systems

1) Residential *buildings* intended for use in the winter months on a continuing basis shall be equipped with heating facilities conforming to this Section.

9.33.3. Design Temperatures

9.33.3.1. Indoor Design Temperatures

1) At the outside winter design temperature, required heating facilities shall be capable of maintaining an indoor air temperature of not less than

a) 22°C in all living spaces,
b) 18°C in unfinished *basements*,
c) 18°C in common *service rooms*, ancillary spaces and *exits* in houses with a *secondary suite*, and
d) 15°C in heated crawl spaces.

9.33.3.2. Outdoor Design Temperatures

1) The outdoor conditions to be used in designing heating and air-conditioning systems shall be determined in conformance with Article 1.1.3.1.

9.33.4. General Requirements for Heating and Air-conditioning Systems

9.33.4.1. Design of Heating and Air-conditioning Systems

1) Heating and air-conditioning systems, including ducting, and mechanical heating and refrigeration equipment, shall be designed, constructed and installed to conform to the relevant provincial or territorial regulations or municipal bylaws or, in the absence of such regulations or bylaws, with good practice such as that described in the ASHRAE Handbooks and Standards, the HRAI Digest, the CHC Handbook on Hydronic Heating Systems, the Hydronics Institute Manuals and the SMACNA Manuals. (See also Subsection 9.32.3. for the design of systems that also provide ventilation.)

9.33.4.2. Installation of Hydronic Heating Systems

1) The installation of a hydronic heating system shall conform to applicable provincial or territorial regulations or municipal bylaws or, in the absence of such regulations or bylaws, to CAN/CSA-B214, "Installation Code for Hydronic Heating Systems."

9.33.4.3. Heating System Control

1) Where a single heating system serves a house with a *secondary suite*, individual temperature controls shall be provided in each *dwelling unit* served by the system. (See Appendix A.)

9.33.4.4. Access

1) Equipment forming part of a heating or air-conditioning system, with the exception of embedded pipes or ducts, shall be installed with provision for access for inspection, maintenance, repair and cleaning.

Table 9.34.2.7.
Lighting for Public Areas
Forming Part of Sentences 9.34.2.7.(2) and (3)

Room or Space	Minimum Illumination, lx	Minimum Lighting Power Density, W/m^2 of *floor area* (incandescent lighting)
Storage rooms	50	5
Service rooms and laundry areas	200	20
Garages	50	5
Public water closet rooms	100	10
Service hallways and stairways	50	5
Recreation rooms	100	10

9.34.3. Emergency Lighting

9.34.3.1. Criteria for Emergency Lighting

1) Emergency lighting shall conform to Subsection 9.9.12.

Section 9.35. Garages and Carports

9.35.1. Scope

9.35.1.1. Application

1) This Section applies to garages and carports serving not more than one *dwelling unit*.

9.35.1.2. Construction Requirements

1) The construction of a garage or carport shall conform to the requirements for other *buildings* in this Part except as provided in this Section.

9.35.2. General

9.35.2.1. Carport Considered to be Garage

1) Where a roofed enclosure used for the storage or parking of motor vehicles has more than 60% of the total perimeter enclosed by walls, doors or windows, the enclosure shall be considered a garage.

9.35.2.2. Garage Floor

1) Where an attached or built-in garage is provided and where adjacent spaces in the *building* are less than 50 mm above the garage floor,

a) the garage floor shall be sloped to the outdoors, or
b) where the garage can accommodate not more than 3 vehicles, an airtight curb or *partition* not less than 50 mm high shall be installed at the edges of the garage floor adjacent to interior space.

(See Appendix A.)

9.35.3. Foundations

9.35.3.1. Foundation Required

1) Except as permitted in this Subsection, *foundations* conforming to Sections 9.12. and 9.15. shall be provided for the support of carport and garage super-structures, including that portion beneath garage doors.

9.35.3.2. Protection from Damage due to Soil Movement

1) In clay-type *soils* subject to significant movement with a change in *soil* moisture content, the *foundation* depth of carports or garages connected to a *dwelling unit* directly or by a breezeway shall be approximately the same depth as the main *building foundation*.

2) Where slab-on-ground construction is used, a construction joint shall be provided between the main *building* slab and a slab serving an attached garage, breezeway or carport.

3) Except as provided in Section 9.12., *foundations* for attached unheated garages or carports shall be below frost level.

9.35.3.3. Small Garages

1) Detached garages of less than 55 m^2 *floor area* and not more than 1 *storey* in height are permitted to be supported on wood mud sills provided the garage is not of masonry or masonry veneer construction.

9.35.3.4. Column Piers

1) Piers for the support of carport columns shall extend not less than 150 mm above ground level.

2) Piers referred to in Sentence (1) shall project not less than 25 mm beyond the base of the column but in no case be less than 190 mm by 190 mm in size.

9.35.4. Walls and Columns

9.35.4.1. Interior Finish

1) Interior finish need not be applied to garage and carport walls.

9.35.4.2. Columns

1) Columns for garages and carports shall conform to Section 9.17., except that 89 mm by 89 mm wood columns may be used.

9.35.4.3. Anchorage

1) Garage or carport walls and columns shall be anchored to the *foundation* to resist wind uplift in conformance with Subsection 9.23.6., except that where a garage is supported on the surface of the ground, ground anchors shall be provided to resist wind uplift.

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 Appendix A.)

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* in accordance with the requirements of the Code that are not within a *suite* but shall not include crawl spaces and *vertical service spaces*. (See A-9.36.1.3.(3) in Appendix A.)

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

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 $(m^2 \cdot K)/W$. (See Appendix A.)

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 Appendix A.)

9.36.1.3. Compliance and Application

(See Appendix A.)

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., or
c) the NECB.

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) Subsection 9.36.5. applies 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 Appendix A.)

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 required to be *conditioned spaces* are exempted from the requirements of this Section. (See Appendix A.)

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 Appendix A and A-9.36.1.3.(5) in Appendix A.)

3) Except for skylight shafts addressed in Sentence 9.36.2.6.(3), 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. in Appendix A 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 A440.2-09, 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 Appendix A.)

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 –35±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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

6) 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 Appendix A.)

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·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 Appendix A.)

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 Appendix A.)

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), (m²·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), (m²·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·K)/W. (See Appendix A.)

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 (8) and Article 9.36.2.11., fenestration and doors shall have an overall thermal transmittance (U-value) not greater than, or an Energy Rating not less than, the values listed in Table 9.36.2.7.A. for the applicable heating-degree day category. (See Appendix A.)

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/(m^2·K)	1.80	1.80	1.60	1.60	1.40	1.40
	Min. Energy Rating	21	21	25	25	29	29

Notes to Table 9.36.2.7.A.:
(1) See Appendix 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 Appendix A.)

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/(m^2·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 Appendix A.)

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 ≤ 3999 HDD			Climate Zones 6 and 7A 4000 to 5999 HDD			Climate Zones 7B and 8 ≥ 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) One door separating a *conditioned space* from an unconditioned space or the exterior is permitted to have an overall thermal transmittance up to 2.6 W/(m²·K).

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.

9.36.2.8. 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 Appendix A.)

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), $(m^2 \cdot K)/W$					
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 Appendix A.

(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

Table 9.36.2.8.B. (Continued)

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·K)/W					
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 Appendix A.
(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 Appendix A.)

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 Appendix A.)

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 Appendix A.) (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."

(See Appendix A.)

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" (Canadian Supplement).

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 Appendix A.)

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 Appendix A.)

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 A-9.25.5.1.(1) in Appendix A 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 A-9.36.2.10.(5)(b) in Appendix A.)

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

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 Appendix A), 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 Appendix 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 Appendix A.) (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 Appendix A.)

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 Appendix A.)

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 Appendix A and A-9.36.2.11.(2) and (3) in Appendix A.)

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 Appendix A and A-9.36.2.11.(2) and (3) in Appendix A.)

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 Appendix A and A-9.36.2.11.(2) and (3) in Appendix A.)

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) RSI = 20/(57-ER), where the energy rating is known.

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 Appendix 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 Appendix A.)

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

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·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 Appendix A.)

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 3500 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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 CAN/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 Appendix A.)

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 Appendix A.)

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 ANSI/AHRI 1060, "Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation,"(see Appendix 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 Appendix A.)

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 Appendix A.)

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

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 Appendix A.)

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

Air-Cooled Unitary Air Conditioners and Heat Pumps – Electrically Operated			
Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance(1)
Split system	≤ 19	CAN/CSA-C656	SEER = 14.5 EER = 11.5 HSPF = 7.1 (region 5 in standard)
Single-package system	≤ 19	CAN/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			
Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance(1)
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		$COP_c \geq 3.52$, $COP_h \geq 4.2$

Table 9.36.3.10. (Continued)

Water-Cooled Unitary Air Conditioners and Heat Pumps – Electrically Operated			
Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance[1]
Water-cooled air conditioners – all types	< 19	ANSI/AHRI 210/240 or CTI 201	COP = 3.54, ICOP = 3.60
Direct-Expansion Ground-Source Heat Pumps – Electrically Operated			
Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance[1]
Direct-expansion ground-source heat pumps	≤ 21	CSA C748	EER = 13.0
			COP_h = 3.1
Room Air Conditioners and Room Air Conditioner Heat Pumps			
Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance[1]
Room air conditioners with reverse cycle			
with louvered sides	< 10.55	ANSI/AHAM RAC-1	EER = 8.5
without louvered sides			EER = 8.0

Table 9.36.3.10. (Continued)

Room Air Conditioners and Room Air Conditioner Heat Pumps			
Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance(1)
Room air conditioners without reverse cycle and with louvered sides	< 1.8	CAN/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			
Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance(1)
Electric *boilers*	≤ 88		Must be equipped with automatic water temperature control(2)
Gas-fired *boilers*(3)	≤ 88	CAN/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			
Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance(1)
Gas-fired warm-air *furnaces*(3)	≤ 65.9	CAN/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)

Warm-Air Furnaces, Combination Warm-Air Furnace/Air-conditioning Units, Duct Furnaces and Unit Heaters			
Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance(1)
Combined space- and water-heating systems (combos)	≤ 87.9 if *boiler*-based ≤ 73.2 if based on *service water heater*	CAN/CSA-P.9(4)	TPF = 0.65
Integrated mechanical systems	—	CSA P.10	OTPF = 0.78
Other			
Component or Equipment	Heating or Cooling Capacity, kW	Standard	Minimum Performance(1)
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 (COP_c = in cooling mode and COP_h = 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 Appendix A.)

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 NPC.

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 Appendix A.)

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)

Storage-Type Service Water Heaters			
Component	Input[1]	Standard	Performance Requirement[2]
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	E_t ≥ 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	E_t ≥ 78% and standby loss ≤ rated input[4]/(800 + 16.57·√V)
Tankless Service Water Heaters			
Component	Input[1]	Standard	Performance Requirement[2]
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	$EF \geq 0.59 - 0.0019V_m$
	Other	ANSI Z21.10.3/CSA 4.3 and DOE 10 CFR, Part 431, Subpart G	E_t ≥ 80%
Electric	—	—	[6]

Table 9.36.4.2. (Continued)

Tankless Service Water Heaters			
Component	Input[1]	Standard	Performance Requirement[2]
Combined space- and water-heating systems (combos)	≤ 87.9 kW if *boiler*-based ≤ 73.2 kW if based on *service water heater*	CAN/CSA-P.9	TPF = 0.65
Integrated mechanical systems	—	CSA P.10	OTPF = 0.78
Pool Heaters			
Component	Input[1]	Standard	Performance Requirement[2]
Gas-fired[3]	< 117.2 kW	ANSI Z21.56/CSA 4.7 or CSA P.6	$E_t \geq 82\%$
Oil-fired	—	CSA B140.12	$E_t \geq 75\%$

Notes to Table 9.36.4.2.:

(1) 1 kW = 3.412 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 US 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 Appendix A.)

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 NPC.

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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

Table 9.36.5.4. (Continued)

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 Appendix A.)

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 Sentence 9.36.5.10.(10) or (11), as applicable.

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 Appendix A.)

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 A-1.1.3.1.(1) in Appendix A), 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 Appendix A.)

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.(3).

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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·°C.

7) Exterior walls, roofs and exposed floors shall have an 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) 3.2 air changes per hour at 50 Pa pressure differential, where the construction complies with Section 9.25.,
b) 2.5 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) where airtightness is tested in accordance with Sentence (11),
   i) the number of air changes per hour at 50 Pa pressure differential, and
   ii) the equivalent leakage area (see Appendix A).

10) A design airtightness 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, "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 Appendix A.)

12) Where airtightness is determined in accordance with Sentence (11) using air changes per hour, the result obtained at an air pressure differential of 50 Pa shall be used in the energy model calculations.

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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) 0.0194 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 Appendix A.)

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 A-9.36.5.9.(1) in Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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 Appendix A.)

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) 0.0194 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 US Congress National Appliance Energy Conservation Act of 1987.

Section 9.37. Objectives and Functional Statements

9.37.1. Objectives and Functional Statements

9.37.1.1. Attributions to Acceptable Solutions

1) For the purpose of compliance with this Code as required in Clause 1.2.1.1.(1)(b) of Division A, the objectives and functional statements attributed

to the acceptable solutions in this Part shall be the objectives and functional statements listed in Table 9.37.1.1. (See A-1.1.2.1.(1) in Appendix A.)

Table 9.37.1.1.

Table 9.37.1.1. is located in Volume 1, Attribution Tables.

Appendix A
Explanatory Material

A-1.1.2.1.(1) Objectives and Functional Statements Attributed to Acceptable Solutions. The objectives and functional statements attributed to each Code provision are shown in Tables at the end of Volume 1.

Many provisions in Division B serve as modifiers of or pointers to other provisions, or serve other clarification or explanatory purposes. In most cases, no objectives and functional statements have been attributed to such provisions, which therefore do not appear in the above-mentioned tables.

For provisions that serve as modifiers of or pointers to other referenced provisions and that do not have any objectives and functional statements attributed to them, the objectives and functional statements that should be used are those attributed to the provisions they reference.

A-1.1.3.1.(1) Climatic and Seismic Values. Climatic values for municipalities not listed in Appendix C may be obtained by writing to the Meteorological Service of Canada, Environment Canada, 4905 Dufferin Street, Toronto, Ontario M3H 5T4.

Seismic values for municipalities not listed in Appendix C may be obtained through the Natural Resources Canada Web site at www.EarthquakesCanada.ca, or by writing to the Geological Survey of Canada at 7 Observatory Crescent, Ottawa, Ontario K1A 0Y3, or at P.O. Box 6000, Sidney, B.C. V8L 4B2.

A-1.1.3.1.(2) Winter Design Temperatures. The 2.5% values referred to in Sentence 1.1.3.1.(2) are the least restrictive temperatures that can be used. A designer may choose to use the 1% values given in Appendix C, which are in excess of the Code minimums but are considered acceptable.

A-1.3.1.2.(1) Applicable Editions. Where documents are referenced in Appendices A, B and C of this Code, they shall be the editions designated in Table A-1.3.1.2.(1).

Table A-1.3.1.2.(1)
Documents Referenced in Appendices A, B and C of the National Building Code of Canada 2010

Issuing Agency	Document Number(1)	Title of Document(2)	Code Reference
ASCE	SEI/ASCE 8-02	Design of Cold-Formed Stainless Steel Structural Members	A-4.3.4.2.(1)
ANSI/ ASHRAE	62-2001	Ventilation for Acceptable Indoor Air Quality (except Addendum n)	A-9.25.5.2.
ASHRAE	2009	ASHRAE Handbook – Fundamentals	A-9.36.2.4.(1) Table A-9.36.2.4.(1)D.
ASME	B18.6.1-1981	Wood Screws (Inch Series)	A-9.23.3.1.(3)
ASME/CSA	ASME A17.1-2007/CSA B44-07	Safety Code for Elevators and Escalators	A-3.5.2.1.(1)
ASTM	A 390-06	Zinc-Coated (Galvanized) Steel Poultry Fence Fabric (Hexagonal and Straight Line)	Table A-9.10.3.1.B.
ASTM	C 516-08	Vermiculite Loose Fill Thermal Insulation	A-9.25.2.4.(5)
ASTM	C 1193-09	Use of Joint Sealants	A-Table 5.10.1.1. A-9.27.4.2.(1)

This Appendix is included for explanatory purposes only and does not form part of the requirements. The numbers that introduce each Appendix Note correspond to the applicable requirements in this Division.

Table A-1.3.1.2.(1) (Continued)

Issuing Agency	Document Number[1]	Title of Document[2]	Code Reference
ASTM	C 1299-03	Selection of Liquid-Applied Sealants	A-Table 5.10.1.1. A-9.27.4.2.(1)
ASTM	C 1472-00	Calculating Movement and Other Effects When Establishing Sealant Joint Width	A-Table 5.10.1.1. A-9.27.4.2.(1)
ASTM	D 1037-06a	Evaluating Properties of Wood-Base Fiber and Particle Panel Materials	A-9.23.15.2.(4)
ASTM	D 1143/D 1143M-07e1	Deep Foundations Under Static Axial Compressive Load	A-4.2.7.2.(2)
ASTM	E 336-05	Measurement of Airborne Sound Attenuation between Rooms in Buildings	A-9.11.1.1.(1)
ASTM	E 492-09	Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using The Tapping Machine	A-9.11.1.1.(1)
ASTM	E 597-95	Determining a Single Number Rating of Airborne Sound Insulation for Use in Multi-Unit Building Specifications	A-9.11.1.1.(1)
ASTM	E 736-00	Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members	Table A-9.10.3.1.B.
ASTM	E 1007-04e1	Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures	A-9.11.1.1.(1)
ASTM	E 2357-11	Determining Air Leakage of Air Barrier Assemblies	A-9.36.2.9.(1)
ASTM	F 476-84	Security of Swinging Door Assemblies	A-9.7.5.2.(2)
CCBFC	NRCC 35951	Guidelines for Application of Part 3 of the National Building Code of Canada to Existing Buildings	A-1.1.1.1.(1)[3]
CCBFC	NRCC 38730	Model National Energy Code of Canada for Houses 1997	A-9.36.3.10.(1) A-9.36.4.2.(1)
CCBFC	NRCC 54435	National Energy Code of Canada for Buildings 2011	A-9.36.1.3. A-9.36.2.4.(1) A-9.36.3.10.(1) A-9.36.4.2.(1) A-9.36.5.2.
CCBFC	NRCC 38732	National Farm Building Code of Canada 1995	A-1.4.1.2.(1)[3] A-Table 4.1.2.1. A-5.1.2.1.(1)
CCBFC	NRCC 53303	National Fire Code of Canada 2010	A-1.1.1.1.(1)[3] A-2.2.1.1.(1)[3] A-3.1.2.3.(1) A-3.2.1.1.(1)[3] A-3.2.4.7.(2) A-3.2.7.8.(3) A-3.3. A-3.3.1.2.(1) A-3.3.1.7.(1) A-3.3.3.1.(1) A-3.3.6.1.(1) B-3.2.6.
CCBFC	NRCC 53302	National Plumbing Code of Canada 2010	A-2.2.1.1.(1)[3] A-3.2.1.1.(1)[3] A-4.1.6.4.(3) A-9.36.5.8.(5) Appendix C
CCBFC	NRCC 43963	User's Guide – NBC 1995, Application of Part 9 to Existing Buildings	A-1.1.1.1.(1)[3]
CCBFC	NRCC 40383	User's Guide – NBC 1995, Fire Protection, Occupant Safety and Accessibility (Part 3)	A-1.1.1.1.(1)[3]

Table A-1.3.1.2.(1) (Continued)

Issuing Agency	Document Number[1]	Title of Document[2]	Code Reference
CCBFC	NRCC 53543	User's Guide – NBC 2010, Structural Commentaries (Part 4 of Division B)	A-1.1.1.1.(1)[3] A-4.1.1.3.(1) A-4.1.1.3.(2) A-4.1.2.1. A-4.1.2.1.(1) A-4.1.3. A-4.1.3.2.(2) A-4.1.3.2.(4) A-4.1.3.2.(5) A-4.1.3.3.(2) A-4.1.3.4.(1) A-4.1.3.5.(1) A-4.1.3.5.(3) A-4.1.3.6.(1) A-4.1.3.6.(2) A-4.1.3.6.(3) A-4.1.5.8. A-4.1.5.17. A-4.1.6.2. A-4.1.6.2.(4)(b) A-4.1.6.3.(2) A-4.1.6.4.(1) A-4.1.7.1.(1) to (3) A-4.1.7.1.(5)(a) to (c) A-4.1.7.1.(5)(d) A-4.1.7.1.(6)(a) A-4.1.7.1.(6)(c) A-4.1.7.1.(6)(d) and 4.1.7.2.(1)(b) A-4.1.7.2.(1) and (2) A-4.1.7.3.(1) A-4.1.8.2.(1) A-4.1.8.3.(4) A-4.1.8.3.(6) A-4.1.8.3.(7)(b) and (c) A-4.1.8.3.(8) A-4.1.8.4.(3) and Table 4.1.8.4.A. A-Table 4.1.8.5. A-Table 4.1.8.6. A-4.1.8.7.(1) A-4.1.8.9.(4) A-4.1.8.9.(5) A-4.1.8.11.(3) A-4.1.8.12.(1)(a) A-4.1.8.12.(1)(b) A-4.1.8.12.(3) A-4.1.8.12.(4)(a) A-4.1.8.13.(4) A-4.1.8.15.(1) A-4.1.8.15.(3) A-4.1.8.15.(4) A-4.1.8.15.(5) A-4.1.8.15.(6) A-4.1.8.15.(7) A-4.1.8.16.(1) A-4.1.8.16.(3)(a) A-4.1.8.16.(4) A-4.1.8.16.(5)(a) A-4.1.8.16.(7) A-4.1.8.17.(1)

Table A-1.3.1.2.(1) (Continued)

Issuing Agency	Document Number[1]	Title of Document[2]	Code Reference
CCBFC	NRCC 53543	User's Guide – NBC 2010, Structural Commentaries (Part 4 of Division B) (cont.)	A-4.1.8.18. A-4.2.4.1.(3) A-4.2.4.1.(5) A-4.2.5.1.(1) A-4.2.6.1.(1) A-4.2.7.2.(1) A-5.1.4.2. Appendix C
CGSB	CAN/CGSB-7.2-94	Adjustable Steel Columns	A-9.17.3.4.
CGSB	CAN/CGSB-12.20-M89	Structural Design of Glass for Buildings	A-9.6.1.3.(1)
CGSB	CAN/CGSB-71.26-M88	Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems	Table A-9.23.4.2.(2)C.
CGSB	CAN/CGSB-82.6-M86	Doors, Mirrored Glass, Sliding or Folding, Wardrobe	A-9.6.1.2.(2)
CGSB	CAN/CGSB-93.1-M85	Sheet, Aluminum Alloy, Prefinished, Residential	A-9.27.11.1.(3) and (4)
CGSB	CAN/CGSB-93.2-M91	Prefinished Aluminum Siding, Soffits, and Fascia, for Residential Use	A-9.27.11.1.(3) and (4)
CGSB	CAN/CGSB-149.10-M86	Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method	A-9.36.5.10.(11)
CISC	2009	Crane-Supporting Steel Structures: Design Guide	A-4.1.3.2.(2)
CMHC	1993	Testing of Fresh Air Mixing Devices	A-9.32.3.4.
CMHC	1988	Air Permeance of Building Materials	A-5.4.1.2.(1) and (2) Table A-9.25.5.1.(1)
CMHC/HC	2007	Radon: A Guide for Canadian Homeowners	A-5.4.1.1. A-6.2.1.1. A-9.13.4.3.
CSA	CAN/CSA-A23.3-04	Design of Concrete Structures	A-4.1.3.2.(4) A-4.3.3.1.(1)
CSA	A23.4-05	Precast Concrete – Materials and Construction	A-4.3.3.1.(1)
CSA	A82.31-M1980	Gypsum Board Application	Table A-9.10.3.1.A. Table A-9.10.3.1.B.
CSA	CAN/CSA-A277-08	Procedure for Factory Certification of Buildings	A-1.1.1.1.(2)[3]
CSA	CAN/CSA-A370-04	Connectors for Masonry	A-9.21.4.5.(2)
CSA	AAMA/WDMA/CSA 101/I.S.2/A440-08	NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights	A-5.3.1.2. A-9.7.4.2.(1)
CSA	A440S1-09	Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS – North American Fenestration Standard/Specification for Windows, Doors, and Skylights	A-5.10.2.2. A-9.7.4.2.(1)
CSA	A440.2-09	Fenestration Energy Performance	A-9.7.4.2.(1)
CSA	A440.2-09/A440.3-09	Fenestration Energy Performance/User Guide to CSA A440.2-09, Fenestration Energy Performance	A-Table 9.36.2.7.A.
CSA	B111-1974	Wire Nails, Spikes and Staples	A-Table 9.23.3.5.B.
CSA	CAN/CSA-B149.1-05	Natural Gas and Propane Installation Code	A-9.10.22.
CSA	CAN/CSA-B214-07	Installation Code for Hydronic Heating Systems	A-9.36.3.4.(1)
CSA	CAN/CSA-B365-01	Installation Code for Solid-Fuel-Burning Appliances and Equipment	A-9.33.1.1.(2) A-9.33.5.3.
CSA	C22.1-09	Canadian Electrical Code, Part I	A-3.1.4.3.(1)(b)(i) A-3.2.4.21.(6)(a) A-3.3.6.2.(4) A-9.10.22. A-9.34.2. A-9.35.2.2.(1)

Table A-1.3.1.2.(1) (Continued)

Issuing Agency	Document Number[1]	Title of Document[2]	Code Reference
CSA	CAN/CSA-C439-00	Rating the Performance of Heat/Energy-Recovery Ventilators	A-9.36.3.9.(3)
CSA	CAN/CSA-F280-M90	Determining the Required Capacity of Residential Space Heating and Cooling Appliances	A-9.36.3.2.(1) A-9.36.5.15.(5)
CSA	CAN/CSA-F326-M91	Residential Mechanical Ventilation Systems	A-9.32.3.1.(1) A-9.32.3.5. A-9.32.3.7. A-9.32.3.8. A-9.33.6.13.
CSA	O86-09	Engineering Design in Wood	A-9.15.2.4.(1) A-9.23.4.2.
CSA	O112.6-M1977	Phenol and Phenol-Resorcinol Resin Adhesives for Wood (High-Temperature Curing)	Table A-9.10.3.1.B.
CSA	O112.7-M1977	Resorcinol and Phenol-Resorcinol Resin Adhesives for Wood (Room- and Intermediate-Temperature Curing)	Table A-9.10.3.1.B.
CSA	O141-05	Softwood Lumber	A-9.3.2.1.(1)
CSA	O437.0-93	OSB and Waferboard	A-9.23.15.4.(2)
CSA	CAN/CSA-S6-06	Canadian Highway Bridge Design Code	A-Table 4.1.5.3. A-Table 4.1.5.9.
CSA	S16-09	Design of Steel Structures	A-4.1.5.11. A-4.3.4.1.(1)
CSA	S304.1-04	Design of Masonry Structures	A-5.1.4.1.(5)(b) and (c)
CSA	CAN/CSA-S406-92	Construction of Preserved Wood Foundations	A-9.15.2.4.(1)
CSA	Z32-04	Electrical Safety and Essential Electrical Systems in Health Care Facilities	A-3.2.7.6.(1)
CSA	CAN/CSA-Z240 MH Series-09	Manufactured Homes	A-1.1.1.1.(2)[3]
CSA	Z240.2.1-09	Structural Requirements for Manufactured Homes	A-1.1.1.1.(2)[3]
CSA	Z240.10.1-08	Site Preparation, Foundation, and Anchorage of Manufactured Homes	A-1.1.1.1.(2)[3]
CWC	1997	Introduction to Wood Building Technology	A-9.27.3.8.(4)
CWC	2000	Wood Reference Handbook	Table A-9.27.3.8.(4)
CWC	2009	The Span Book	A-9.23.4.2.
CWC	2009	Engineering Guide for Wood Frame Construction	A-9.4.1.1. A-9.23.13.1.
EC	CEPA 1988	Canadian Environmental Protection Act, Section 8, Part 1	A-6.2.1.7.(2)
EPA	625/R-92/016 (1994)	Radon Prevention in the Design and Construction of Schools and Other Large Buildings	A-5.4.1.1.
FPI	Project 43-10C-024 (1988)	Deflection Serviceability Criteria for Residential Floors	A-9.23.4.2.(2)
HC	2004	Fungal Contamination in Public Buildings: Health Effects and Investigation Methods	A-5.5.1.1.
HC	2008	Guide for Radon Measurements in Public Buildings (Schools, Hospitals, Care Facilities, Detention Centres)	A-5.4.1.1. A-6.2.1.1.
HC	2008	Guide for Radon Measurements in Residential Dwellings (Homes)	A-9.13.4.3.
HRAI	SAR-G1	HRAI Digest 2005	A-9.36.3.2.(1) A-9.36.3.2.(2) A-9.36.3.4.(1)
HVI		Certified Home Ventilating Products Directory	A-9.36.3.9.(3)
ICC	400-2007	Design and Construction of Log Structures	A-9.36.2.2.(5)
ISO	7010:2003	Graphical symbols – Safety colours and safety signs – Safety signs used in workplaces and public areas	A-3.4.5.1.(2)(c)

Table A-1.3.1.2.(1) (Continued)

Issuing Agency	Document Number[1]	Title of Document[2]	Code Reference
ISO	7731:2003(E)	Ergonomics – Danger signals for public and work areas – Auditory danger signals	A-3.2.4.22.(1)(b)
ISO	8201:1987(E)	Acoustics – Audible emergency evacuation signal	A-3.2.4.19.(2)
NFPA	2001 Edition	Fire Protection Guide to Hazardous Materials	A-6.2.2.6.(1)
NFPA	FPH 2008-2008	Fire Protection Handbook	A-3.2.2.2.(1) A-3.6.2.7.(5)
NFPA	13-2007	Installation of Sprinkler Systems	A-3.2.4.10.(3)(f) A-3.2.5.12.(1) A-3.2.5.12.(6) A-3.2.5.13.(1) A-3.2.8.2.(3)
NFPA	13D-2007	Installation of Sprinkler Systems in One- and Two-Family Dwellings and Manufactured Homes	A-3.2.5.12.(6) A-3.2.5.13.(1)
NFPA	13R-2007	Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height	A-3.2.5.12.(6) A-3.2.5.13.(1)
NFPA	20-2007	Installation of Stationary Pumps for Fire Protection	A-3.2.4.10.(3)(f)
NFPA	30-2008	Flammable and Combustible Liquids Code	A-6.2.2.6.(1)
NFPA	30A-2008	Motor Fuel Dispensing Facilities and Repair Garages	A-6.2.2.6.(1)
NFPA	32-2007	Drycleaning Plants	A-6.2.2.6.(1)
NFPA	33-2007	Spray Application Using Flammable or Combustible Materials	A-6.2.2.6.(1)
NFPA	34-2007	Dipping and Coating Processes Using Flammable or Combustible Liquids	A-6.2.2.6.(1)
NFPA	35-2005	Manufacture of Organic Coatings	A-6.2.2.6.(1)
NFPA	36-2009	Solvent Extraction Plants	A-6.2.2.6.(1)
NFPA	40-2007	Storage and Handling of Cellulose Nitrate Film	A-6.2.2.6.(1)
NFPA	51-2007	Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes	A-6.2.2.6.(1)
NFPA	51A-2006	Acetylene Cylinder Charging Plants	A-6.2.2.6.(1)
NFPA	55-2005	Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks	A-6.2.2.6.(1)
NFPA	61-2008	Prevention of Fires and Dust Explosions in Agricultural and Food Processing Facilities	A-6.2.2.6.(1)
NFPA	68-2007	Explosion Protection by Deflagration Venting	A-3.6.2.7.(5) A-6.2.2.6.(1)
NFPA	69-2008	Explosion Prevention Systems	A-3.6.2.7.(5) A-6.2.2.6.(1)
NFPA	72-2007	National Fire Alarm and Signaling Code	A-3.2.4.22.(2)
NFPA	80-2007	Fire Doors and Other Opening Protectives	A-3.1.8.1.(2) A-3.2.8.2.(3)
NFPA	80A-2007	Protection of Buildings from Exterior Fire Exposures	A-3
NFPA	85-2007	Boiler and Combustion Systems Hazards Code	A-6.2.2.6.(1)
NFPA	86-2007	Ovens and Furnaces	A-6.2.2.6.(1)
NFPA	88A-2007	Parking Structures	A-6.2.2.6.(1)
NFPA	91-2004	Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids	A-6.2.2.6.(1)
NFPA	96-2008	Ventilation Control and Fire Protection of Commercial Cooking Operations	A-3.3.1.2.(2) A-6.2.2.6.(1) A-9.10.1.4.(1)

Table A-1.3.1.2.(1) (Continued)

Issuing Agency	Document Number[1]	Title of Document[2]	Code Reference
NFPA	101-2009	Life Safety Code	A-3.3.2.1.(2)
NFPA	204-2007	Smoke and Heat Venting	A-6.2.2.6.(1)
NFPA	303-2006	Marinas and Boatyards	A-6.2.2.6.(1)
NFPA	307-2006	Construction and Fire Protection of Marine Terminals, Piers, and Wharves	A-6.2.2.6.(1)
NFPA	409-2004	Aircraft Hangars	A-6.2.2.6.(1)
NFPA	415-2008	Airport Terminal Buildings, Fueling, Ramp Drainage, Loading Walkways	A-6.2.2.6.(1)
NFPA	484-2009	Combustible Metals	A-6.2.2.6.(1)
NFPA	654-2006	Prevention of Fire and Dust Explosions from the Manufacturing, Processing, and Handling of Combustible Particulate Solids	A-6.2.2.6.(1)
NFPA	655-2007	Prevention of Sulfur Fires and Explosions	A-6.2.2.6.(1)
NFPA	664-2007	Prevention of Fires and Explosions in Wood Processing and Woodworking Facilities	A-6.2.2.6.(1)
NFPA	1710-2004	Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments	A-3.2.3.1.(8)
NLGA	2007	Standard Grading Rules for Canadian Lumber	A-9.3.2.1.(1) A-9.3.2.8.(1) A-9.23.10.4.(1)
NLGA	SPS-1-2007	Fingerjoined Structural Lumber	Table A-9.10.3.1.A. A-9.23.10.4.(1)
NLGA	SPS-3-2007	Fingerjoined 'Vertical Stud Use Only' Lumber	Table A-9.10.3.1.A. A-9.23.10.4.(1)
NRCA	2005	The NRCA Waterproofing Manual	A-5.6.2.1.
NRCA	2007	The NRCA Roofing Manual: Membrane Roof Systems	A-5.6.2.1.
NRC-IRC	CBD 222	Airtight Houses and Carbon Monoxide Poisoning	A-9.33.1.1.(2)
NRC-IRC	CBD 230	Applying Building Codes to Existing Buildings	A-1.1.1.1.(1)[3]
NRC-IRC	CBD 231	Moisture Problems in Houses	A-9.25.3.1.(1)
NRC-IRC	1988	Performance and Acceptability of Wood Floors – Forintek Studies	A-9.23.4.2.(2)
NYCDH	2008	Guidelines on Assessment and Remediation of Fungi in Indoor Environments	A-5.5.1.1.
OMMAH	2006	2006 Building Code Compendium, Volume 2, Supplementary Standard SB-7, Guards for Housing and Small Buildings	A-9.8.8.2.
SMACNA	6th Edition	Architectural Sheet Metal Manual	A-5.6.2.1.
SMACNA	ANSI/SMACNA 006-2006	HVAC Duct Construction Standards – Metal and Flexible	A-9.36.3.2.(2)
TC	SOR/2008-34	Transportation of Dangerous Goods Regulations (TDGR)	A-3.3.1.2.(1)
TWC	1993	Details of Air Barrier Systems for Houses	Table A-9.25.5.1.(1)
TWC	1995	High-Rise Residential Construction Guide	A-5.6.2.1.
ULC	CAN/ULC-S101-07	Fire Endurance Tests of Building Construction and Materials	A-3.1.5.12.(2)(e) Table A-9.10.3.1.B. B-3.2.6.5.(6)(b)
ULC	CAN/ULC-S112-M90	Fire Test of Fire-Damper Assemblies	Table B-3.2.6.6.C.
ULC	CAN/ULC-S113-07	Wood Core Doors Meeting the Performance Required by CAN/ULC-S104 for Twenty Minute Fire Rated Closure Assemblies	A-9.10.9.3.(2) A-9.10.13.2.(1)
ULC	CAN/ULC-S124-06	Test for the Evaluation of Protective Coverings for Foamed Plastic	A-3.1.5.12.(2)(e)
ULC	ULC-S332-93	Burglary Resisting Glazing Material	A-9.7.5.2.(1)

Table A-1.3.1.2.(1) (Continued)

Issuing Agency	Document Number[1]	Title of Document[2]	Code Reference
ULC	CAN/ULC-S524-06	Installation of Fire Alarm Systems	A-3.2.4.19.(8) A-3.2.4.21.(7)
ULC	CAN/ULC-S526-07	Visible Signal Devices for Fire Alarm Systems, Including Accessories	A-3.2.4.20.(2)
ULC	CAN/ULC-S572-10	Photoluminescent and Self-Luminous Signs and Path Marking Systems	A-3.4.5.1.(4)
ULC	CAN/ULC-S701-05	Thermal Insulation, Polystyrene, Boards and Pipe Covering	Table A-9.36.2.4.(1)D.
ULC	CAN/ULC-S702-09	Mineral Fibre Thermal Insulation for Buildings	A-5.10.1.1.(1) Table A-9.36.2.4.(1)D.
ULC	CAN/ULC-S703-01	Cellulose Fibre Insulation (CFI) for Buildings	Table A-9.36.2.4.(1)D.
ULC	CAN/ULC-S704-03	Thermal Insulation, Polyurethane and Polyisocyanurate, Boards, Faced	Table A-9.36.2.4.(1)D.
ULC	CAN/ULC-S705.1-01	Thermal Insulation – Spray Applied Rigid Polyurethane Foam, Medium Density – Material - Specification	Table A-9.36.2.4.(1)D.
ULC	CAN/ULC-S712.1-10	Thermal Insulation - Light Density, Open Cell Spray Applied Semi-Rigid Polyurethane Foam - Material Specification	Table A-9.36.2.4.(1)D.
ULC	CAN/ULC-S741-08	Air Barrier Materials – Specification	A-9.36.2.9.(1)
ULC	CAN/ULC-S742-11	Air Barrier Assemblies – Specification	A-9.36.2.9.(1) A-9.36.2.10.(5)(b)
ULC	CAN/ULC-S770-09	Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams	Table A-9.36.2.4.(1)D.
WCLIB	No. 17 (2004)	Standard Grading Rules	A-Table 9.3.2.1.
WWPA	2005	Western Lumber Grading Rules	A-Table 9.3.2.1.

Notes to Table A-1.3.1.2.(1):

(1) Some documents may have been reaffirmed or reapproved. Check with the applicable issuing agency for up-to-date information.

(2) Some titles have been abridged to omit superfluous wording.

(3) Code reference is in Division A.

A-3 Application of Part 3. In applying the requirements of this Part, it is intended that they be applied with discretion to buildings of unusual configuration that do not clearly conform to the specific requirements, or to buildings in which processes are carried out which make compliance with particular requirements in this Part impracticable. The definition of "building" as it applies to this Code is general and encompasses most structures, including those which would not normally be considered as buildings in the layman's sense. This occurs more often in industrial uses, particularly those involving manufacturing facilities and equipment that require specialized design that may make it impracticable to follow the specific requirements of this Part. Steel mills, aluminum plants, refining, power generation and liquid storage facilities are examples. A water tank or an oil refinery, for example, has no floor area, so it is obvious that requirements for exits from floor areas would not apply. Requirements for structural fire protection in large steel mills and pulp and paper mills, particularly in certain portions, may not be practicable to achieve in terms of the construction normally used and the operations for which the space is to be used. In other portions of the same building, however, it may be quite reasonable to require that the provisions of this Part be applied (e.g., the office portions). Similarly, areas of industrial occupancy which may be occupied only periodically by service staff, such as equipment penthouses, normally would not need to have the same type of exit facility as floor areas occupied on a continuing basis. It is expected that judgment will be exercised in evaluating the application of a requirement in those cases when extenuating circumstances require special consideration, provided the occupants' safety is not endangered.

The provisions in this Part for fire protection features installed in buildings are intended to provide a minimum acceptable level of public safety. It is intended that all fire protection features of a building, whether required or not, will be designed in conformance with good fire protection engineering practice and will meet the appropriate installation requirements in relevant standards. Good design is necessary to ensure that the level of public safety established by the Code requirements will not be reduced by a voluntary installation.

Firefighting Assumptions

The requirements of this Part are based on the assumption that firefighting capabilities are available in the event of a fire emergency. These firefighting capabilities may take the form of a paid or volunteer public fire department or in some cases a private fire brigade. If these firefighting capabilities are not available, additional fire safety measures may be required.

Firefighting capability can vary from municipality to municipality. Generally, larger municipalities have greater firefighting capability than smaller ones. Similarly, older, well established municipalities may have better firefighting facilities than newly formed or rapidly growing ones. The level of municipal fire protection considered to be adequate will normally depend on both the size of the municipality (i.e., the number of buildings to be protected) and the size of buildings within that municipality. Since larger buildings tend to be located in larger municipalities, they are generally, but not always, favoured with a higher level of municipal protection.

Although it is reasonable to consider that some level of municipal firefighting capability was assumed in developing the fire safety provisions in Part 3, this was not done on a consistent or defined basis. The requirements in the Code, while developed in the light of commonly prevailing municipal fire protection levels, do not attempt to relate the size of building to the level of municipal protection. The responsibility for controlling the maximum size of building to be permitted in a municipality in relation to local firefighting capability rests with the municipality. If a proposed building is too large, either in terms of floor area or building height, to receive reasonable protection from the municipal fire department, fire protection requirements in addition to those prescribed in this Code, may be necessary to compensate for this deficiency. Automatic sprinkler protection may be one option to be considered.

Alternatively, the municipality may, in light of its firefighting capability, elect to introduce zoning restrictions to ensure that the maximum building size is related to available municipal fire protection facilities. This is, by necessity, a somewhat arbitrary decision and should be made in consultation with the local firefighting service, who should have an appreciation of their capability to fight fires.

The requirements of Subsection 3.2.3. are intended to prevent fire spread from thermal radiation assuming there is adequate firefighting available. It has been found that periods of from 10 to 30 minutes usually elapse between the outbreak of fire in a building that is not protected with an automatic sprinkler system and the attainment of high radiation levels. During this period, the specified spatial separations should

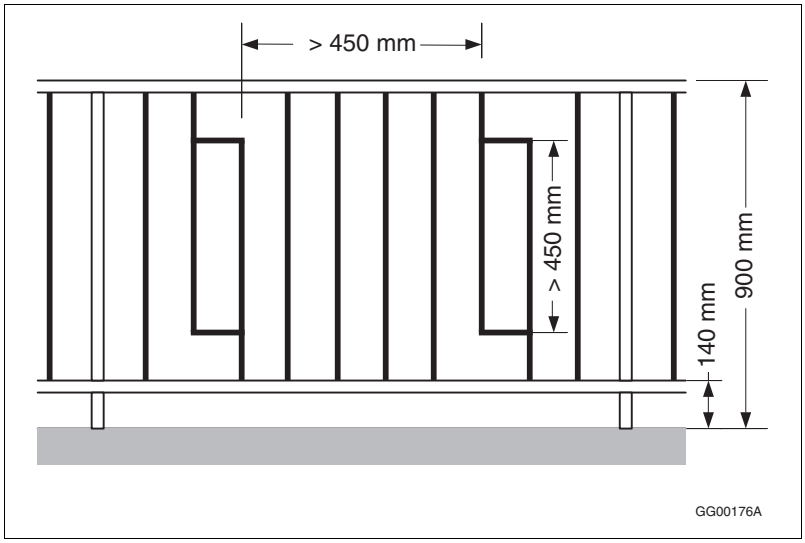


Figure A-9.8.8.6.(2)-A
Example of minimum horizontal and vertical clearances between protrusions in guards as described in Clause 9.8.8.6.(2)(a)

Clause 9.8.8.6.(2)(b) allows guards with protrusions that present a horizontal offset of 15 mm or less because insufficient foot purchase is provided to facilitate climbing.

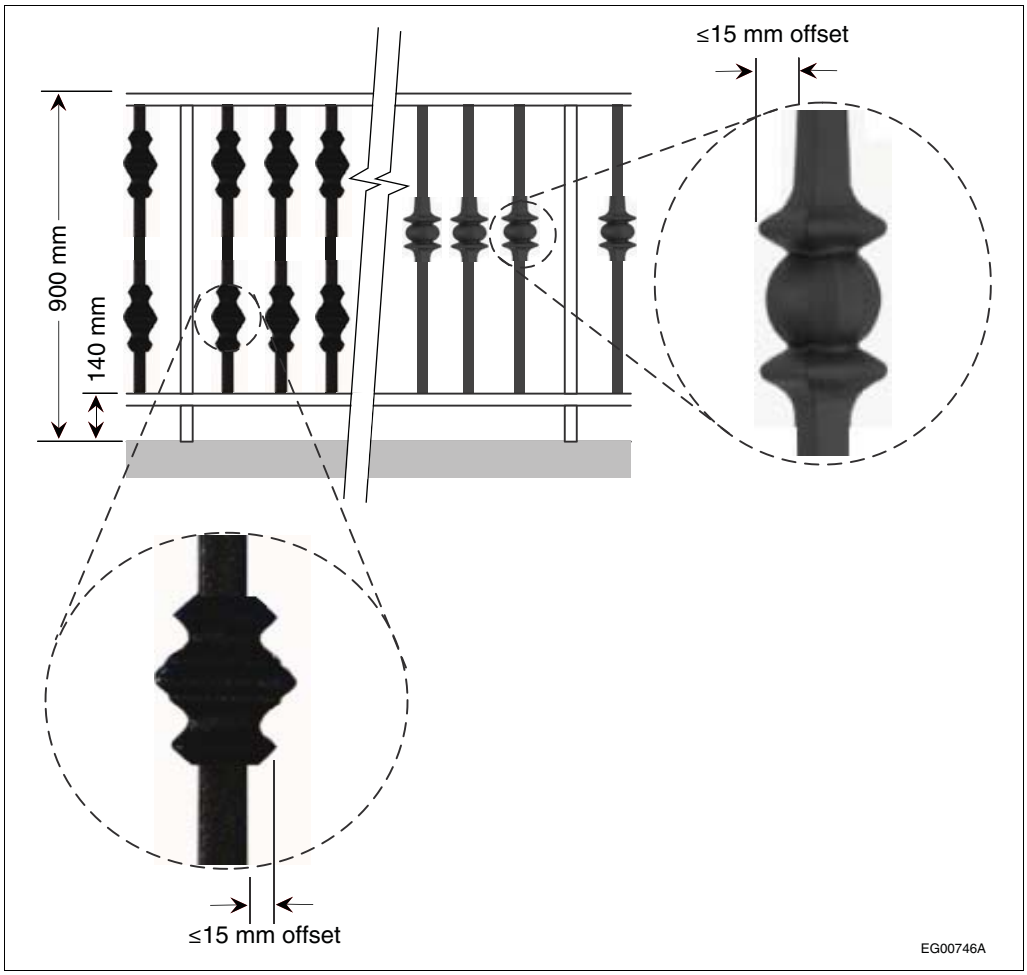


Figure A-9.8.8.6.(2)-B
Examples of maximum horizontal offset of protrusions in guards as described in Clause 9.8.8.6.(2)(b)

A guard that complies with Clause 9.8.8.6.(2)(c) is deemed to not facilitate climbing because the spaces created by the protruding elements are too small to provide a toehold.

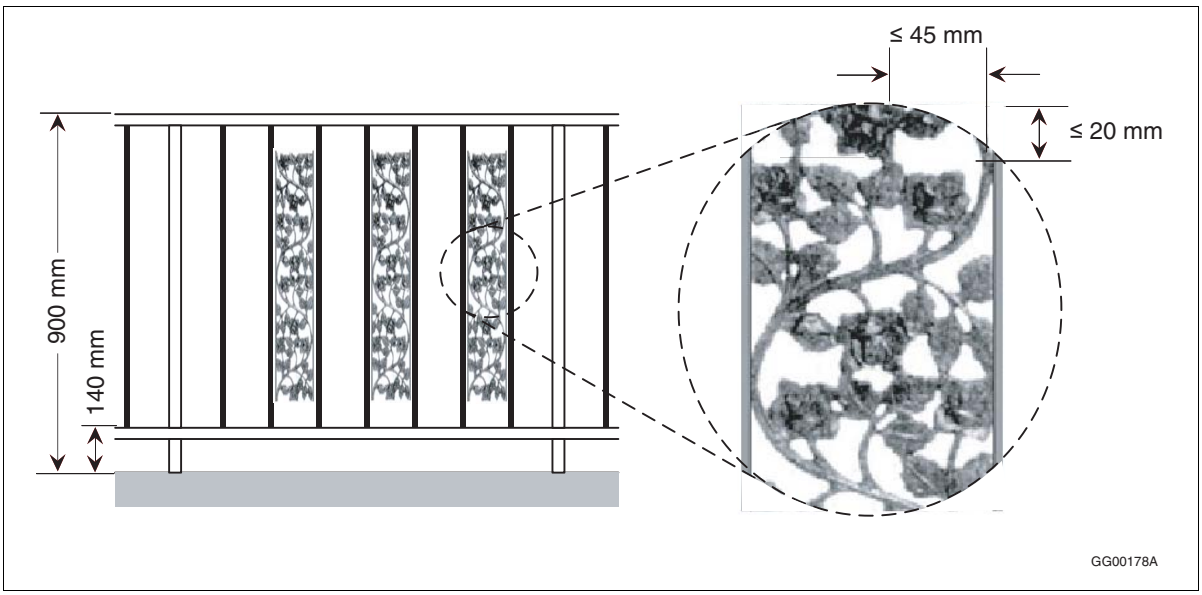


Figure A-9.8.8.6.(2)-C
Example of a guard with spaces created by the protruding elements that are not more than 45 mm wide and 20 mm high as described in Clause 9.8.8.6.(2)(c)

A guard with protrusions that comply with Clause 9.8.8.6.(2)(d) is deemed to not facilitate climbing because the slope of the protruding elements is considered too steep to provide adequate footing.

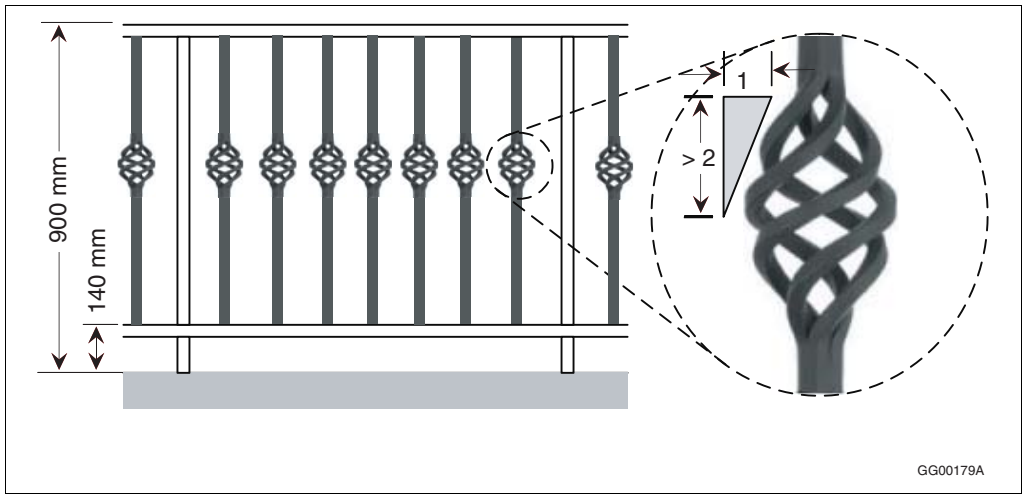
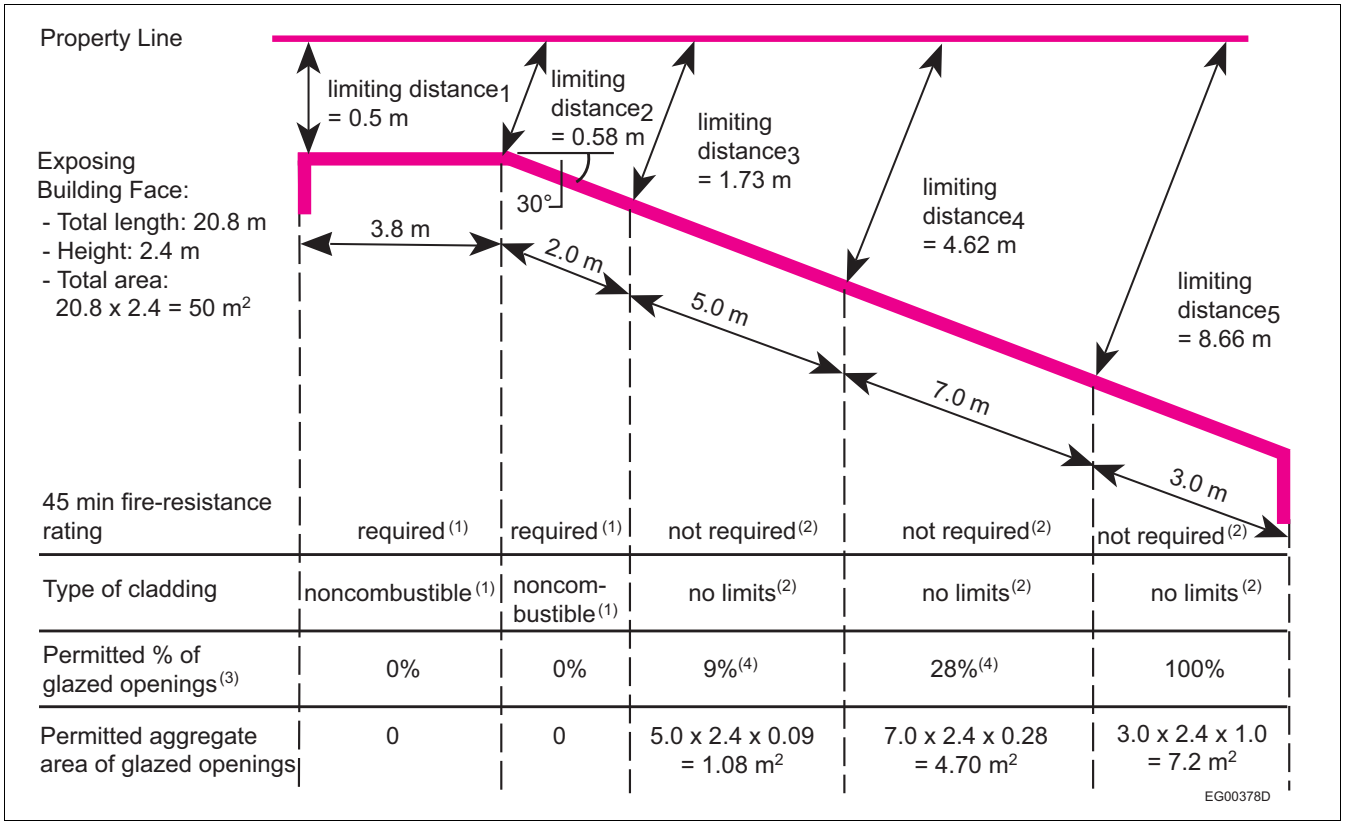


Figure A-9.8.8.6.(2)-D
Example of guard protrusions with a slope greater than 2 in 1 as described in Clause 9.8.8.6.(2)(d)



45 min fire-resistance rating	required (1)	required (1)	not required (2)	not required (2)	not required (2)
Type of cladding	noncombustible (1)	noncom-bustible (1)	no limits (2)	no limits (2)	no limits (2)
Permitted % of glazed openings (3)	0%	0%	9% (4)	28% (4)	100%
Permitted aggregate area of glazed openings	0	0	5.0 x 2.4 x 0.09 = 1.08 m^2	7.0 x 2.4 x 0.28 = 4.70 m^2	3.0 x 2.4 x 1.0 = 7.2 m^2

Figure A-9.10.15.4.(2)-B

Example of determination of criteria for the exposing building face of a skewed wall of a house with some arbitrary division of the wall

Notes to Figure A-9.10.15.4.(2)-B:

(1) See Sentence 9.10.15.5.(2).

(2) See Sentence 9.10.15.5.(3).

(3) See Table 9.10.15.4.

(4) To simplify the calculations, choose the column for the lesser limiting distance nearest to the actual limiting distance. Interpolation for limiting distance is also acceptable and may result in a slightly larger permitted area of glazed openings. Interpolation can only be used for limiting distances greater than 1.2 m.

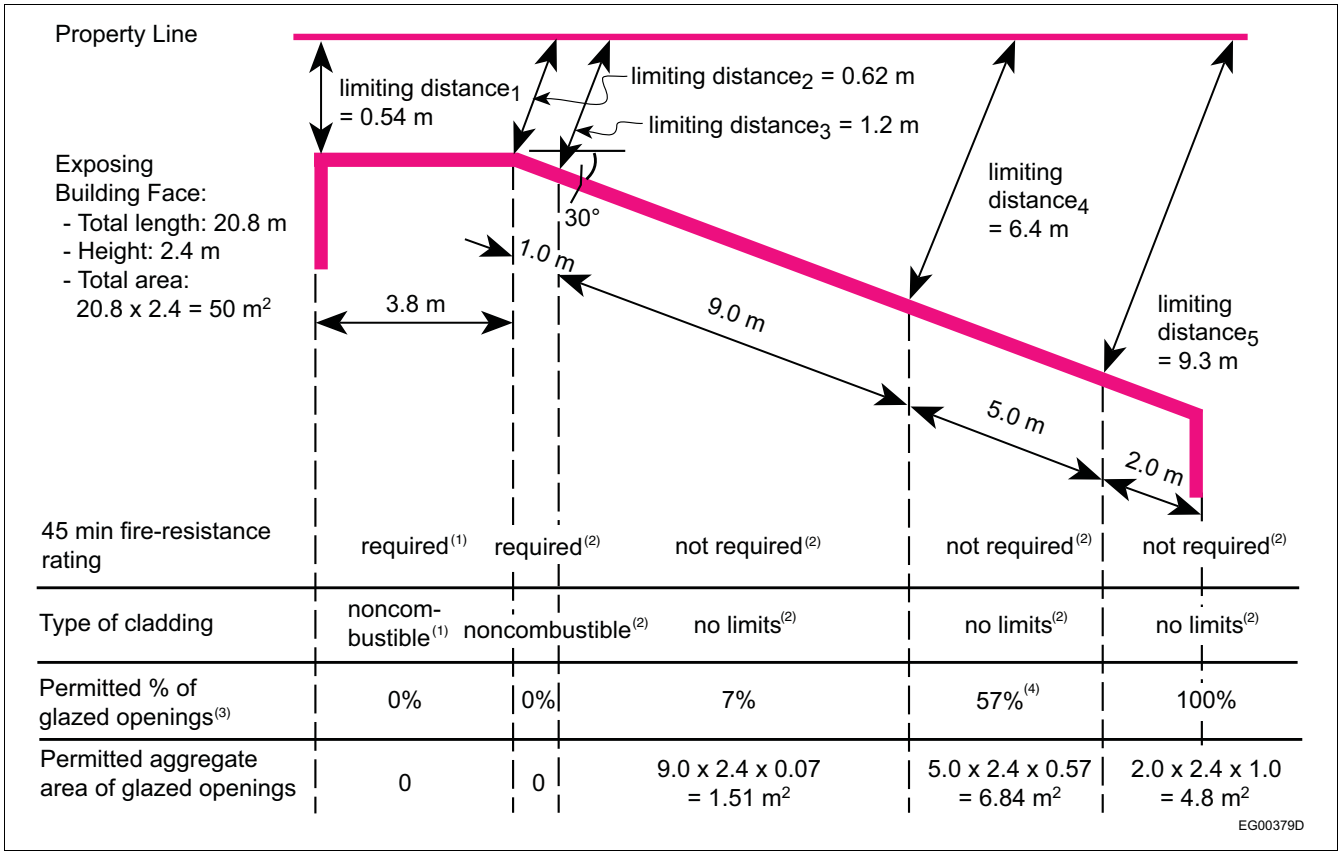


Figure A-9.10.15.4.(2)-C

Example of determination of criteria for the exposing building face of a skewed wall of a house with a different arbitrary division of the wall

Notes to Figure A-9.10.15.4.(2)-C:

(1) See Sentence 9.10.15.5.(2).

(2) See Sentence 9.10.15.5.(3).

(3) See Table 9.10.15.4.

(4) To simplify the calculations, choose the column for the lesser limiting distance nearest to the actual limiting distance. Interpolation for limiting distance is also acceptable and may result in a slightly larger permitted area of glazed openings. Interpolation can only be used for limiting distances greater than 1.2 m.

A-9.10.19.3.(1) Location of Smoke Alarms. There are two important points to bear in mind when considering where to locate smoke alarms in dwelling units:

- The most frequent point of origin for fires in dwelling units is the living area.
- The main concern in locating smoke alarms is to provide warning to people asleep in bedrooms.

A smoke alarm located in the living area and wired so as to sound another smoke alarm located near the bedrooms is the ideal solution. However, it is difficult to define exactly what is meant by "living area." It is felt to be too stringent to require a smoke alarm in every part of a dwelling unit that could conceivably be considered a "living area" (living room, family room, study, etc.). Sentence 9.10.19.3.(1) addresses these issues by requiring at least one smoke alarm on every storey containing a sleeping room. Thus, in a dwelling unit complying with Sentence 9.10.19.3.(1), every living area will probably be located within a reasonable distance of a smoke alarm. Nevertheless, where a choice arises as to where on a storey to locate the required smoke alarm or alarms, one should be located as close as possible to a living area, provided the requirements related to proximity to bedrooms are also satisfied.

A smoke alarm is not required on each level in a split-level dwelling unit as each level does not count as a separate storey. Determine the number of storeys in a split-level dwelling unit and which levels are part of which storey as follows:

1. establish grade, which is the lowest of the average levels of finished ground adjoining each exterior wall of a building;
2. identify the first storey, which is the uppermost storey having its floor level not more than 2 m above grade;

(d) required minimum footing size = 1.22 x 350 mm (minimum footing size provided in Table 9.15.3.4.) = 427 mm.

A-9.17.2.2.(2) Lateral Support of Columns. Because the NBC does not provide prescriptive criteria to describe the minimum required lateral support, constructions are limited to those that have demonstrated effective performance over time and those that are designed according to Part 4. Verandas on early 20th century homes provide one example of constructions whose floor and roof are typically tied to the rest of the building to provide effective lateral support. Large decks set on tall columns, however, are likely to require additional lateral support even where they are connected to the building on one side.

A-9.17.3.4. Design of Steel Columns. The permitted live floor loads of 2.4 kPa and the spans described for steel beams, wood beams and floor joists are such that the load on columns could exceed 36 kN, the maximum allowable load on columns prescribed in CAN/CGSB-7.2, "Adjustable Steel Columns." In the context of Part 9, loads on columns are calculated from the supported area times the live load per unit area, using the supported length of joists and beams. The supported length is half of the joist spans on each side of the beam and half the beam span on each side of the column.

Dead load is not included based on the assumption that the maximum live load will not be applied over the whole floor. Designs according to Part 4 must consider all applied loads.

A-9.18.7.1.(4) Protection of Ground Cover in Warm Air Plenums. The purpose of the requirement is to protect combustible ground cover from smoldering cigarette butts that may drop through air registers. The protective material should extend beyond the opening of the register and have up-turned edges, as a butt may be deflected sideways as it falls.

A-9.19.1.1.(1) Venting of Attic or Roof Spaces. Controlling the flow of moisture by air leakage and vapour diffusion into attic or roof spaces is necessary to limit moisture-induced deterioration. Given that imperfections normally exist in the vapour barriers and air barrier systems, recent research indicates that venting of attic or roof spaces is generally still required. The exception provided in Article 9.19.1.1. recognizes that some specialized ceiling-roof assemblies, such as those used in some factory-built buildings, have, over time, demonstrated that their construction is sufficiently tight to prevent excessive moisture accumulation. In these cases, ventilation would not be required.

A-9.19.2.1.(1) Access to Attic or Roof Space. The term "open space" refers to the space between the insulation and the roof sheathing. Sentence 9.19.2.1.(1) requires the installation of an access hatch where the open space in the attic or roof is large enough to allow visual inspection. Although the dimensions of an uninsulated attic or roof space may meet the size that triggers the requirement for an access hatch to be installed, most of that space will actually be filled with insulation and may therefore not be easily inspected, particularly in smaller buildings or under low-sloped roofs. See also Article 9.36.2.6.

A-9.20.1.2. Seismic Information. Information on spectral response acceleration values for various locations can be found in Appendix C, Climatic and Seismic Information for Building Design in Canada.

A-9.20.5.1.(1) Masonry Support. Masonry veneer must be supported on a stable structure in order to avoid cracking of the masonry due to differential movement relative to parts of the support. Wood framing is not normally used as a support for the weight of masonry veneer because of its shrinkage characteristics. Where the weight of masonry veneer is supported on a wood structure, as is the case for the preserved wood foundations referred to in Sentence 9.20.5.1.(1) for example, measures must be taken to ensure that any differential movement that may be harmful to the performance of masonry is minimized or accommodated. The general principle stated in Article 9.4.1.1., however, makes it possible to support the weight of masonry veneer on wood framing, provided that engineering design principles prescribed in Part 4 are followed to ensure that the rigidity of the support is compatible with the stiffness of the masonry being supported and that differential movements between the support and masonry are accommodated.

A-9.20.8.5. Distance from Edge of Masonry to Edge of Supporting Members.

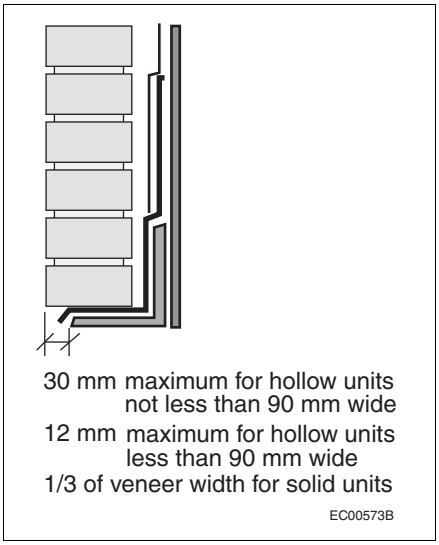


Figure A-9.20.8.5.
Maximum projection of masonry beyond its support

A-9.20.12.2.(2) Corbelling of Masonry Foundation Walls.

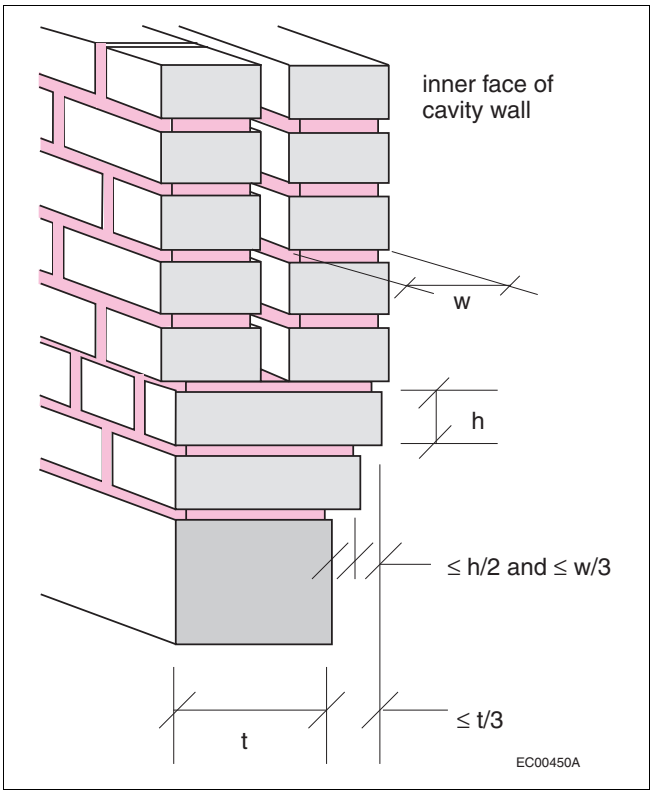


Figure A-9.20.12.2.(2)
Maximum corbel dimensions

A-9.23.1.1.(1) Application of Section 9.23. In previous editions of the Code, Sentence 9.23.1.1.(1) referred to "conventional" wood-frame construction. Over time, conventions have changed and the application of Part 9 has expanded.

The prescriptive requirements provided in Section 9.23. still focus on lumber beams, joists, studs and rafters as the main structural elements of "wood-frame construction." The requirements recognize—and have recognized for some time—that walls and floors may be supported by components made of material other than lumber; for example, by foundations described in Section 9.15. or by steel beams described in Article 9.23.4.3. These constructions still fall within the general category of wood-frame construction.

With more recent innovations, alternative structural components are being incorporated into wood-frame buildings. Wood I-joists, for example, are very common. Where these components are used in lieu of lumber, the requirements in Section 9.23. that specifically apply to lumber joists do not apply to these components: for example, limits on spans and acceptable locations for notches and holes. However, requirements regarding the fastening of floor sheathing to floor joists still apply, and the use of wood I-joists does not affect the requirements for wall or roof framing.

Similarly, if steel floor joists are used in lieu of lumber joists, the requirements regarding wall or roof framing are not affected.

Conversely, Sentence 9.23.1.1.(1) precludes the installation of pre-cast concrete floors on wood-frame walls since these are not "generally comprised of ... small repetitive structural members ... spaced not more than 600 mm o.c."

Thus, the reference to "engineered components" in Sentence 9.23.1.1.(1) is intended to indicate that, where an engineered product is used in lieu of lumber for one part of the building, this does not preclude the application of the remainder of Section 9.23. to the structure, provided the limits to application with respect to cladding, sheathing or bracing, spacing of framing members, supported loads and maximum spans are respected.

A-9.23.3.1.(2) Alternative Nail Sizes. Where power nails or nails with smaller diameters than required by Table 9.23.3.4. are used to connect framing, the following equations can be used to determine the required spacing or required number of nails.

The maximum spacing can be reduced using the following equation:

$$S_{adj} = S_{table} \bullet (D_{red}/D_{table})^2$$

where

S_{adj} = adjusted nail spacing ≥ 20 x nail diameter,
S_{table} = nail spacing required by Table 9.23.3.4.,
D_{red} = smaller nail diameter than required by Table 9.23.3.1., and
D_{table} = nail diameter required by Table 9.23.3.1.

The number of nails can be increased using the following equation:

$$N_{adj} = N_{table} \bullet (D_{table}/D_{red})^2$$

where

N_{adj} = adjusted number of nails,
N_{table} = number of nails required by Table 9.23.3.4.,
D_{table} = nail diameter required by Table 9.23.3.1., and
D_{red} = smaller nail diameter than required by Table 9.23.3.1.

Note that nails should be spaced sufficiently far apart—preferably no less than 55 mm apart—to avoid splitting of framing lumber.

A-9.23.3.1.(3) Standard for Screws. The requirement that wood screws conform to ASME B18.6.1, "Wood Screws (Inch Series)," is not intended to preclude the use of Robertson head screws. The requirement is intended to specify the mechanical properties of the fastener, not to restrict the means of driving the fastener.

A-9.23.3.3.(1) Prevention of Splitting. Figure A-9.23.3.3.(1) illustrates the intent of the phrase "staggering the nails in the direction of the grain."

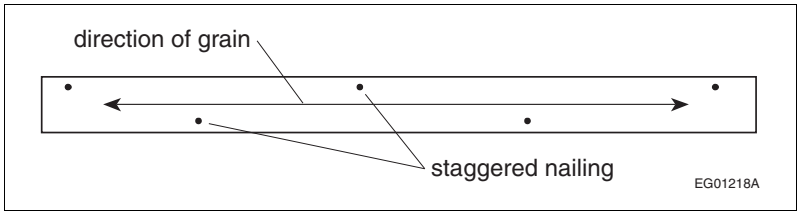


Figure A-9.23.3.3.(1)
Staggered nailing

A-Table 9.23.3.5.B. Alternative Nail Sizes. Where power nails or nails having a different diameter than the diameters listed in CSA B111 are used to connect the edges of the wall sheathing to the wall framing of wood-sheathed braced wall panels, the maximum spacing should be as shown in Table A-Table 9.23.3.5.B.

Table A-Table 9.23.3.5.B.
Alternative Nail Diameters and Spacing

Element	Nail Diameter, mm(1)	Maximum Spacing of Nails Along Edges of Wall Sheathing, mm o.c.
Plywood, OSB or waferboard	2.19-2.52	75
	2.53-2.82	100
	2.83-3.09	125
	> 3.09	150

Notes to Table A-Table 9.23.3.5.B.:
(1) For alternative nail lengths of 63 mm or longer.

A-9.23.4.2. Span Tables for Wood Joists, Rafters and Beams. In these span tables the term "rafter" refers to a sloping wood framing member which supports the roof sheathing and encloses an attic space but does not support a ceiling. The term "roof joist" refers to a horizontal or sloping wood framing member that supports the roof sheathing and the ceiling finish but does not enclose an attic space.

Where rafters or roof joists are intended for use in a locality having a higher specified roof snow load than shown in the tables, the maximum member spacing may be calculated as the product of the member spacing and specified snow load shown in the span tables divided by the specified snow load for the locality being considered. The following examples show how this principle can be applied:

(a) For a 3.5 kPa specified snow load, use spans for 2.5 kPa and 600 mm o.c. spacing but space members 400 mm o.c.
(b) For a 4.0 kPa specified snow load, use spans for 2.0 kPa and 600 mm o.c. spacing but space members 300 mm o.c.

The maximum spans in the span tables are measured from the inside face or edge of support to the inside face or edge of support.

In the case of sloping roof framing members, the spans are expressed in terms of the horizontal distance between supports rather than the length of the sloping member. The snow loads are also expressed in terms of the horizontal projection of the sloping roof. Spans for odd size lumber may be estimated by straight line interpolation in the tables.

These span tables may be used where members support a uniform live load only. Where the members are required to be designed to support a concentrated load, they must be designed in conformance with Subsection 4.3.1.

Supported joist length in Tables A-8, A-9 and A-10 means half the sum of the joist spans on both sides of the beam. For supported joist lengths between those shown in the tables, straight line interpolation may be used in determining the maximum beam span.

Tables A-1 to A-16 cover only the most common configurations. Especially in the area of floors, a wide variety of other configurations is possible: glued subfloors, concrete toppings, machine stress rated lumber, etc. The Canadian Wood Council publishes "The Span Book," a compilation of span tables covering many of these alternative configurations. Although these tables have not been subject to the formal committee review

process, the Canadian Wood Council generates, for the CCBFC, all of the Code's span tables for wood structural components; thus Code users can be confident that the alternative span tables in "The Span Book" are consistent with the span tables in the Code and with relevant Code requirements.

Spans for wood joists, rafters and beams which fall outside the scope of these tables, including those for U.S. species and individual species not marketed in the commercial species combinations described in the span tables, can be calculated in conformance with CSA O86, "Engineering Design in Wood."

A-9.23.4.2.(2) Numerical Method to Establish Vibration-Controlled Spans for Wood-Frame Floors. In addition to the normal strength and deflection analyses, the calculations on which the floor joist span tables are based include a method of ensuring that the spans are not so long that floor vibrations could lead to occupants perceiving the floors as too "bouncy" or "springy." Limiting deflection under the normal uniformly distributed loads to 1/360 of the span does not provide this assurance.

Normally, vibration analysis requires detailed dynamic modelling. However, the calculations for the span tables use the following simplified static analysis method of estimating vibration-acceptable spans:

- The span which will result in a 2 mm deflection of a single joist supporting a 1 kN concentrated midpoint load is calculated.
- This span is multiplied by a factor, K, to determine the "vibration-controlled" span for the entire floor system. If this span is less than the strength- or deflection-controlled span under uniformly distributed load, the vibration-controlled span becomes the maximum span.
- The K factor is determined from the following relationship:

$$\ln(\mathrm{K}) = \mathrm{A} - \mathrm{B} \bullet \ln(\mathrm{S_i}/\mathrm{S_{184}}) + \mathrm{G}$$

A-9.33.10.2.(1) Factory-Built Chimneys. Under the provisions of Article 1.2.1.1. of Division A, certain solid-fuel-burning appliances may be connected to factory-built chimneys other than those specified in Sentence 9.33.10.2.(1) if tests show that the use of such a chimney will provide an equivalent level of safety.

A-9.34.2. Lighting Outlets. The Canadian Electrical Code contains requirements relating to lighting that are similar to those in the NBC. The Electrical Code requirements, however, apply only to residential occupancies, whereas many of the requirements in the NBC apply to all Part 9 buildings. Code users must therefore be careful to ensure that all applicable provisions of the NBC are followed, irrespective of the limitations in the Electrical Code.

A-9.35.2.2.(1) Garage Floor. Sources of ignition, such as electrical wiring and appliances, can set off an explosion if exposed to gases or vapours such as those that can be released in garages. This provision applies where the frequency and concentration of such releases are low. Where the garage can accommodate more than 3 vehicles, and where wiring is installed within 50 mm of the garage floor, the Canadian Electrical Code should be consulted as it specifies more stringent criteria for wiring.

The capacity of the garage is based on standard-size passenger vehicles such as cars, mini-vans and sport utility vehicles, and half-ton trucks. In a typical configuration, the capacity of the garage is defined by the width of the garage doors—generally single or double width—which correlates to the number of parking bays.

In many constructions, floor areas adjacent to the garage are either above the garage floor level or separated from it by a foundation wall. Where the foundation wall is cast-in-place concrete and rises at least 50 mm above the garage floor, it can serve as the airtight curb. Where the foundation wall is block or preserved wood, extra measures may be needed to provide airtightness. In many instances, the construction will be required to be airtight to conform with Sentence 9.25.3.1.(1), and in any case, must comply with Sentences 9.10.9.16.(4) and (5).

Where the space adjacent to the garage is at the same level as the garage, a 50 mm curb or partition is not needed if the wall complies with Sentences 9.10.9.16.(4) and (5), and there is no connecting door. Where there is a connecting door, it must be raised at least 50 mm off the floor or be installed so it closes against the curb.

In some instances, access to the basement is via a stair from the garage. In such cases, a curb must be installed at the edge of the garage floor area and must be sealed to the foundation wall, curb or partition between the garage and adjacent spaces.

See Figure A-9.35.2.2.(1).

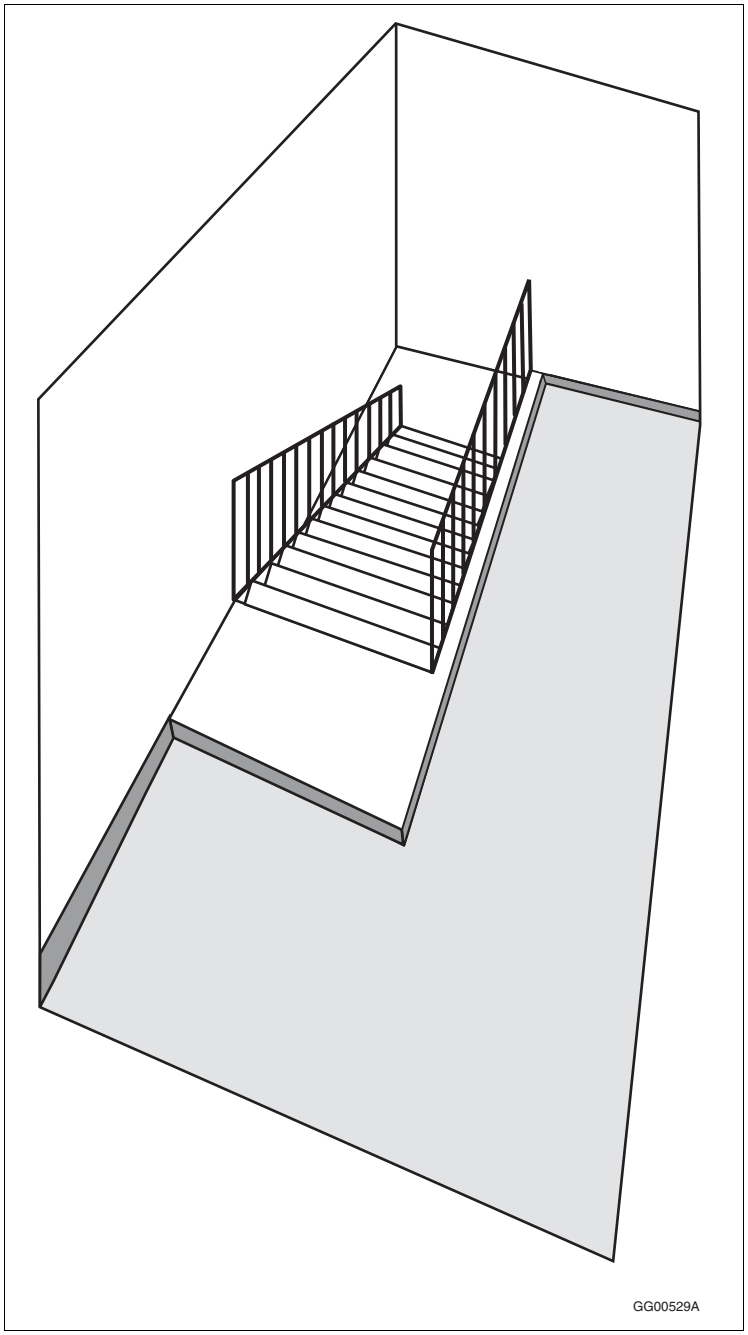


Figure A-9.35.2.2.(1)
Curb around garage floor at stairs

A-9.36.1.1.(1) Energy Used by the Building.

Energy used by the building = space-heating energy lost and gained through building envelope
+ losses due to inefficiencies of heating equipment
+ energy necessary to heat outdoor air to ventilate the building
+ energy used to heat service water

A-9.36.1.2.(2) Overall Thermal Transmittance. The U-value represents the amount of heat transferred through a unit area in a unit of time induced under steady-state conditions by a unit temperature difference between the environments on its two faces. The U-value reflects the capacity of all elements to transfer heat through the thickness of the assembly, as well as, for instance, through air films on both faces of above-ground components. Where heat is not transferred homogeneously across the area being considered, the thermal transmittance of each component is determined: for example, the thermal transmittance values of the glazing and the frame of a window are combined to determine the overall thermal transmittance (U-value) of the window.

A-9.36.1.2.(3) Conversion of Metric Values to Imperial Values. To convert a metric RSI value to an imperial R-value, use 1 $(m^2 \cdot K)/W = 5.678263\ h \cdot ft^2 \cdot °F/Btu$. "R-value," or simply the prefix "R" (e.g. R20 insulation), is often used in the housing industry to refer to the imperial equivalent of "RSI value." Note that R-values in Section 9.36. are provided for information purposes only; the stated metric RSI values are in fact the legally binding requirements.

A-9.36.1.2.(4) Fenestration. The term "fenestration" is intentionally used in Articles 9.36.2.3. (prescriptive provisions) and 9.36.2.11. (trade-off provisions), and in Subsection 9.36.5. (performance provisions) as opposed to the terms "window," "door" and "skylight," which are used in the prescriptive provisions in Subsections 9.36.2. to 9.36.4. that address these components individually. The term "fenestration" is sometimes used in conjunction with the term "doors" depending on the context and the intent of the requirement.

A-9.36.1.3. Compliance Options According to Building Type and Size. Table A-9.36.1.3. describes the types and sizes of Part 9 buildings to which Section 9.36. and the NECB apply.

Table A-9.36.1.3.
Energy Efficiency Compliance Options for Part 9 Buildings

Building Types and Sizes	Energy Efficiency Compliance Options		
	NBC 9.36.2. to 9.36.4. (Prescriptive)	NBC 9.36.5. (Perfor-mance)	NECB
• houses with or without a secondary suite • buildings containing only dwelling units with common spaces ≤ 20% of building's total floor area(1)	✓	✓	✓
• Group C occupancies • buildings containing Group D, E or F3 occupancies whose combined total floor area ≤ 300 m^2 (excluding parking garages that serve residential occupancies) • buildings with a mix of Group C and Group D, E or F3 occupancies where the non-residential portion's combined total floor area ≤ 300 m^2 (excluding parking garages that serve residential occupancies)	✓	X	✓
• buildings containing Group D, E or F3 occupancies whose combined total floor area > 300 m^2 • buildings containing F2 occupancies of any size	X	X	✓

Notes to Table A-9.36.1.3.:

(1) The walls that enclose a common space are excluded from the calculation of floor area of that common space.

A-9.36.1.3.(3) Houses and Common Spaces.

Houses

For the purpose of Sentence 9.36.1.3.(3), the term "houses" includes detached houses, semi-detached houses, duplexes, triplexes, townhouses, row houses and boarding houses.

Common spaces

The walls that enclose a common space are excluded from the calculation of floor area of that common space.

A-9.36.1.3.(5) Exemptions. Examples of buildings and spaces that are exempted from the requirements of Section 9.36. include seasonally heated buildings, storage and parking garages, small service buildings or service rooms and unconditioned spaces in buildings. However, note that, where a building envelope assembly of an exempted building is adjacent to a conditioned space, this assembly must meet the requirements of Section 9.36.

A-9.36.2.1.(2) Wall or Floor between a Garage and a Conditioned Space. A wall or a floor between a conditioned space and a residential garage must be airtight and insulated because, even if the garage is equipped with space-heating equipment, it may in fact be kept unheated most of the time.

A-9.36.2.2.(3) Calculation Tools. The thermal characteristics of windows, doors and skylights can be calculated using software tools such as THERM and WINDOW.

A-9.36.2.2.(5) Calculating Effective Thermal Resistance of Log Walls. ICC 400, "Design and Construction of Log Structures," defines log wall thickness as the "average cross sectional area divided by the stack height." This approach equalizes all log profiles regardless of their size or shape by eliminating the need to vary, average or round out log thickness measurements, which would otherwise be necessary to determine applicable profile factors for different log shapes. The ICC 400 standard lists R-values for log walls, including the exterior and interior air film coefficients, based on wall thickness and wood species' specific gravity.

A-9.36.2.3.(2) and (3) Calculating Gross Wall Area. Where the structure of the lowest floor and rim joist assembly is above the finished ground level or where the above-grade portion of foundation walls separates conditioned space from unconditioned space, they should be included in the calculation of gross wall area. Figure A-9.36.2.3.(2) and (3) shows the intended measurements for the most common type of housing construction.

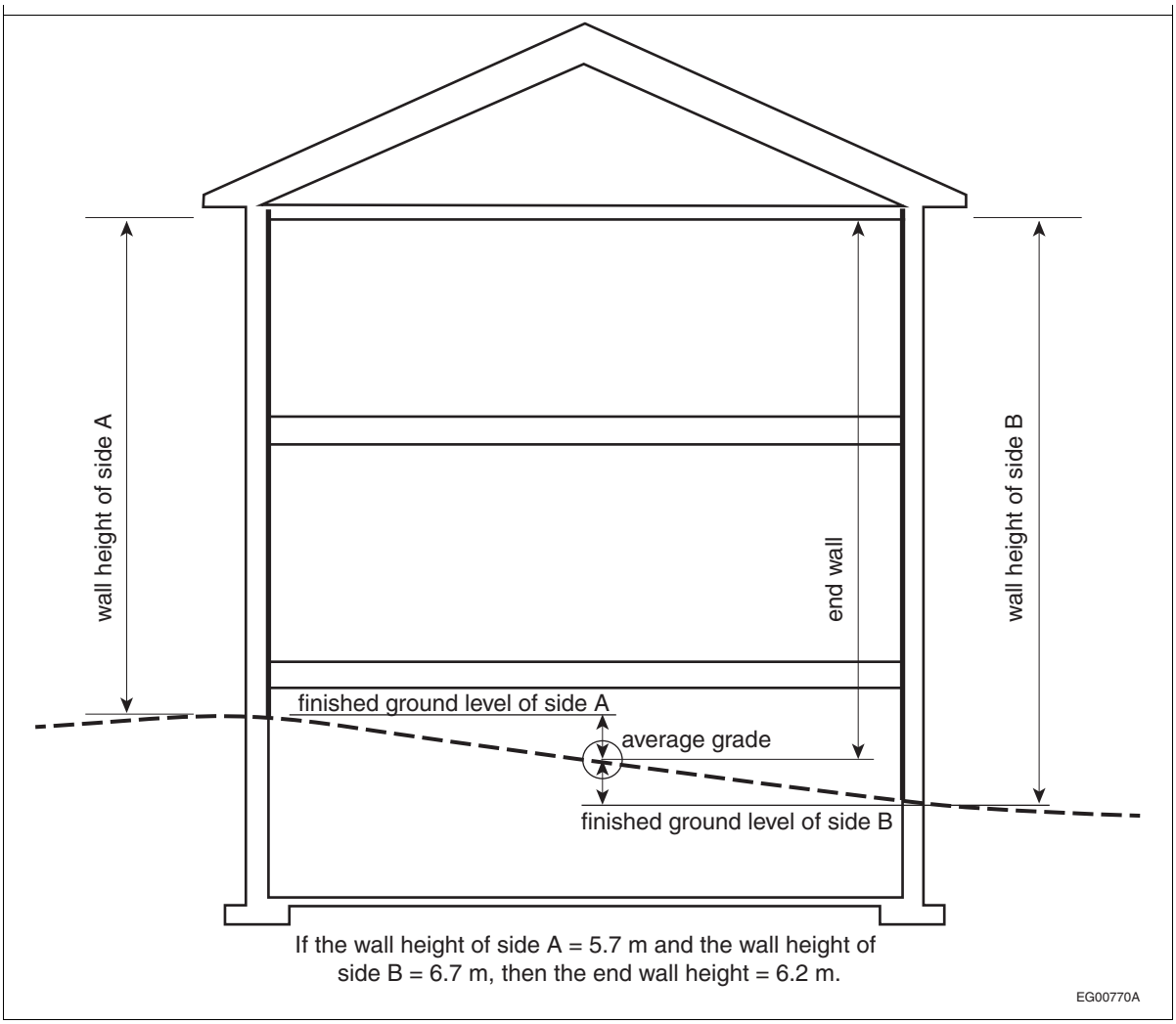


Figure A-9.36.2.3.(2) and (3)
Example of interior wall height to be used in the calculation of gross wall area

A-9.36.2.3.(5) Areas of Other Fenestration. Figure A-9.36.2.3.(5) illustrates how to measure the area of glass panes as described in Sentence 9.36.2.3.(5).

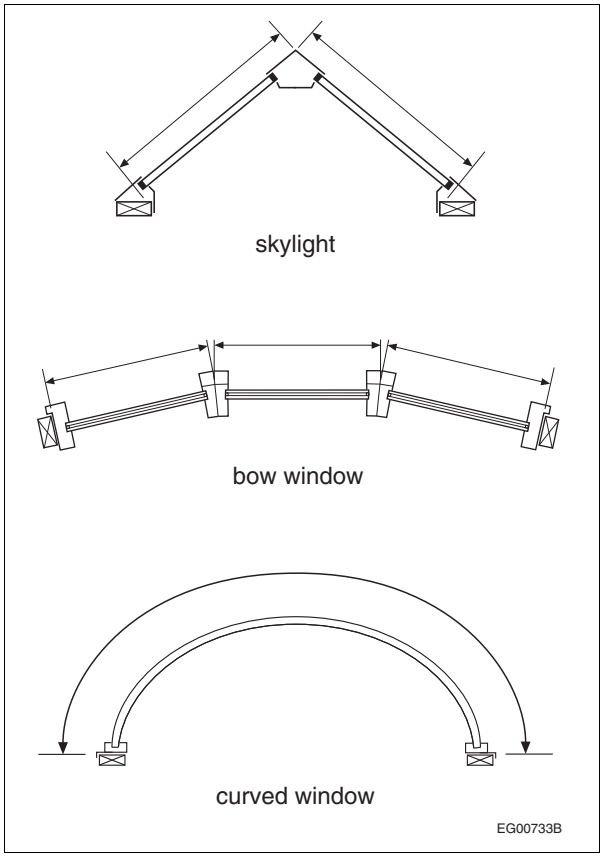


Figure A-9.36.2.3.(5)
Measuring the area of glazing that is not in the same plane

A-9.36.2.4.(1) Calculating the Effective Thermal Resistance of Building Envelope Assemblies. The general theory of heat transfer is based on the concept of the thermal transmittance through an element over a given surface area under the temperature difference across the element (see Sentence 9.36.1.2.(2)). As such, the NECB requires all building envelope assemblies and components to comply with the maximum U-values (overall thermal transmittance) stated therein. However, the requirements in Subsection 9.36.2. are stated in RSI values (effective thermal resistance values), which are the reciprocal of U-values.

To calculate effective thermal resistance, Section 9.36. requires that contributions from all portions of an assembly—including heat flow through studs and insulation—be taken into account because the same insulation product (nominal insulation value) can produce different effective thermal resistance values in different framing configurations. The resulting effective thermal resistance of an assembly also depends on the thermal properties and thickness of the building materials used and their respective location.

The following paragraphs provide the calculations to determine the effective thermal resistance values for certain assemblies and the thermal characteristics of common building materials. The Tables in Appendix Notes A-9.36.2.6.(1) and A-9.36.2.8.(1) confirm the compliance of common building assemblies.

Calculating the Effective Thermal Resistance of an Assembly with Continuous Insulation: Isothermal-Planes Method

To calculate the effective thermal resistance of a building envelope assembly containing only continuous materials—for example, a fully insulated floor slab— simply add up the RSI values for each material. This procedure is described as the "isothermal-planes method" in the ASHRAE 2009, "ASHRAE Handbook – Fundamentals."

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

To calculate the effective thermal resistance of a building envelope assembly containing wood framing, RSI_{eff}, add up the results of the following calculations:

A. calculate the effective thermal resistance of all layers with continuous materials using the isothermal-planes method, and

B. calculate the effective thermal resistance of the framing portion, $RSI_{parallel}$, using the following equation, which is taken from the parallel-path flow method described in the ASHRAE 2009, "ASHRAE Handbook – Fundamentals":

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

where

RSI_F = thermal resistance of the framing member obtained from Table A-9.36.2.4.(1)D.,

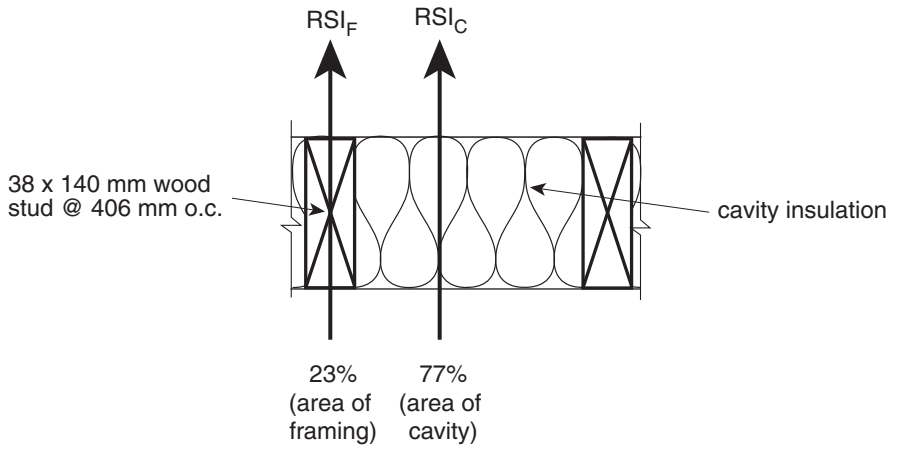
RSI_C = thermal resistance of the cavity (usually filled with insulation) obtained from Table A-9.36.2.4.(1)D.,

% area of framing = value between 0 and 100 obtained from Table A-9.36.2.4.(1)A. or by calculation, and

% area of cavity = value between 0 and 100 obtained from Table A-9.36.2.4.(1)A. or by calculation.

When the values in Table A-9.36.2.4.(1)D. are used in the calculation of effective thermal resistance of assemblies, they must not be rounded; only the final result, RSI_{eff}, can be rounded to the nearest significant digit.

Example of Calculation of RSI_{eff} for a Typical 38 x 140 mm Wood-frame Wall Assembly Using the Isothermal-Planes and Parallel-Path Flow Methods



1. Determine the thermal resistance of each continuous material layer incorporated in the assembly using Table A-9.36.2.4.(1)D.
2. Calculate the thermal resistance of a section of framing and adjacent cavity portion, $RSI_{parallel}$, using the parallel-path flow method as follows:
   (i) along a line that goes through the framing, which is designated RSI_F, and
   (ii) along a line that goes through the cavity (usually filled with insulation), which is designated RSI_C.

   Look up the % area of framing and cavity for a typical 38 x 140 mm wood-frame wall assembly with studs 400 mm o.c. using Table A-9.36.2.4.(1)A.:
   % area of framing = 23%, and
   % area of cavity = 77%

   Then, combine the sums of RSI_F and RSI_C in proportion to the relative areas of framing and insulation to calculate the value of $RSI_{parallel}$ (thermal resistance of the framing portion):

$$\mathrm{RSI_{parallel}} = \frac{100}{\left(\frac{23}{1.19}\right) + \left(\frac{77}{3.34}\right)} = 2.36\left(\mathrm{m^2 \cdot K}\right)/\mathrm{W} \quad \left(\mathrm{U\text{–}value} = 0.42\mathrm{W}/\left(\mathrm{m^2 \cdot K}\right)\right)$$

3. Add up the values obtained in steps 1 and 2 to determine the effective thermal resistance of the wall assembly, RSI_{eff}.

Layers in 38 x 140 mm Wood-frame Wall Assembly with Studs Spaced 400 mm o.c.:			RSI, $(m^2 \cdot K)/W$
Outside air film			0.03
Metal siding			0.11
Sheathing paper			—
Gypsum sheathing (12.7 mm)			0.08
Stud (140 mm x 0.0085 RSI/mm)	RSI_F = 1.19	% area of framing = 23%	$RSI_{parallel}$ = 2.36 (U-value = 0.42 $W/(m^2 \cdot K)$)
Insulation (140 mm thick; RSI 3.34)	RSI_C = 3.34	% area of cavity = 77%	
Polyethylene (vapour barrier)			—
Gypsum (12.7 mm)			0.08
Interior air film			0.12
			RSI_{eff} = 2.78 $(m^2 \cdot K)/W$ (U-value = 0.36 $W/(m^2 \cdot K)$)

Table A-9.36.2.4.(1)A.
Framing and Cavity Percentages for Typical Wood-frame Assemblies(1)

Wood-frame Assemblies		Frame Spacing, mm o.c.									
		304		406		488		610		1220	
		% Area Framing	% Area Cavity	% Area Framing	% Area Cavity	% Area Framing	% Area Cavity	% Area Framing	% Area Cavity	% Area Framing	% Area Cavity
Floors	lumber joists	–	–	13	87	11.5	88.5	10	90	–	–
	I-joists and truss	–	–	9	91	7.5	92.5	6	94	–	–
Roofs/ Ceilings	ceilings with typical trusses	–	–	14	86	12.5	87.5	11	89	–	–
	ceilings with raised heel trusses	–	–	10	90	8.5	91.5	7	93	–	–
	roofs with lumber rafters and ceilings with lumber joists	–	–	13	87	11.5	88.5	10	90	–	–
	roofs with I-joist rafters and ceilings with I-joists	–	–	9	91	7.5	92.5	6	94	–	–
	roofs with structural insulated panels (SIPs)	–	–	–	–	–	–	–	–	9	91
Walls	typical wood-frame	24.5	75.5	23	77	21.5	78.5	20	80	–	–
	advanced wood-frame with double top plate(2)	–	–	19	81	17.5	82.5	16	84	–	–
	SIPs	–	–	–	–	–	–	–	–	14	86
	basement wood-frame inside concrete foundation wall	–	–	16	84	14.5	85.5	13	87	–	–

Notes to Table A-9.36.2.4.(1)A.:

(1) The framing percentages given in this Table account not just for the repetitive framing components but also for common framing practices, such as lintels, double top plates, cripple studs, etc., and include an allowance for typical mixes of studs, lintels and plates. The values listed represent the percentage of wall area taken up by framing and are based on the net wall area (i.e. gross wall area minus fenestration and door area). If the actual % areas of framing and cavity are known, those should be used rather than the ones in this Table. Rim joists are not accounted for in this Table because they are addressed separately in Sentence 9.36.2.6.(2).

(2) "Advanced framing" refers to a variety of framing techniques designed to reduce the thermal bridging and therefore increase the energy efficiency of a building. Some advanced framing solutions require that some framing components be insulated or eliminated; in such cases, it may be appropriate to calculate the actual % area of framing. Note that using an advanced framing technique may require additional engineering of the framing system. The framing percentage values listed in this Table for advanced framing are based on constructions with insulated lintels or framing designed without lintels, corners with one or two studs, no cripple or jack studs, and double top plates.

Calculating the Effective Thermal Resistance of a Steel-frame Assembly

The parallel-path flow method described above for wood-frame assemblies involves simple one-dimensional heat flow calculations based on two assumptions:

- that the heat flow through the thermal bridge (the stud) is parallel to the heat flow through the insulation, and
- that the temperature at each plane is constant.

Tests performed on steel-frame walls have shown that neither of these assumptions properly represents the highly two-dimensional heat flow that actually occurs. The difference between what is assumed and what actually occurs is even more significant in steel-frame assemblies. The results achieved using the calculation method below compare well with those achieved from actual tests. The method provides a good approximation if a thermal resistance value of 0.0000161 ($m^2 \cdot K$)/W per mm (or a conductivity of 62 (W·m)/($m^2 \cdot °C$)) is used (this value is associated with galvanized steel with a carbon content of 0.14%).

To calculate the effective thermal resistance of a building envelope assembly consisting of steel framing, RSI_{eff}, use the following equation:

$$RSI_{eff} = K_1 \cdot RSI_{T1} + K_2 \cdot RSI_{T3}$$

where

RSI_{T1} = effective thermal resistance of building envelope assembly determined using parallel-path flow method for wood-frame assemblies (use framing and cavity percentages in Table A-9.36.2.4.(1)C.),

RSI_{T3} = RSI_{T2} + thermal resistance values of all other components except steel studs and insulation, where RSI_{T2} = effective thermal resistance of steel studs and insulation determined using parallel-path flow method for wood-frame assemblies,

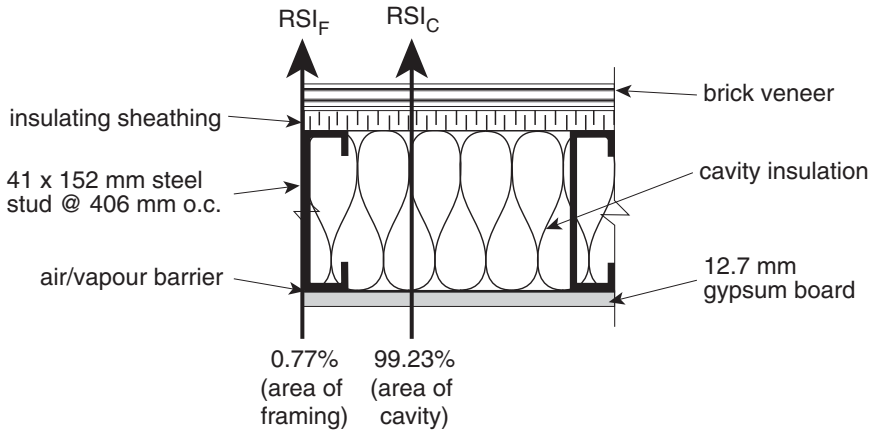
K_1 = applicable value from Table A-9.36.2.4.(1)B., and

K_2 = applicable value from Table A-9.36.2.4.(1)B.

Table A-9.36.2.4.(1)B.
Values for K_1 and K_2

Framing Spacing, mm	K_1	K_2
< 500 without insulating sheathing	0.33	0.67
< 500 with insulating sheathing	0.40	0.60
≥ 500	0.50	0.50

Example of Calculation of RSI_{eff} for a 41 x 152 mm Steel-frame Wall Assembly with Studs 406 mm o.c.



1. Calculate RSI_{T1}

Materials in Assembly		RSI_F (thermal resistance through framing)	RSI_C (thermal resistance through cavity)
Outside air film		0.03	0.03
Brick veneer		0.07	0.07
Air space (25 mm thick)		0.18	0.18
Extruded polystyrene (38 mm thick x RSI 0.035/mm)		1.33	1.33
Steel stud (152 mm thick x RSI 0.0000161/mm)		0.0023	—
Insulation (152 mm thick; RSI 3.52 (R20) batts)		—	3.52
Polyethylene (vapour barrier)		—	—
Gypsum (12.7 mm thick)		0.08	0.08
Interior air film		0.12	0.12
	Total	1.81	5.33
% area framing and cavity from Table A-9.36.2.4.(1)C.		0.77%	99.23%

$$\mathrm{RSI_{T1}} = \frac{100}{\left(\frac{0.77}{1.81}\right) + \left(\frac{99.23}{5.33}\right)} = 5.25\ \left(\mathrm{m^2 \cdot K}\right)/\mathrm{W}$$

(U-value = 0.19 W/(m²·K))

2. Calculate RSI_{T2}

Materials in Assembly		RSI_F (thermal resistance through framing)	RSI_C (thermal resistance through cavity)
Steel stud (152 mm thick x RSI 0.0000161/mm)		0.0023	—
Insulation (152 mm thick; RSI 3.52 (R20) batts)		—	3.52
	Total	0.0023	3.52
% area framing and cavity from Table A-9.36.2.4.(1)C.		0.77%	99.23%

$$\mathrm{RSI_{T2}} = \frac{100}{\left(\frac{0.77}{0.0023}\right) + \left(\frac{99.23}{3.52}\right)} = 0.27\ \left(\mathrm{m^2 \cdot K}\right)/\mathrm{W}$$

(U-value = 3.69 W/(m²·K))

3. Calculate RSI_{T3}	
Materials in Assembly	RSI through Assembly
Outside air film	0.03
Brick veneer	0.07
Air space (25 mm thick)	0.18
Extruded polystyrene (38 mm thick x RSI 0.035/mm)	1.33
RSI_{T2}	0.27
Polyethylene (vapour barrier)	—
Gypsum (12.7 mm thick)	0.08
Interior air film	0.12
	RSI_{T3} = 2.08 (m^2·K)/W (U-value = 0.48 W/(m^2·K))
4. Calculate RSI_{eff}	
$RSI_{eff} = (K_1 \cdot RSI_{T1}) + (K_2 \cdot RSI_{T3}) = (0.40 \cdot 5.25) + (0.60 \cdot 2.08) = 3.35$ (m^2·K)/W (U-value = 0.30 W/(m^2·K))	

Table A-9.36.2.4.(1)C.
Framing and Cavity Percentages for Typical Steel-frame Assemblies(1)

Steel-frame Assemblies	Frame Spacing, mm o.c.							
	< 500		≥ 500		< 2100		≥ 2100	
	% Area Framing	% Area Cavity	% Area Framing	% Area Cavity	% Area Framing	% Area Cavity	% Area Framing	% Area Cavity
Roofs, ceilings, floors	0.43	99.57	0.33	99.67	—	—	—	—
Above-grade walls and strapping	0.77	99.23	0.67	99.33	—	—	—	—
Below-grade walls and strapping	0.57	99.43	0.33	99.67	—	—	—	—
Sheet steel wall	—	—	—	—	0.08	99.92	0.06	99.94

Notes to Table A-9.36.2.4.(1)C.:

(1) The framing percentages given in this Table are based on common framing practices and not simply on the width of the studs and cavity. They are based on 18-gauge (1.2 mm) steel; however, test results indicate that, for the range of thicknesses normally used in light-steel framing, the actual thickness has very little effect on the effective thermal resistance. If the actual % areas of framing and cavity are known, those should be used rather than the ones in this Table.

Table A-9.36.2.4.(1)D.
Thermal Resistance Values of Common Building Materials(1)

Air Films	Thickness of Material	Thermal Resistance (RSI), (m^2·K)/W per mm	Thermal Resistance (RSI), (m^2·K)/W for thickness listed
Exterior:			
ceiling, floors and walls wind 6.7 m/s (winter)	—	—	0.03

Table A-9.36.2.4.(1)D. (Continued)

Air Films	Thickness of Material	Thermal Resistance (RSI), (m^2·K)/W per mm	Thermal Resistance (RSI), (m^2·K)/W for thickness listed
Interior:			
ceiling (heat flow up)	—	—	0.11
floor (heat flow down)	—	—	0.16
walls (heat flow horizontal)	—	—	0.12
Air Cavities(2)(3)	Thickness of Air Space	Thermal Resistance (RSI), (m^2·K)/W per mm	Thermal Resistance (RSI), (m^2·K)/W for thickness listed
Ceiling (heat flow up) faced with non-reflective material(4)	13 mm	—	0.15
	20 mm	—	0.15
	40 mm	—	0.16
	90 mm	—	0.16
Floors (heat flow down) faced with non-reflective material(4)	13 mm	—	0.16
	20 mm	—	0.18
	40 mm	—	0.20
	90 mm	—	0.22
Walls (heat flow horizontal) faced with non-reflective material(4)	13 mm	—	0.16
	20 mm	—	0.18
	40 mm	—	0.18
	90 mm	—	0.18
Cladding Materials	Thickness of Material	Thermal Resistance (RSI), (m^2·K)/W per mm	Thermal Resistance (RSI), (m^2·K)/W for thickness listed
Brick:			
fired clay (2400 kg/m^2)	100 mm	0.0007	0.07
concrete: sand and gravel, or stone (2400 kg/m^2)	100 mm	0.0004	0.04
Cement/lime, mortar, and stucco	—	0.0009	—
Wood shingles:			
400 mm, 190 mm exposure	—	—	0.15
400 mm, 300 mm exposure (double exposure)	—	—	0.21
insulating backer board	8 mm	—	0.25
Siding:			
Metal or vinyl siding over sheathing:			
hollow-backed	—	—	0.11
insulating-board-backed	9.5 mm nominal	—	0.32
foiled-backed	9.5 mm nominal	—	0.52
Wood:			
bevel, 200 mm, lapped	13 mm	—	0.14
bevel, 250 mm, lapped	20 mm	—	0.18
drop, 200 mm	20 mm	—	0.14
hardboard	11 mm	—	0.12
plywood, lapped	9.5 mm	—	0.10

Table A-9.36.2.4.(1)D. (Continued)

Cladding Materials	Thickness of Material	Thermal Resistance (RSI), (m^2·K)/W per mm	Thermal Resistance (RSI), (m^2·K)/W for thickness listed
Stone:			
quartzitic and sandstone (2240 kg/m^3)	—	0.0003	—
calcitic, dolomitic, limestone, marble, and granite (2240 kg/m^3)	—	0.0004	—
Fibre-cement: single-faced, cellulose fibre-reinforced cement	6.35 mm	0.003	0.023
	8 mm	0.003	0.026
Roofing Materials(5)	Thickness of Material	Thermal Resistance (RSI), (m^2·K)/W per mm	Thermal Resistance (RSI), (m^2·K)/W for thickness listed
Asphalt roll roofing	—	—	0.03
Asphalt/tar	—	0.0014	—
Built-up roofing	10 mm	—	0.06
Crushed stone	—	0.0006	—
Metal deck	—	—	negligible
Shingle:			
asphalt	—	—	0.08
wood	—	—	0.17
Slate	13 mm	—	0.01
Sheathing Materials	Thickness of Material	Thermal Resistance (RSI), (m^2·K)/W per mm	Thermal Resistance (RSI), (m^2·K)/W for thickness listed
Gypsum sheathing	12.7 mm	0.0063	0.08
Insulating fibreboard	—	0.016	—
Particleboard:			
low density (593 kg/m^3)	—	0.0098	—
medium density (800 kg/m^3)	—	0.0077	—
high density (993 kg/m^3)	—	0.0059	—
Plywood – generic softwood	9.5 mm	0.0087	0.083
	11 mm		0.096
	12.5 mm		0.109
	15.5 mm		0.135
	18.5 mm		0.161
Plywood – Douglas fir	9.5 mm	0.0111	0.105
	11 mm		0.122
	12.5 mm		0.139
	15.5 mm		0.172
	18.5 mm		0.205
Sheet materials:			
permeable felt	—	—	0.011
seal, 2 layers of mopped (0.73 kg/m^3)	—	—	0.210
seal, plastic film	—	—	negligible
Waferboard (705 kg/m^3)	—	0.0095	—

Table A-9.36.2.4.(1)D. (Continued)

Sheathing Materials	Thickness of Material	Thermal Resistance (RSI), (m^2·K)/W per mm	Thermal Resistance (RSI), (m^2·K)/W for thickness listed
Oriented strandboard (OSB)	9.5 mm	0.0098	0.093
	11 mm		0.108
Insulation Materials[6]	Thickness of Material	Thermal Resistance (RSI), (m^2·K)/W per mm	Thermal Resistance (RSI), (m^2·K)/W for thickness listed
Blanket and batt: rock or glass mineral fibre (CAN/ULC-S702)			
R12	89/92 mm	—	2.11
R14	89/92 mm	—	2.46
R19[7] (R20 compressed)	140 mm	—	3.34
R20	152 mm	—	3.52
R22	140/152 mm	—	3.87
R22.5	152 mm	—	3.96
R24	140/152 mm	—	4.23
R28	178/216 mm	—	4.93
R31	241 mm	—	5.46
R35	267 mm	—	6.16
R40	279/300 mm	—	7.04
Boards and slabs:			
Roof board	—	0.018	—
Building board or ceiling tile, lay-in panel	—	0.016	—
Polyisocyanurate/polyurethane-faced sheathing: Types 1, 2 and 3 (CAN/ULC-S704)			
permeably faced	25 mm	0.03818	0.97
	50 mm	0.0360	1.80
impermeably faced	25 mm	0.03937	1.00
	50 mm	0.0374	1.87
Expanded polystyrene (CAN/ULC-S701)[8]			
Type 1	25 mm	0.026	0.65
Type 2	25 mm	0.028	0.71
Type 3	25 mm	0.030	0.76
Extruded polystyrene: Types 2, 3 and 4 (CAN/ULC-S701)	25 mm	0.035	0.88
	50 mm	0.0336	1.68
Semi-rigid glass fibre wall/roof insulation (48 kg/m^3)	25 mm	0.0298	0.757
Semi-rigid rock wool wall insulation (56 kg/m^3)	25 mm	0.0277	0.704
Loose-fill insulation			
Cellulose (CAN/ULC-S703)	—	0.025	—
Glass fibre loose fill insulation for attics (CAN/ULC-S702)	112 to 565 mm	0.01875	—
Glass fibre loose fill insulation for walls (CAN/ULC-S702)	89 mm	0.02865	2.55
	140 mm	0.0289	4.05
	152 mm	0.030	4.23
Perlite	—	0.019	—
Vermiculite	—	0.015	—

Table A-9.36.2.4.(1)D. (Continued)

Insulation Materials[6]	Thickness of Material	Thermal Resistance (RSI), (m²·K)/W per mm	Thermal Resistance (RSI), (m²·K)/W for thickness listed
Spray-applied insulation			
Sprayed polyurethane foam			
medium density (CAN/ULC-S705.1)	25 mm	0.036	0.90
	50 mm	0.036	1.80
light density (CAN/ULC-S712.1)	25 mm	0.026	0.65
Sprayed cellulosic fibre (CAN/ULC-S703)	settled thickness	0.024	—
Spray-applied glass-fibre insulation (CAN/ULC-S702)			
density: 16 kg/m³	89 mm	0.025	2.30
	140 mm	0.025	3.53
density: 28.8 kg/m³	89 mm	0.029	2.64
	140 mm	0.029	4.06
Structural Materials	Thickness of Material	Thermal Resistance (RSI), (m²·K)/W per mm	Thermal Resistance (RSI), (m²·K)/W for thickness listed
Concrete			
Low-density aggregate			
expanded shale, clay, slate or slags, cinders (1 600 kg/m³)	—	0.0013	—
perlite, vermiculite, and polystyrene bead (480 kg/m³)	—	0.0063	—
Normal-density aggregate			
sand and gravel or stone aggregate (2 400 kg/m³)	—	0.0004	—
Hardwood[9][10]			
Ash	—	0.0063	—
Birch	—	0.0055	—
Maple	—	0.0063	—
Oak	—	0.0056	—
Softwood[9][10]			
Amabilis fir	—	0.0080	—
California redwood	—	0.0089	—
Douglas fir-larch	—	0.0069	—
Eastern white cedar	—	0.0099	—
Eastern white pine	—	0.0092	—
Hemlock-fir	—	0.0084	—
Lodgepole pine	—	0.0082	—
Red pine	—	0.0077	—
Western hemlock	—	0.0074	—
Western red cedar	—	0.0102	—
White spruce	—	0.0097	—
Yellow cyprus-cedar	—	0.0077	—

Table A-9.36.2.4.(1)D. (Continued)

Structural Materials	Thickness of Material	Thermal Resistance (RSI), (m²·K)/W per mm	Thermal Resistance (RSI), (m²·K)/W for thickness listed
Wood, structural framing, spruce-pine-fir[11]	—	0.0085	—
Steel, galvanized sheet, 0.14% carbon content	—	0.0000161	—
Concrete Blocks	Thickness of Material	Thermal Resistance (RSI), (m²·K)/W per mm	Thermal Resistance (RSI), (m²·K)/W for thickness listed
Limestone aggregate with 2 cores			
cores filled with perlite	190 mm	—	0.37
	290 mm	—	0.65
Light-weight units (expanded shale, clay, slate or slag aggregate) with 2 or 3 cores			
no insulation in cores	90 mm	—	0.24
	140 mm	—	0.30
	190 mm	—	0.32
	240 mm	—	0.33
	290 mm	—	0.41
cores filled with perlite	140 mm	—	0.74
	190 mm	—	0.99
	290 mm	—	1.35
cores filled with vermiculite	140 mm	—	0.58
	190 mm	—	0.81
	240 mm	—	0.98
	290 mm	—	1.06
cores filled with molded EPS beads	190 mm	—	0.85
molded EPS inserts in cores	190 mm	—	0.62
Medium-weight units (combination of normal- and low-mass aggregate) with 2 or 3 cores			
no insulation in cores	190 mm	—	0.26
cores filled with molded EPS beads	190 mm	—	0.56
molded EPS inserts in cores	190 mm	—	0.47
cores filled with perlite	190 mm	—	0.53
cores filled with vermiculite	190 mm	—	0.58
Normal-weight units (sand and gravel aggregate) with 2 or 3 cores			
no insulation in cores	90 mm	—	0.17
	140 mm	—	0.19
	190 mm	—	0.21
	240 mm	—	0.24
	290 mm	—	0.26
cores filled with perlite	190 mm	—	0.35

Table A-9.36.2.4.(1)D. (Continued)

Concrete Blocks	Thickness of Material	Thermal Resistance (RSI), (m^2·K)/W per mm	Thermal Resistance (RSI), (m^2·K)/W for thickness listed
cores filled with vermiculite	140 mm	—	0.40
	190 mm	—	0.51
	240 mm	—	0.61
	290 mm	—	0.69
Hollow Clay Bricks	Thickness of Material	Thermal Resistance (RSI), (m^2·K)/W per mm	Thermal Resistance (RSI), (m^2·K)/W for thickness listed
Multi-cored without insulation in cores	90 mm	—	0.27
Rectangular 2-core			
no insulation in cores	140 mm	—	0.39
	190 mm	—	0.41
	290 mm	—	0.47
cores filled with vermiculite	140 mm	—	0.65
	190 mm	—	0.86
	290 mm	—	1.29
Rectangular 3-core			
no insulation in cores	90 mm	—	0.35
	140 mm	—	0.38
	190 mm	—	0.41
	240 mm	—	0.43
	290 mm	—	0.45
cores filled with vermiculite	140 mm	—	0.68
	190 mm	—	0.86
	240 mm	—	1.06
	290 mm	—	1.19
Interior Finish Materials(12)	Thickness of Material	Thermal Resistance (RSI), (m^2·K)/W per mm	Thermal Resistance (RSI), (m^2·K)/W for thickness listed
Gypsum board	—	0.0061	—
Hardboard – medium-density (800 kg/m^3)	—	0.0095	—
Interior finish (plank, tile) board	—	0.0198	—
Particleboard			
low-density (590 kg/m^3)	—	0.0098	—
medium-density (800 kg/m^3)	—	0.0074	—
high-density (1 000 kg/m^3)	—	0.0059	—
underlay	15.9 mm	—	0.140
Plywood	—	0.0087	—
Flooring material			
Carpet and fibrous pad	—	—	0.370
Carpet and rubber pad	—	—	0.220
Cork tile	3.2 mm	—	0.049
Hardwood flooring	19 mm	—	0.120

Table A-9.36.2.4.(1)D. (Continued)

Interior Finish Materials[12]	Thickness of Material	Thermal Resistance (RSI), (m²·K)/W per mm	Thermal Resistance (RSI), (m²·K)/W for thickness listed
Terrazzo	25 mm	—	0.014
Tile (linoleum, vinyl, rubber)	—	—	0.009
Tile (ceramic)	9.5 mm	—	0.005
Wood subfloor	19 mm	—	0.170
Plastering			
Cement plaster: sand aggregate	—	0.0014	—
Gypsum plaster			
low-density aggregate	—	0.0044	—
sand aggregate	—	0.0012	—

Notes to Table A-9.36.2.4.(1)D.:

(1) The thermal resistance values given in Table A-9.36.2.4.(1)D. are generic values for the materials listed or minimum acceptable values taken from the standards listed. Values published by manufacturers for their proprietary materials may differ slightly but are permitted to be used, provided they were obtained in accordance with the test methods referenced in Article 9.36.2.2. For materials not listed in the Table or where the listed value does not reflect the thickness of the product, the thermal resistance value has to be calculated by dividing the material's thickness, in m, by its conductivity, in W/(m·K), which can be found in the manufacturer's literature.

(2) RSI values can be interpolated for air cavity sizes that fall between 13 and 90 mm, and they can be moderately extrapolated for air cavities measuring more than 90 mm. However, air cavities measuring less than 13 mm cannot be included in the calculation of effective thermal resistance of the assembly.

(3) Where strapping is installed, use the RSI value for an air layer of equivalent thickness.

(4) Reflective insulation material may contribute a thermal property value depending on its location and installation within an assembly. Where a value is obtained through evaluation carried out in accordance with Clause 9.36.2.2.(4)(b), it may be included in the calculation of the thermal resistance or transmittance of the specific assembly.

(5) Materials installed towards the exterior of a vented air space cannot be included in the calculation of effective thermal resistance of the assembly.

(6) All types of cellular foam plastic insulation manufactured to be able to retain a blowing agent, other than air, for a period longer than 180 days shall be tested for long-term thermal resistance (LTTR) in accordance with CAN/ULC-S770, "Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulating Foams." This LTTR value shall be input as the design thermal resistance value for the purpose of energy calculations in Section 9.36. Product standards contain a baseline LTTR for a thickness of 50 mm, from which the LTTR for other thicknesses can be calculated.

(7) An RSI 3.52 (R20) batt compressed into a 140 mm cavity has a thermal resistance value of 3.34 (R19); if installed uncompressed in a 152 mm cavity (e.g. in a metal stud assembly), it will retain its full thermal resistance value of 3.52 (m²·K)/W.

(8) Expanded polystyrene insulation is not manufactured to be able to retain a blowing agent; it is therefore not necessary to test its LTTR. See Note (6).

(9) The thermal resistance values for wood species are based on a moisture content (MC) of 12%. In Canada, equilibrium moisture content for wood in buildings ranges from 8–14%. The difference between the thermal properties of wood species with 12% MC and those with 14% MC is negligible.

(10) For wood species not listed in the Table, the RSI value of a wood species of equal or greater density (or specific gravity (relative density)) can be used since the thermal resistance of wood is directly related to its density (higher density wood has a lower thermal resistance).

(11) 0.0085 is considered a common value for structural softwood (see also ASHRAE 2009, "ASHRAE Handbook – Fundamentals").

(12) Materials installed towards the interior of a conditioned air space cannot be included in the calculation of effective thermal resistance of the assembly.

A-9.36.2.4.(3) Calculating Thermal Resistance of Major Structural Penetrations. Projecting slabs contribute a large area to the 2% exclusion so calculation and analysis of the heat loss through the area they penetrate should be carried out; where construction features only occasional penetrations by beams or joists, the heat loss is less critical to the overall energy performance of a building. Although the 2% exemption is based on gross wall area, it applies to penetrations through any building envelope assembly.

A-9.36.2.4.(4) Credit for Unheated Spaces Protecting the Building Envelope. The reduction in RSI afforded by Sentence 9.36.2.4.(4) is intended to provide a simple credit under the prescriptive path for any unheated space that protects a component of the building envelope. The credited value is conservative because it cannot take into account the construction of the enclosure surrounding the unheated space, which may or may not comply with the Code; as such, too many variables, such as its size or airtightness, may negate any higher credit that could be allowed.

There may be simulation tools that can be used under the performance path to provide a better assessment of the effect of an indirectly heated space; these tools may be used to calculate the credit more accurately when an unheated space is designed to provide significantly better protection than the worst-case situation assumed here. Vented spaces, such as attic and roof spaces or crawl spaces, are considered as exterior spaces; the RSI-value credit allowed in Sentence 9.36.2.4.(4) can therefore not be applied in the calculation of the effective thermal resistance of assemblies separating conditioned spaces from vented spaces.

A-9.36.2.5.(1) Continuity of Insulation. Sentence 9.36.2.5.(1) is intended to apply to building components such as partitions, chimneys, fireplaces, and columns and beams that are embedded along exterior walls, but not to stud framing and ends of joists. Studs and joists in frame construction are not considered to break the continuity of the insulation because the method for calculating the effective thermal resistance of such assemblies, which is described in Appendix Note A-9.36.2.4.(1), takes their presence into consideration.

The rest of Article 9.36.2.5. contains exceptions to Sentence (1): Sentences (2) to (8) introduce relaxations for various construction details while Sentence (9) allows a complete exemption to the requirements in Sentence (1) for three specific construction details. Balcony and canopy slabs are also exempt from the requirements in Sentence (1) because their presence is permitted to be disregarded when calculating the overall effective thermal resistance of walls they penetrate.

A-9.36.2.5.(2) Thermal Bridging. Sentence 9.36.2.5.(2) aims to minimize thermal bridging within the building envelope, which occurs when building elements conduct more heat than the insulated portion of the building envelope, which can lead to significant heat loss through the thermal bridge. The most typical case to which Clause 9.36.2.5.(2)(a) applies is that of a firewall that must completely penetrate the building envelope (see Figure A-9.36.2.5.(2)-A). Figures A-9.36.2.5.(2)-B and A-9.36.2.5.(2)-C illustrate the insulation options presented in Clauses 9.36.2.5.(2)(b) and (c).

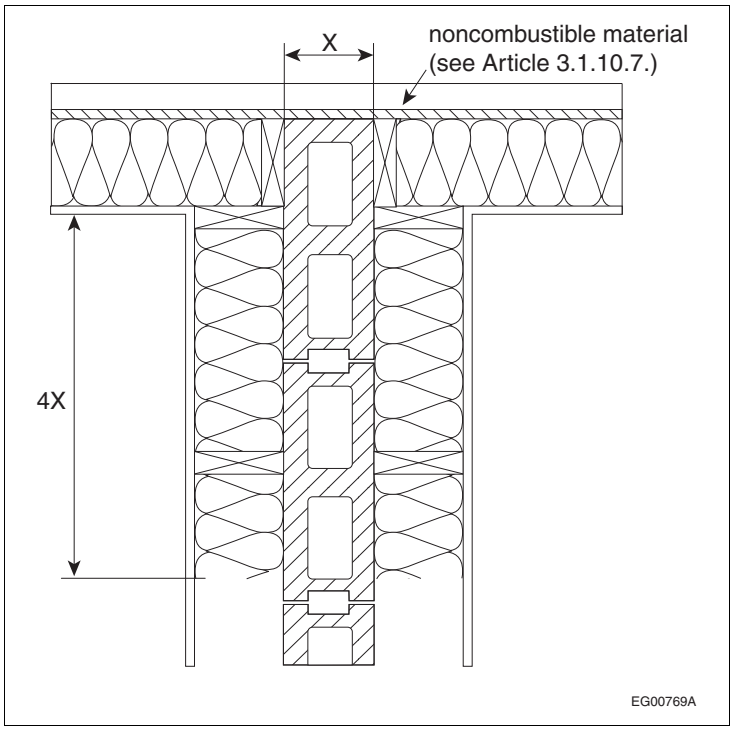


Figure A-9.36.2.5.(2)-A
Penetrating element insulated on both sides

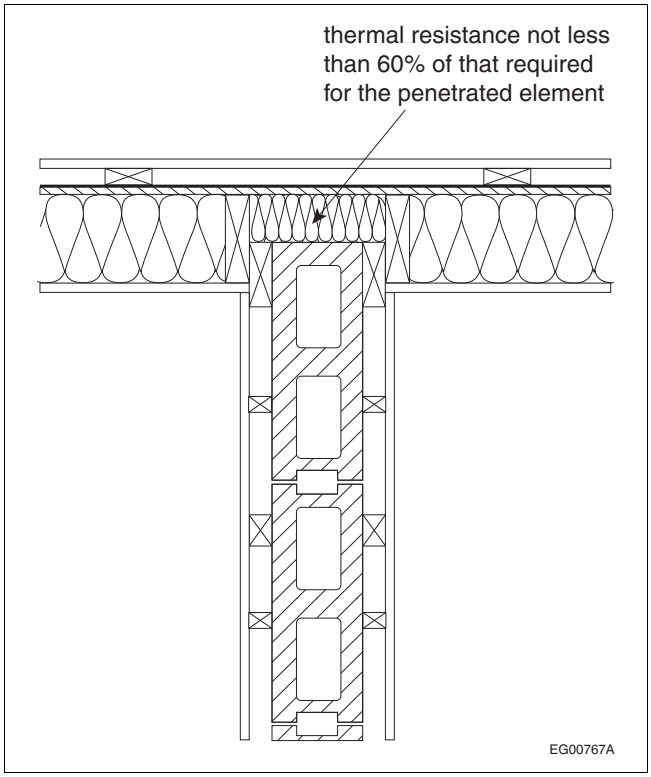


Figure A-9.36.2.5.(2)-B
Penetrating element insulated within exterior wall

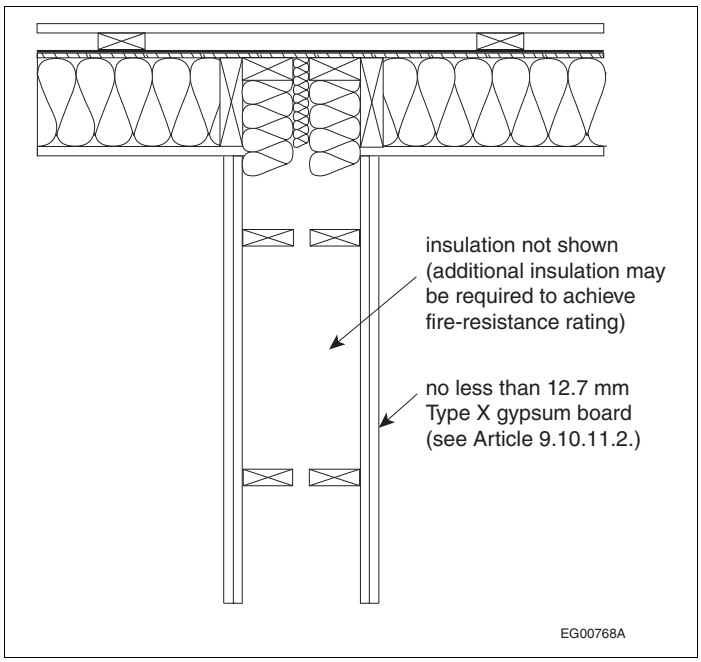


Figure A-9.36.2.5.(2)-C
Penetrating element insulated within itself

A-9.36.2.5.(3) Insulation of Masonry Fireplaces. The two insulation options for masonry fireplaces and flues presented in Sentence 9.36.2.5.(3) are consistent with those presented in Sentences 9.36.2.5.(2) and (4) with the exception of the option to insulate the sides of the penetrating element to 4 times the thickness of the penetrated wall, which would not be an energy-efficient option in cases where the penetration by the fireplace or flue is several feet wide. Figures A-9.36.2.5.(3)-A and A-9.36.2.5.(3)-B illustrate the options for achieving a continuously insulated exterior wall where it is penetrated by a masonry fireplace or flue.

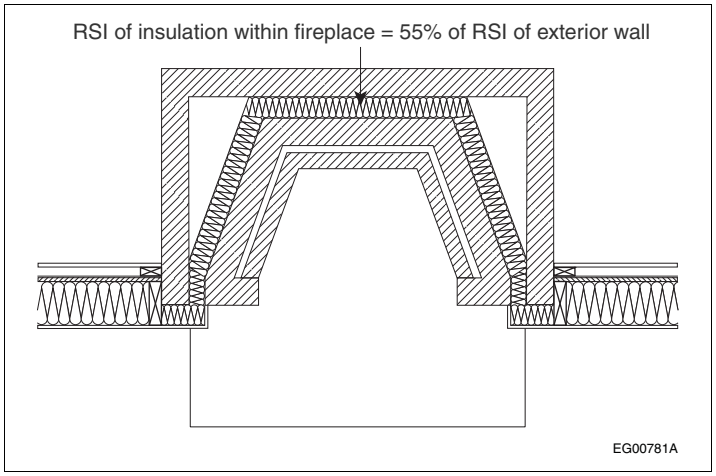


Figure A-9.36.2.5.(3)-A
Masonry fireplace insulated within itself

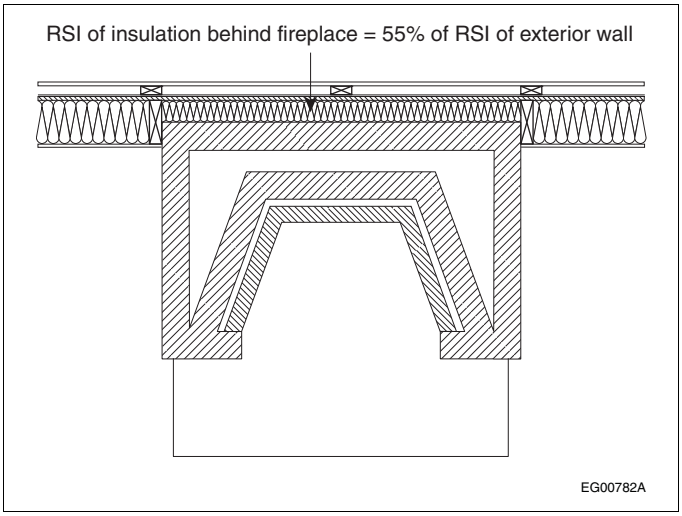


Figure A-9.36.2.5.(3)-B
Masonry fireplace insulated within plane of insulation of exterior wall

A-9.36.2.5.(5) Maintaining Continuity of Insulation. An example to which Sentence 9.36.2.5.(5) does not apply is that of a foundation wall that is insulated on the inside and the insulation continues through the joist cavity and into the wall assembly. An example to which Sentence (5) does apply is a foundation wall that is insulated on the outside below grade and on the inside above grade, in which case the distance separating the two planes of insulation is the thickness of the foundation wall.

In the configuration described in Sentence (5), the top of the foundation wall might also be required to be insulated to reduce the effect of thermal bridging through it. Insulation is not required to be overlapped as stated in Sentence (5) in cases where the joist cavities on top of the foundation wall are filled with insulation.

For cast-in-place concrete foundation walls, Sentence (5) ensures that the continuity of the insulation is maintained at every section across the wall.

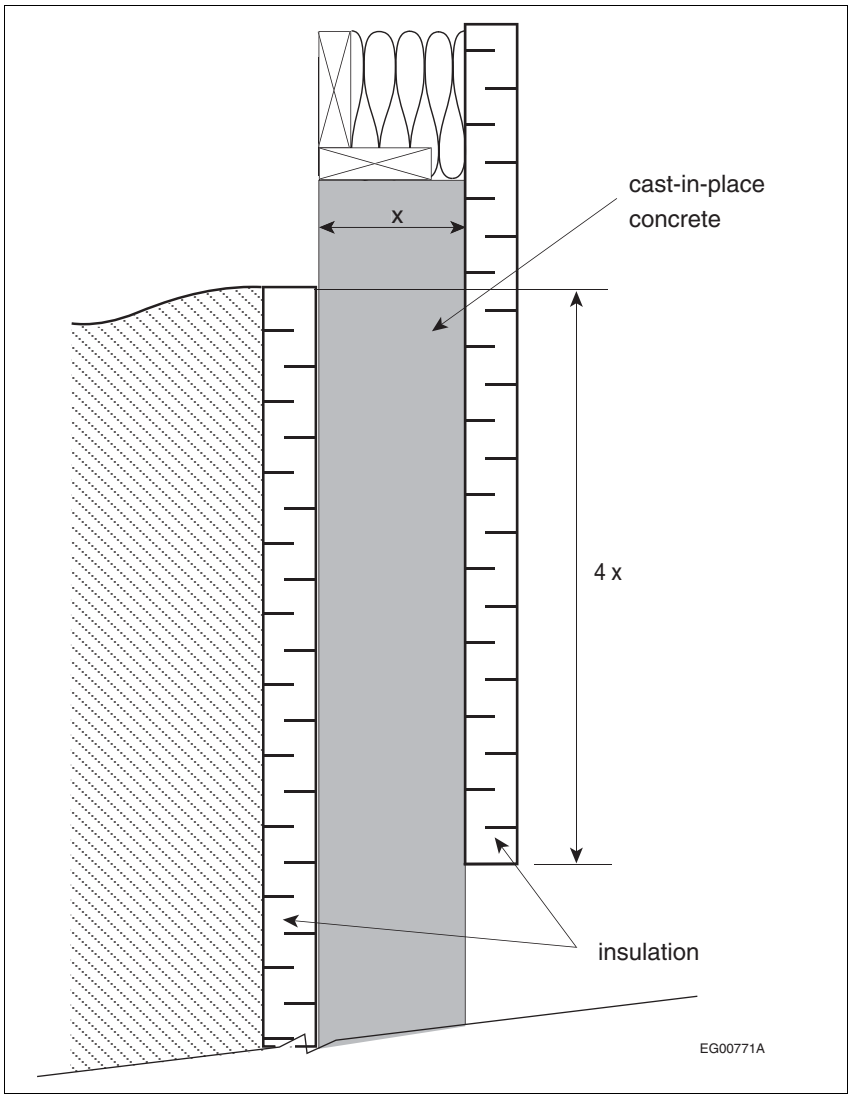


Figure A-9.36.2.5.(5)-A
Application of Sentence 9.36.2.5.(5) to a cast-in-place concrete foundation wall

In the case of hollow-core masonry walls, the effect of convection in the cores needs to be addressed. The cores of the block course that coincide with the respective lowest and highest ends of each plane of insulation should be filled with grout, mortar or insulation to reduce convection within the cores, which could short-circuit the insulation's function.

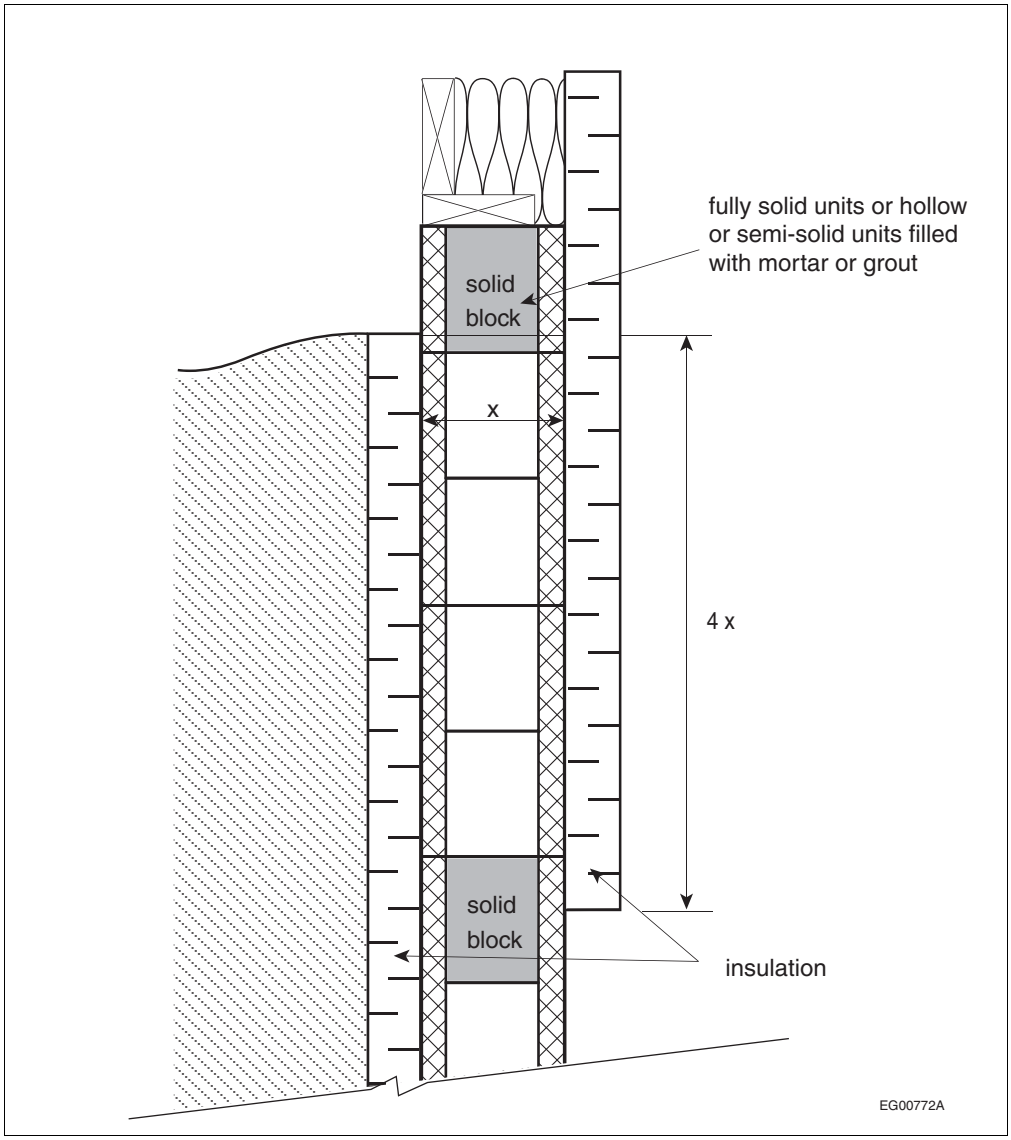


Figure A-9.36.2.5.(5)-B
Application of Sentence 9.36.2.5.(5) to a hollow-core masonry foundation wall

A-9.36.2.5.(6) Effective Thermal Resistance at Projected Area. Sentence 9.36.2.5.(6) does not apply to components that completely penetrate the building envelope, such as air intake or exhaust ducts. However, it does apply to components that are installed within or partially within the building envelope but that don't penetrate to the outdoors, and to any piece of equipment that is merely recessed into the wall.

A-9.36.2.5.(8) Effective Thermal Resistance at Joints in the Building Envelope. Sentence 9.36.2.5.(8) calls for continuity of the effective thermal resistance at the junction between two components of the building envelope, such as a wall with another wall, a wall with a roof, or a wall with a window. For example, where the gap is between a door frame (required U-value 1.8 = RSI value 0.56) and the rough framing members (required RSI value 2.93), it would have to be insulated to the RSI value of the door as a minimum. However, completely filling the gap with insulation may not be necessary as this may in fact compromise the rainscreen principle where required. Care should therefore be taken when installing insulation between windows, doors and walls.

A-9.36.2.6.(1) Thermal Characteristics of Above-ground Opaque Building Assemblies.

Building Envelope Insulation and Ventilation Options

Although the Code does not present any formal trade-off options between the building envelope requirements and the ventilation or water-heating requirements, Tables 9.36.2.6.A. and 9.36.2.6.B. recognize that the same level of energy performance can be achieved through two different combinations of building envelope insulation levels and different ventilation strategies. The insulation values in Table 9.36.2.6.A. are based on mechanical ventilation solutions without heat recovery, while those in Table 9.36.2.6.B. are based on a heat recovery ventilator (HRV) that operates for at least 8 hours a day throughout the year at the minimum required ventilation capacity. The operation of the HRV affords a reduction in the RSI values for some assemblies, most notably for walls and rim joists.

Nominal Insulation Values for Above-ground Walls

Tables A-9.36.2.6.(1)A. and A-9.36.2.6.(1)B. are provided to help Code users assess the compliance of above-ground walls with Table 9.36.2.6.A. or 9.36.2.6.B. Table A-9.36.2.6.(1)A. presents the minimum nominal thermal resistance to be made up in a given wall assembly for it to achieve the applicable RSI value required by Table 9.36.2.6.A. or 9.36.2.6.B. The amount of additional materials needed to meet the prescribed RSI value can then be estimated using the thermal resistance values listed in Table A-9.36.2.4.(1)D. for the rest of the building materials in the assembly, any finishing materials, sheathing or insulation, if applicable, and the interior and exterior air films. See the example given in Note (4) of Table A-9.36.2.6.(1)A.

Note that the wall assemblies described in Table A-9.36.2.6.(1)A. do not necessarily address other building envelope requirements (see Section 9.25.).

Table A-9.36.2.6.(1)A.
Minimum Nominal Thermal Resistance (RSI) to be Made up by Insulation, Sheathing or Other Materials and Air Films in Above-ground Wall Assemblies

Description of Framing or Material	Thermal Resistance of Insulated Assembly			Minimum Effective Thermal Resistance Required by Article 9.36.2.6. for Above-ground Wall Assemblies, (m²·K)/W			
	Nominal, (m²·K)/W (ft²·°F·h/Btu)		Effective, (m²·K)/W	2.78	2.97	3.08	3.85
	Insulation in Framing Cavity	Continuous Materials	Entire Assembly	Minimum Nominal Thermal Resistance,[1] in (m²·K)/W, to be Made up by Insulation, Sheathing[2] or Other Materials and Air Film Coefficients			
38 x 140 mm wood at 406 mm o.c.	3.34 (R19)[3]	None	2.36	0.42[4]	0.61	0.72	1.49
		1.32 (R7.5)	3.68	—	—	—	0.17
	3.87 (R22)	None	2.55	0.23	0.42	0.54	1.30
		0.88 (R5)	3.43	—	—	—	0.42
	4.23 (R24)	None	2.66	0.12	0.30	0.42	1.18
38 x 140 mm wood at 610 mm o.c.	3.34 (R19)[3]	None	2.45	0.33	0.52	0.63	1.40
		0.88 (R5)	3.33	—	—	—	0.52
		1.32 (R7.5)	3.77	—	—	—	0.08
	3.87 (R22)	None	2.67	0.11	0.30	0.42	1.18
	4.23 (R24)	None	2.80	—	0.17	0.28	1.05
38 x 89 mm wood at 406 mm o.c.	2.11 (R12)	0.88 (R5)	2.37	0.40	0.59	0.71	1.47
		1.32 (R7.5)	2.81	—	0.15	0.27	1.03
		1.76 (R10)	3.25	—	—	—	0.59
	2.46 (R14)	0.88 (R5)	2.50	0.28	0.47	0.58	1.35
		1.76 (R10)	3.38	—	—	—	0.47

Table A-9.36.2.6.(1)A. (Continued)

Description of Framing or Material	Thermal Resistance of Insulated Assembly			Minimum Effective Thermal Resistance Required by Article 9.36.2.6. for Above-ground Wall Assemblies, (m²·K)/W			
	Nominal, (m²·K)/W (ft²·°F·h/Btu)		Effective, (m²·K)/W	2.78	2.97	3.08	3.85
	Insulation in Framing Cavity	Continuous Materials	Entire Assembly	Minimum Nominal Thermal Resistance,(1) in (m²·K)/W, to be Made up by Insulation, Sheathing(2) or Other Materials and Air Film Coefficients			
38 x 89 mm wood at 610 mm o.c.	2.11 (R12)	0.88 (R5)	2.43	0.35	0.54	0.65	1.42
		1.32 (R7.5)	2.87	—	0.10	0.21	0.98
	2.46 (R14)	1.76 (R10)	3.46	—	—	—	0.39
Insulating concrete form (ICF), 150 mm thick(5)	n/a	3.52 (R20)	3.58	—	—	—	0.27
		3.73 (R21.2)	3.79	—	—	—	0.06
Concrete block masonry: lightweight, 190 mm thick	n/a	1.76 (R10)	2.08	0.70	0.89	1.00	1.77
		2.64 (R15)	2.96	—	0.01	0.12	0.89
		3.52 (R20)	3.84	—	—	—	0.01
Concrete block masonry: normal-weight, 190 mm thick	n/a	1.76 (R10)	1.97	0.81	1.00	1.11	1.88
		2.64 (R15)	2.85	—	0.12	0.23	1.00
		3.52 (R20)	3.73	—	—	—	0.12

Notes to Table A-9.36.2.6.(1)A.:

(1) A dash (—) means that no additional materials are needed in order to meet the minimum required effective thermal resistance for the assembly in question; however, sheathing may be required for fastening of cladding or lateral bracing.

(2) Where insulating sheathing is installed towards the exterior of the assembly, low permeance requirements addressed in Article 9.25.5.2. must be taken into consideration.

(3) When RSI 3.52 (R20) insulation batts are installed in 140 mm wood framing, they undergo some compression, which reduces their original RSI value to 3.34 (m²·K)/W (R19). However, when they are installed in 152 mm metal framing, R20 batts retain their original thermal resistance value.

(4) Example: To determine what additional materials would be needed to make up 0.42 (m²·K)/W, the RSI values of the other components in the wall assembly are added up as follows:

interior air film coefficient (walls): 0.12 (m²·K)/W
12.7 mm gypsum board interior finish: 0.08 (m²·K)/W
12.7 mm gypsum board exterior sheathing: 0.08 (m²·K)/W
metal or vinyl siding: 0.11 (m²·K)/W
exterior air film coefficient (walls): 0.03 (m²·K)/W
RSI of other components in assembly: 0.12 + 0.08 + 0.08 + 0.11 + 0.03 = 0.42 (m²·K)/W

Result: no additional materials are needed to meet the effective thermal resistance required for this particular wall assembly.

(5) There are many types of ICF designs with different form thicknesses and tie configurations. Where ICF systems incorporate metal ties, thermal bridging should be accounted for. Where permanent wood blocking (bucks) for windows and doors is not covered by the same interior and exterior levels of insulation, it shall be accounted for in the calculation of effective thermal resistance.

Table A-9.36.2.6.(1)B. can be used to determine the total effective thermal resistance (RSI) value of the framing/cavity portion of a number of typical above-ground wall assemblies as well as some atypical ones not covered in Table A-9.36.2.6.(1)A. Additional configurations and assembly types are listed in EnergyStar tables available online at http://ENERGYSTARforNewHomesStandard.NRCan.gc.ca.

Select the applicable stud/joist size and spacing and the RSI/R-value of the insulation to obtain the resultant effective RSI value for that frame configuration. If the RSI/R-value of the insulation product to be installed falls between two RSI/R-values listed in the Table, the lower value must be used. Once the effective RSI value of the framing/cavity portion is known, add up the nominal RSI values of all other materials in the assembly (see Table A-9.36.2.4.(1)D.) to obtain the total effective RSI value for the entire assembly. See the calculation examples in Appendix Note A-9.36.2.4.(1) for further guidance.

Table A-9.36.2.6.(1)B.
Effective Thermal Resistance (RSI) Values of the Framing/Cavity Portion of Above-Ground Wall Assemblies

Nominal Thermal Resistance of Cavity Insulation		Size, mm, and Spacing, mm o.c., of Above-ground Wood-frame Wall Assembly							
		38 x 89				38 x 140			
		304	406	488	610	304	406	488	610
RSI, (m²·K)/W	R, ft²·°F·h/Btu	Effective Thermal Resistance of Framing/Cavity Portion,(1) (m²·K)/W							
1.94	11	1.40	1.43	1.45	1.48	—	—	—	—
2.11	12	1.47	1.49	1.52	1.55	—	—	—	—
2.29	13	1.53	1.56	1.59	1.63	—	—	—	—
2.47	14	1.59	1.62	1.66	1.70	1.95	1.98	2.01	2.03
2.64	15	1.64	1.68	1.72	1.76	2.03	2.06	2.09	2.12
2.82	16	1.69	1.73	1.78	1.82	2.11	2.14	2.18	2.21
2.99	17	1.74	1.78	1.83	1.88	2.18	2.22	2.26	2.30
3.17	18	1.78	1.83	1.88	1.94	2.25	2.29	2.33	2.38
3.34	19	1.82	1.87	1.93	1.98	2.32	2.36	2.41	2.45
3.52	20	1.86	1.91	1.97	2.03	2.38	2.43	2.48	2.53
3.70	21	—	—	—	—	2.44	2.49	2.55	2.60
3.87	22	—	—	—	—	2.49	2.55	2.61	2.67
4.05	23	—	—	—	—	2.55	2.61	2.67	2.74
4.23	24	—	—	—	—	2.60	2.66	2.73	2.80
4.40	25	—	—	—	—	2.65	2.72	2.78	2.86
4.58	26	—	—	—	—	2.70	2.77	2.84	2.92
4.76	27	—	—	—	—	2.74	2.82	2.89	2.98
4.93	28	—	—	—	—	2.79	2.86	2.94	3.03
5.11	29	—	—	—	—	2.83	2.91	2.99	3.08
5.28	30	—	—	—	—	2.87	2.95	3.04	3.13

Notes to Table A-9.36.2.6.(1)B.:

(1) These RSI values are valid where the cavity is completely filled with insulation and they do not account for air space in the cavity. A dash (—) means that it is not feasible to install the cavity insulation listed within the frame configuration in question.

A-9.36.2.6.(3) Reduced Effective Thermal Resistance Near the Eaves of Sloped Roofs. Minimum thermal resistance values for attic-type roofs are significantly higher than those for walls. The exemption in Sentence 9.36.2.6.(3) recognizes that the effective thermal resistance of a ceiling below an attic near its perimeter will be affected by roof slope, truss design and required ventilation of the attic space. It is assumed that the thickness of the insulation will be increased as the roof slope increases until there is enough space to allow for the installation of the full thickness of insulation required.

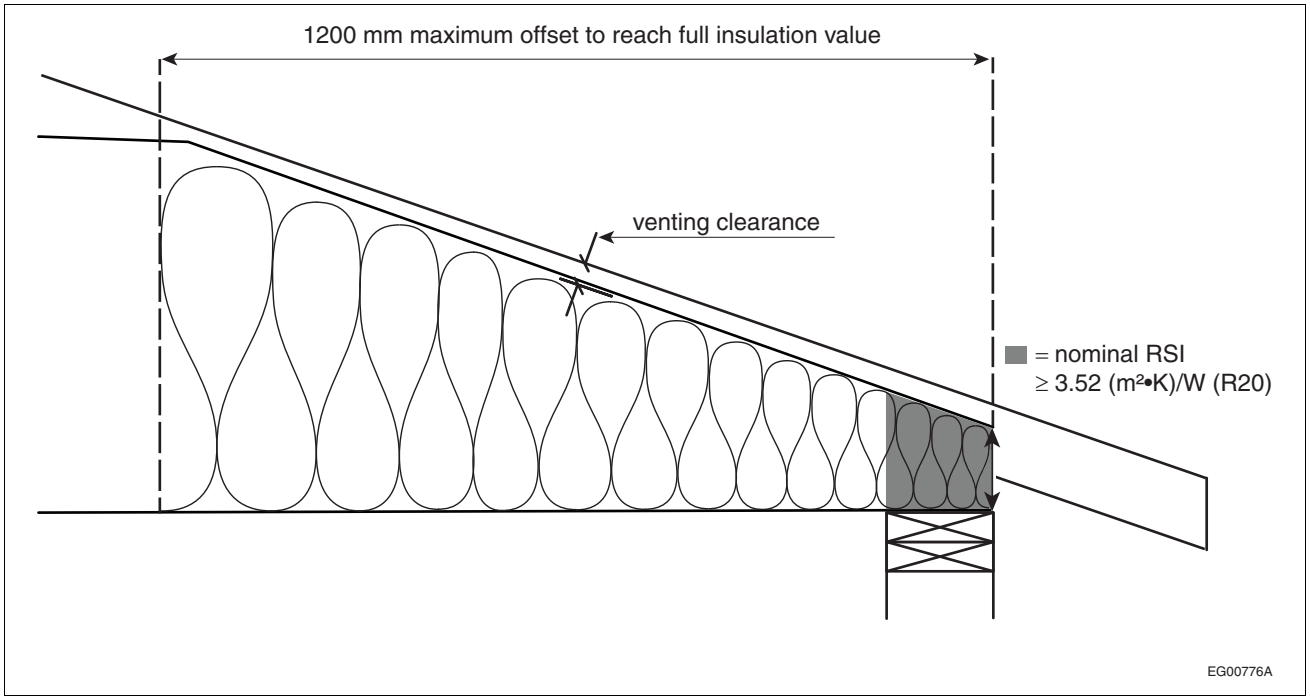


Figure A-9.36.2.6.(3)
Area of ceiling assemblies in attics permitted to have reduced thermal resistance

A-9.36.2.7.(1) and (2) Design of Windows, Glazed Doors and Skylights. The design of windows, glazed doors and skylights involves many variables that impact their energy performance and their compliance with the Code's energy efficiency requirements, such as the type of framing material, number of glass layers, type and position of low-emissivity (low-e) coating, type and size of spacer between glass layers, type of gas used to fill the glass unit, and additionally for glazed doors, type of materials used to construct the door slab.

Here are a few examples of common window and glazed door constructions:

- a U-value of about 1.8 is typically achieved using argon-filled glazing units with a low-e coating and energy-efficient spacer materials installed in a frame chosen mostly for aesthetic reasons;
- a U-value of about 1.6 is typically achieved using triple glazing but may be achieved using double glazing with an optimized gas, spacer and coating configuration installed in an insulated frame;
- a U-value of about 1.4 is typically achieved using triple glazing and multiple low-e coatings.

U-values and Energy Ratings (ER) for manufactured windows, glazed doors and skylights are obtained through testing in accordance with the standards referenced in Sentence 9.36.2.2.(3). The U-value and/or ER number for a proprietary product that has been tested can be found in the manufacturer's literature or on a label affixed to the product.

A-Table 9.36.2.7.A. Thermal Characteristics of Windows and Doors. Energy Ratings, also known as ER numbers, are based on CSA A440.2/A440.3, "Fenestration Energy Performance/User Guide to CSA A440.2-09, Fenestration Energy Performance."

They are derived from a formula that measures the overall performance of windows or doors based on solar heat gain, heat loss and air leakage through frames, spacers and glass. The ER formula produces a single unitless ER number between 0 and 50 for each of the specified sample sizes found in CSA A440.2/A440.3 (the number only applies to the product at the sample size and not to a particular proprietary window or door). The higher the ER number, the more energy-efficient the product. Note that the ER formula does not apply to sloped glazing so skylights do not have an ER value.

The maximum U-values specified in Table 9.36.2.7.A. are based on the following assumptions:

- that of moderate solar gain for each window and glazed door,
- that houses have a mix of picture and sash windows, each of which performs differently from an energy-efficiency perspective, and
- that fenestration area to gross wall area ratios typically vary between 8% and 25%.

A-9.36.2.7.(3) Site-built Windows. Site-built windows are often installed in custom-built homes or in unique configurations for which manufactured units are not available. The airtightness requirements in Section 9.7. also apply to site-built windows.

A-9.36.2.8.(1) Nominal Insulation Values for Walls Below-Grade or in Contact with the Ground. Tables A-9.36.2.8.(1)A., A-9.36.2.8.(1)B. and A-9.36.2.8.(1)C. are provided to help Code users assess the compliance of walls that are below-grade or in contact with the ground with Table 9.36.2.8.A. or 9.36.2.8.B. Table A-9.36.2.8.(1)A. presents the minimum nominal thermal resistance to be made up in a given wall assembly for it to achieve the applicable RSI value required by Table 9.36.2.8.A. or 9.36.2.8.B. The amount of additional materials needed to meet the prescribed RSI value can then be estimated using the thermal resistance values listed in Table A-9.36.2.4.(1)D. for the rest of the building materials in the assembly, any finishing materials, sheathing or insulation, if applicable, and the interior air film. For example, an RSI value of 0.20 (m^2·K)/W needed to achieve the minimum RSI for a given assembly could be made up by installing 12.7 mm gypsum board, which has an RSI value of 0.0775 (m^2·K)/W, and by taking into account the air film coefficient on the interior side of the wall, which is 0.12 (m^2·K)/W.

Note that the wall assemblies described in Table A-9.36.2.8.(1)A. do not necessarily address other structural or building envelope requirements (see Section 9.25.).

Table A-9.36.2.8.(1)A.
Minimum Nominal Thermal Resistance (RSI) to be Made up by Insulation, Sheathing or Other Materials and Air Films in Wall Assemblies Below-Grade or in Contact with the Ground

Description of Framing or Material	Size and Spacing of Wood Framing	Thermal Resistance of Insulated Assembly			Minimum Effective Thermal Resistance Required by Article 9.36.2.8. for Wall Assemblies Below-Grade or in Contact with the Ground, (m^2·K)/W			
		Nominal, (m^2·K)/W (ft^2·°F·h/Btu)		Effective, (m^2·K)/W	1.99	2.98	3.46	3.97
		Insulation in Framing Cavity	Continuous Materials	Entire Assembly	Minimum Nominal Thermal Resistance,(1) in (m^2·K)/W, to be Made up by Insulation, Sheathing(2) or Other Materials and Air Film Coefficients			
200 mm cast-in-place concrete	38 x 89 mm, 610 mm o.c.	2.11 (R12)	None	1.79	0.20	1.19	1.67	2.18
			1.41 (R8)	3.20	—	—	0.26	0.77
		2.46 (R14)	1.76 (R10)	3.75	—	—	—	0.22
	38 x 140 mm, 610 mm o.c.	3.34 (R19)(3)	None	2.78	—	0.20	0.68	1.19
		4.23 (R24)	None	3.26	—	—	0.20	0.71
	None	n/a	1.76 (R10)	1.84	0.15	1.14	1.62	2.13
			2.64 (R15)	2.72	—	0.26	0.74	1.25
			3.52 (R20)(3)	3.60	—	—	—	0.37
190 mm concrete block masonry: normal-weight, no insulation in cores	38 x 89 mm, 610 mm o.c.	2.11 (R12)	None	1.92	0.07	1.06	1.54	2.05
			1.41 (R8)	3.33	—	—	0.13	0.64
			2.11 (R12)	4.03	—	—	—	—
	38 x 140 mm, 610 mm o.c.	3.34 (R19)(3)	None	2.91	—	0.07	0.55	1.06
		4.23 (R24)	None	3.39	—	—	0.07	0.58
	None	n/a	1.76 (R10)	1.97	0.02	1.01	1.49	2.00
			2.64 (R15)	2.85	—	0.13	0.61	1.12
			3.52 (R20)(3)	3.73	—	—	—	0.24

Table A-9.36.2.8.(1)A. (Continued)

Description of Framing or Material	Size and Spacing of Wood Framing	Thermal Resistance of Insulated Assembly			Minimum Effective Thermal Resistance Required by Article 9.36.2.8. for Wall Assemblies Below-Grade or in Contact with the Ground, (m²·K)/W			
		Nominal, (m²·K)/W (ft²·°F·h/Btu)		Effective, (m²·K)/W	1.99	2.98	3.46	3.97
		Insulation in Framing Cavity	Continuous Materials	Entire Assembly	Minimum Nominal Thermal Resistance,[1] in (m²·K)/W, to be Made up by Insulation, Sheathing[2] or Other Materials and Air Film Coefficients			
190 mm concrete block masonry: light-weight, no insulation in cores	38 x 89 mm, 610 mm o.c.	2.11 (R12)	None	2.03	—	0.95	1.43	1.94
			1.41 (R8)	3.44	—	—	0.02	0.53
			2.11 (R12)	4.14	—	—	—	—
	38 x 140 mm, 610 mm o.c.	3.34 (R19)[3]	None	3.02	—	—	0.44	0.95
		4.23 (R24)	None	3.50	—	—	—	0.47
	None	n/a	1.76 (R10)	2.08	—	0.90	1.38	1.89
			2.64 (R15)	2.96	—	0.02	0.50	1.01
			3.52 (R20)	3.84	—	—	—	0.13
Insulating concrete form (ICF):[4] 150 mm concrete	n/a	n/a	3.52 (R20)[3]	3.58	—	—	—	0.39
			3.73 (R21.2)	3.79	—	—	—	0.18
Pressure-treated wood frame	38 x 140 mm, 203 mm o.c.	3.34 (R19)[3]	None	2.33	—	0.65	1.13	1.64
		4.23 (R24)	None	2.62	—	0.36	0.84	1.35
	38 x 186 mm, 203 mm o.c.	4.93 (R28)	None	2.81	—	0.17	0.65	1.16
	38 x 235 mm, 203 mm o.c.	5.28 (R31)	None	3.86	—	—	—	0.11
	38 x 140 mm, 406 mm o.c.	3.34 (R19)[3]	None	2.59	—	0.39	0.87	1.38
		4.23 (R24)	None	3.00	—	—	0.46	0.97
	38 x 186 mm, 406 mm o.c.	4.93 (R28)	None	3.85	—	—	—	0.12
	38 x 235 mm, 406 mm o.c.	5.28 (R31)	None	4.11	—	—	—	—

Notes to Table A-9.36.2.8.(1)A.:

(1) A dash (—) means that no additional materials are needed in order to meet the minimum required effective thermal resistance for the assembly in question; however, sheathing may be required for fastening of cladding or lateral bracing.

(2) Wood-based sheathing ≥ 11 mm thick generally has a thermal resistance of 0.11 (m²·K)/W (R0.62). However, thicker sheathing may be required for structural stability or fastening of cladding. Note that thinner R0.62 wood-based sheathing products are also available (see Table A-9.36.2.4.(1)D.).

(3) When RSI 3.52 (R20) insulation batts are installed in 140 mm wood framing, they undergo some compression, which reduces their original RSI value to 3.34 (m²·K)/W (R19). However, when they are installed in 152 mm metal framing or in a wood frame that is offset from the back-up wall, R20 batts retain their original thermal resistance value.

(4) There are many types of ICF designs with different form thicknesses and tie configurations. Where ICF systems incorporate metal ties, thermal bridging should be accounted for.

Tables A-9.36.2.8.(1)B. and A-9.36.2.8.(1)C. can be used to determine the total effective thermal resistance (RSI) value of the framing/cavity portion of a number of typical below-grade wall assemblies as well as some atypical ones not covered in Table A-9.36.2.8.(1)A. Additional configurations and assembly types are listed in EnergyStar tables available online at http://ENERGYSTARforNewHomesStandard.NRCan.gc.ca.

Select the applicable stud/joist size and spacing and the RSI/R-value of the insulation to obtain the resultant effective RSI value for that frame configuration. If the RSI/R-value of the insulation product to be installed falls between two RSI/R-values listed in the Table, the lower value must be used. Once the effective RSI value of the

framing/cavity portion is known, add up the nominal RSI values of all other materials in the assembly (see Table A-9.36.2.4.(1)D.) to obtain the total effective RSI value of the entire assembly. See the calculation examples in Appendix Note A-9.36.2.4.(1) for further guidance.

Table A-9.36.2.8.(1)B.
Effective Thermal Resistance (RSI) Values of the Framing/Cavity Portion of Pressure-treated Foundation Wall Assemblies

Nominal Thermal Resistance of Cavity Insulation		Size, mm, and Spacing, mm o.c., of Pressure-treated Wood-frame Foundation Wall Assembly					
		38 x 185			38 x 235		
		203	304	406	203	304	406
RSI, (m²·K)/W	R, ft²·°F·h/Btu	Effective Thermal Resistance of Framing/Cavity Portion,(1) (m²·K)/W					
2.11	12	1.95	1.98	2.00	2.08	2.09	2.09
2.29	13	2.06	2.10	2.13	2.21	2.23	2.24
2.47	14	2.17	2.23	2.26	2.34	2.36	2.38
2.64	15	2.27	2.33	2.38	2.45	2.49	2.51
2.82	16	2.36	2.45	2.50	2.57	2.62	2.65
2.99	17	2.45	2.55	2.61	2.67	2.73	2.77
3.17	18	2.54	2.65	2.72	2.78	2.85	2.90
3.34	19	2.62	2.75	2.83	2.88	2.96	3.02
3.52	20	2.71	2.84	2.93	2.98	3.07	3.14
3.70	21	2.79	2.94	3.04	3.07	3.18	3.26
3.87	22	2.86	3.02	3.13	3.16	3.28	3.37
4.05	23	2.93	3.11	3.23	3.25	3.39	3.48
4.23	24	3.00	3.20	3.32	3.34	3.49	3.59
4.40	25	3.07	3.27	3.41	3.41	3.58	3.69
4.58	26	3.13	3.35	3.50	3.50	3.68	3.79
4.76	27	3.19	3.43	3.59	3.57	3.77	3.90
4.93	28	3.25	3.50	3.67	3.65	3.85	3.99
5.11	29	3.31	3.57	3.75	3.72	3.94	4.09
5.28	30	3.36	3.64	3.83	3.79	4.02	4.18
5.46	31	3.42	3.71	3.90	3.86	4.11	4.27

Notes to Table A-9.36.2.8.(1)B.:

(1) These RSI values are valid where the cavity is completely filled with insulation and they do not account for air space in the cavity.

Table A-9.36.2.8.(1)C.
Effective Thermal Resistance (RSI) Values of the Framing/Cavity Portion of Below-Grade Interior Non-loadbearing Wood-frame Wall Assemblies

Nominal Thermal Resistance of Cavity Insulation		Size, mm, and Spacing, mm o.c., of Below-Grade Interior Non-loadbearing Wood-frame Wall Assembly							
		38 x 89				38 x 140			
		203	304	406	610	203	304	406	610
RSI, $(m^2 \cdot K)/W$	R, $ft^2 \cdot °F \cdot h/Btu$	Effective Thermal Resistance of Framing/Cavity Portion,[1] $(m^2 \cdot K)/W$							
0.00	0	0.22	0.21	0.20	0.20	—	—	—	—
1.41	8	1.17	1.21	1.24	1.27	—	—	—	—
1.94	11	1.41	1.50	1.55	1.61	—	—	—	—
2.11	12	1.48	1.57	1.64	1.71	—	—	—	—
2.29	13	1.54	1.65	1.73	1.81	—	—	—	—
2.47	14	1.60	1.73	1.81	1.91	—	—	—	—
2.64	15	1.65	1.79	1.89	1.99	—	—	—	—
2.82	16	1.70	1.86	1.96	2.08	2.12	2.24	2.31	2.39
2.99	17	1.75	1.92	2.03	2.16	2.19	2.32	2.41	2.50
3.17	18	1.80	1.97	2.10	2.24	2.27	2.41	2.50	2.61
3.34	19	1.84	2.03	2.16	2.31	2.33	2.49	2.59	2.70
3.52	20	1.88	2.08	2.22	2.39	2.39	2.57	2.68	2.81
3.70	21	1.91	2.13	2.28	2.46	2.46	2.64	2.77	2.90
3.87	22	1.95	2.17	2.33	2.52	2.51	2.71	2.84	2.99
4.05	23	1.98	2.22	2.39	2.59	2.57	2.78	2.93	3.09
4.23	24	2.01	2.26	2.44	2.65	2.62	2.85	3.00	3.18
4.40	25	—	—	—	—	2.67	2.91	3.07	3.26
4.58	26	—	—	—	—	2.72	2.97	3.15	3.34
4.76	27	—	—	—	—	2.77	3.03	3.22	3.42
4.93	28	—	—	—	—	2.81	3.09	3.28	3.50

Notes to Table A-9.36.2.8.(1)C.:

(1) These RSI values are valid where the cavity is completely filled with insulation and they do not account for air space in the cavity. A dash (—) means that it is not feasible to install the cavity insulation listed within the frame configuration in question.

A-Tables 9.36.2.8.A. and B. Multiple Applicable Requirements. In cases where a single floor assembly is made up of several types of the floor assemblies listed in Tables 9.36.2.8.A. and 9.36.2.8.B., each portion of that floor must comply with its respective applicable RSI value. For example, in the case of a walkout basement, the portion of floor that is above the frost line—i.e. the walkout portion—should be insulated in accordance with the values listed in the applicable Table whereas the portion below the frost line can remain uninsulated.

A-9.36.2.8.(2) Combination Floor Assemblies. An example of a floor assembly to which Sentence 9.36.2.8.(2) would apply is a heated slab-on-grade with an integral footing.

A-9.36.2.8.(4) Unheated Floors-on-ground Above the Frost Line. Figure A-9.36.2.8.(4) illustrates the insulation options for unheated floors-on-ground that are above the frost line.

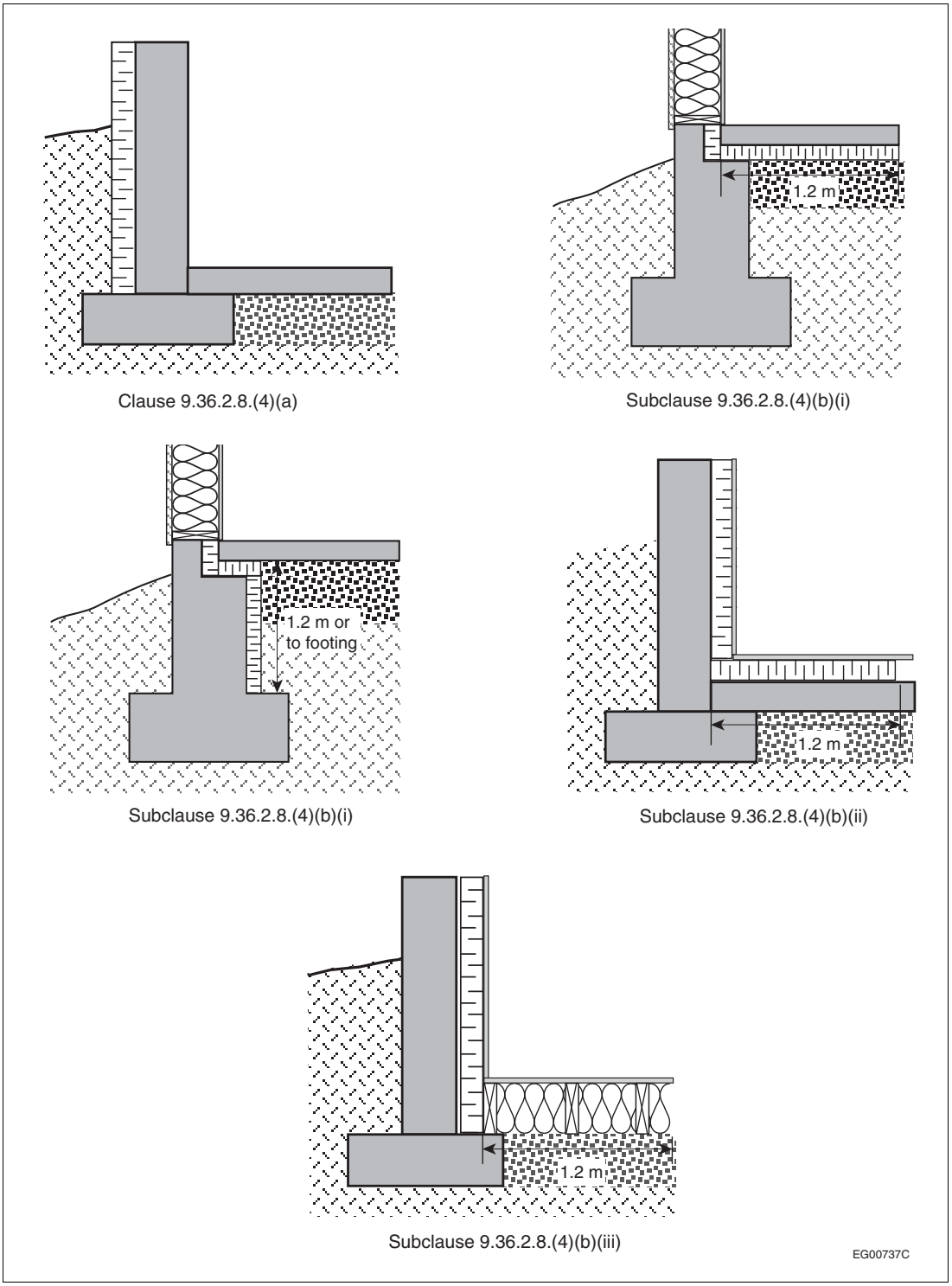


Figure A-9.36.2.8.(4)
Options for insulating unheated floors-on-ground

A-9.36.2.8.(9) Skirt Insulation. "Skirt insulation" refers to insulation installed on the exterior perimeter of the foundation and extended outward horizontally or at a slope away from the foundation. In cold climates, skirt insulation is typically extended 600 to 1000 mm out from the vertical foundation wall over the footings to reduce heat loss from the house into the ground and to reduce the chance of frost forming under the footings.

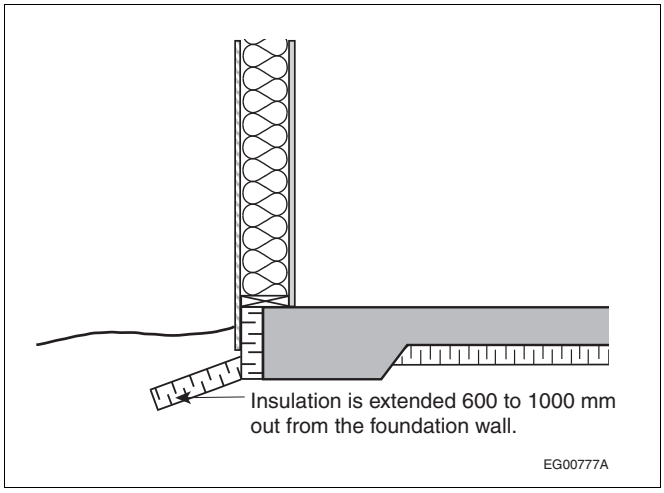


Figure A-9.36.2.8.(9)
Skirt insulation

A-9.36.2.9.(1) Controlling air leakage.

Airtightness Options

Sentence 9.36.2.9.(1) presents three options for achieving an airtight building envelope: one prescriptive option (Clause (a)) and two testing options (Clauses (b) and (c)).

Air Barrier System Approaches

For an air barrier system to be effective, all critical junctions and penetrations addressed in Articles 9.36.2.9. and 9.36.2.10. must be sealed using either an interior or exterior air barrier approach or a combination of both.

The following are examples of typical materials and techniques used to construct an interior air barrier system:

- airtight-drywall approach
- sealed polyethylene approach
- joint sealant method
- rigid panel material (i.e. extruded polystyrene)
- spray-applied foams
- paint or parging on concrete masonry walls or cast-in-place concrete

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

The following are examples of typical materials and techniques used to construct an exterior air barrier system:

- rigid panel material (i.e. extruded polystyrene)
- house wraps
- peel-and-stick membranes
- liquid-applied membranes

When designing an exterior air barrier system, consideration should be given to the strength of the vapour barrier and expected relative humidity levels as well as to the climatic conditions at the building's location and the properties of adjoining materials.

A-9.36.2.9.(5) Making Fireplaces Airtight. Besides fireplace doors, other means to reduce air leakage through fireplaces are available; for example, installing a glass-enclosed fireplace.

A-9.36.2.9.(6) Exterior Air Barrier Design Considerations. Any airtight assembly—whether interior or exterior—will control air leakage for the purpose of energy efficiency. However, the materials selected and their location in the assembly can have a significant impact on their effectiveness with regard to moisture control and the resistance to deterioration of the entire building envelope.

A-9.36.2.10.(5)(b) Sealing the Air Barrier System with Sheathing Tape. One method of sealing air barrier materials at joints and junctions is to apply sheathing tape that has an acceptable air leakage characteristic, is compatible with the air barrier material and resistant to the mechanisms of deterioration to which the air barrier material will be exposed. Where an assembly tested to CAN/ULC-S742, "Air Barrier Assemblies – Specification," includes sheathing tape as a component, the sheathing tape will have been tested for compatibility and resistance to deterioration and will be referenced in the manufacturer's literature as acceptable for use with that air barrier assembly.

A-9.36.2.10.(7)(a) Components Designed to Provide a Seal at Penetrations. An example of the component referred to in Clause 9.36.2.10.(7)(a) is a plastic surround for electrical outlet boxes that has a flange to which sealant can be applied or that has an integrated seal.

A-9.36.2.10.(9) Sealing the Air Barrier around Windows, Doors and Skylights. A continuous seal between windows, doors and skylights and adjacent air barrier materials can be achieved by various means including applying exterior sealant, interior sealant, low-expansion foam or sheathing tape in combination with drywall, polyethylene, a closed-cell backer rod, or a wood liner.

A-9.36.2.10.(14) Sealing Duct Penetrations. Article 9.32.3.11. requires that joints in all ventilation system ducting be sealed with mastic, metal foil duct tape or sealants specified by the manufacturer. Sentence 9.36.2.10.(14) requires that penetrations made by ducts through ceilings or walls be sealed with appropriate sealant materials and techniques to prevent air leakage. Mechanical fastening of the duct at the penetration may further reduce the likelihood of air leakage through the penetration.

A-9.36.2.11. Concept of Trade-offs. The trade-off options presented in Sentences 9.36.2.11.(2) to (4) afford some degree of flexibility in the design and construction of energy-efficient features in houses and buildings as they allow a builder/designer to install one or more assemblies with a lower RSI value than that required in Articles 9.36.2.1. to 9.36.2.7. as long as the discrepancy in RSI value is made up by other assemblies and that the total area of the traded assemblies remains the same.

Limitations to Using Trade-off Options

In some cases, the energy-conserving impact of requirements cannot be easily quantified and allowing trade-offs would be unenforceable: this is the case, for instance, for airtightness requirements (Article 9.36.2.10.). In other cases, no credit can be given for improving energy performance where the Code permits reduced performance: for example, the Code allows insulation to be reduced at the eaves under a sloped roof so no credit can be given for installing raised heel trusses to accommodate the full insulation value otherwise required by the Code; in other words, the increased RSI value that would be achieved with the raised truss cannot be traded.

Furthermore, the trade-off calculations only address conductive heat loss through the building envelope and are therefore limited in their effectiveness at keeping the calculated energy performance of a building in line with its actual energy performance, which includes solar heat gains. The limitations stated in Sentence 9.36.2.11.(6) address this by ensuring that the thermal resistances are relatively evenly distributed across all building assemblies.

Terms Used in Trade-off Provisions

For the purposes of Article 9.36.2.11., the term "reference" (e.g. reference assembly) refers to a building element that complies with the prescriptive requirements of Articles 9.36.2.1. to 9.36.2.7., whereas the term "proposed" refers to a building element whose RSI value can be traded in accordance with Sentence 9.36.2.11.(2), (3) or (4), as applicable.

A-9.36.2.11.(2) Trading RSI Values of Above-Ground Opaque Building Envelope Assemblies. Sentence 9.36.2.11.(2) applies where a designer wants to use a wall or ceiling assembly with a lower effective thermal resistance than required by Subsection 9.36.2. in one building envelope area and an assembly with a compensating higher effective thermal resistance in another building envelope area to achieve the same energy performance through the combined total areas as would be achieved by complying with Subsection 9.36.2.

Example

A designer wants to reduce the insulation in 40 m² of wall area in the proposed design from the required effective RSI value of 3.27 (R24 batts in a 38 x 140 mm frame, 406 mm o.c.) to a value of 2.93 (R20 batts). The proposed design has 200 m² of attic space where more insulation could be added to compensate for the lower RSI value in the 40 m² of wall.

Assemblies Being Traded	Area of Each Assembly (A)	Reference Design Values		Proposed Design Values	
		RSI values (R)	A/R Values	RSI values (R)	A/R Values
Attic	200 m²	8.66 (m²·K)/W	23.09 W/K	8.66 (m²·K)/W	23.09 W/K
Wall	40 m²	3.27 (m²·K)/W	12.23 W/K	2.93 (m²·K)/W	13.65 W/K
		Total A/R value: 35.32 W/K		Total A/R value: 36.74 W/K	

The increased total A/R value for the attic and wall assemblies of the proposed design, which is caused by less insulation in the wall, now has to be compensated for by an increase in attic insulation while keeping the respective areas of the building assemblies constant. To determine the RSI value to be made up by insulation in the attic (i.e. increase in effective thermal resistance of attic assembly), first calculate the difference between the two total A/R values:

36.74 W/K – 35.32 W/K = 1.42 W/K

Then, subtract this residual A/R value from the A/R value required for the attic insulation:

23.09 W/K – 1.42 W/K = 21.67 W/K

Adding this decreased A/R value for the proposed attic to the increased A/R value for the proposed wall now gives a total A/R value that is less than or equal to that of the reference design:

21.67 W/K + 13.65 W/K = 35.32 W/K

To determine the RSI value to be made up by insulation in the attic of the proposed design, divide the area of the attic by the decreased A/R value required for the attic of the proposed design (21.67 W/K):

200 m²/21.67 W/K = 9.23 (m²·K)/W (R52.4)

Assemblies Being Traded	Area of Each Assembly (A)	Reference Design Values		Proposed Design Trade-off Values	
		RSI values (R)	A/R Values	RSI values (R)	A/R Values
Attic	200 m²	8.66 (m²·K)/W	23.09 W/K	9.23 (m²·K)/W	21.67 W/K
Wall	40 m²	3.27 (m²·K)/W	12.23 W/K	2.93 (m²·K)/W	13.65 W/K
		Total A/R value: 35.32 W/K		Total A/R value: 35.32 W/K	

A-9.36.2.11.(2) and (3) Calculating Trade-off Values. To trade effective thermal resistance values between above-ground building envelope components or assemblies, the ratios of area and effective thermal resistance of all such components or assemblies for the reference case (in which all components and assemblies comply with Article 9.36.2.6.) and the proposed case (in which the effective thermal resistance values of some areas are traded) must be added up and compared using the following equation:

$$\sum_{i=1}^{n} \frac{A_{ir}}{R_{ir}} \geq \sum_{i=1}^{n} \frac{A_{ip}}{R_{ip}}$$

where

R_{ir} = effective thermal resistance of assembly i of the reference case,

A_{ir} = area of assembly i of the reference case,
R_{ip} = effective thermal resistance of assembly i of the proposed case,
A_{ip} = area of assembly i of the proposed case,
n = total number of above-ground components or assemblies, and
i = 1, 2, 3, …, n.

The sum of the areas of the above-ground assemblies being traded in the proposed case (A_{ip}) must remain the same as the sum of the areas of the corresponding above-ground assemblies in the reference case (A_{ir}). Only the trade-off option described in Sentence 9.36.2.11.(4) allows a credit for a reduction in window area where the window to gross wall area ratio is less than 17%.

A-9.36.2.11.(3) Trading R-values of Windows. Sentence 9.36.2.11.(3) applies where a designer wants to install one or more windows having a U-value above the maximum permitted by Article 9.36.2.7. and reduce the U-value of other windows to achieve the same overall energy performance through the combined total area of all windows as would be achieved by complying with Article 9.36.2.7. (Note that R-values, not U-values as are typically used in relation to windows, are used in this Appendix Note.)

Example

A designer wants to install a large stained glass window on the south side of the proposed house as well as other windows for a total 12 m² in area. The designer wants the stained glass window to have a U-value of 2.7 W/(m²·K) (R-value 0.37 (m²·K)/W), which is higher than the maximum permitted by Subsection 9.7.3. for condensation resistance, and proposes to compensate for its reduced energy performance by reducing the U-value of the remaining windows on that side, which total 10 m².

Assemblies on South Side	Total Area of Assemblies (A)	Reference Design Values	
		R-value (R)	A/R Value
Windows	12 m²	0.56 (m²·K)/W	21.54 W/K
		Total A/R value: 21.54 W/K	

Assemblies Being Traded on South Side	Total Area of Assemblies (A)	Proposed Design Values	
		R-value (R)	A/R Values
Stained glass window	2 m²	0.37 (m²·K)/W	5.41 W/K
Other windows	10 m²	0.56 (m²·K)/W	17.86 W/K
		Total A/R value: 23.27 W/K	

The increased total A/R value for the window assemblies on the south side of the proposed house, which is due to the stained glass window, now has to be compensated for by better windows (i.e. with a lower U-value than the maximum allowed) while keeping the total area of windows in the house constant (12 m²). To determine the R-value required to be made up by the rest of the windows on the south side, first calculate the difference between the two total A/R values:

23.27 W/K – 21.54 W/K = 1.73 W/K

This value (1.73 W/K) now has to be subtracted from the A/R value for the 10 m² of windows to determine the compensating energy performance needed:

17.86 W/K – 1.73 W/K = 16.13 W/K

Adding this decreased A/R value for the windows to the increased A/R value for the stained glass window will now give a total A/R value that is less than or equal to that of the reference design:

16.13 W/K + 5.41 W/K = 21.54 W/K

To determine the R-value to be made up by the rest of the windows on the south side of the proposed house, divide the area of the remaining windows by the decreased A/R value for the 10 m² of windows:

10 m²/16.13 W/K = 0.62 (m²·K)/W (or a U-value of 1.6 W/(m²·K))

Assemblies Being Traded on South Side	Total Area of Assemblies (A)	Proposed Design Trade-off Values	
		R-values (R)	A/R Values
Stained glass window	2 m²	0.37 (m²·K)/W	5.41 W/K
Other windows	10 m²	0.62 (m²·K)/W	16.13 W/K
		Total A/R value: 21.54 W/K	

A-9.36.2.11.(4) RSI Values of Insulation in Attics under Sloped Roofs.

Trade-off Option for Buildings with Low Ceilings

The trade-off option presented in Sentence 9.36.2.11.(4) relating to buildings with a low floor-to-ceiling height and a relatively low window and door area to wall area ratio recognizes the proven energy performance of single-section factory-constructed buildings, which have very low sloped roofs in order to comply with transportation height limitations. This option is provided to avoid unnecessarily imposing performance modeling costs. It is unlikely to be applied to site-constructed buildings or to factory-constructed buildings that are not subject to stringent transportation height restrictions because low ceilings are not the preferred choice, and the cost of cutting framing and interior finish panel products to size would exceed the cost of meeting the prescriptive attic and floor insulation levels.

Trade-off Calculation

The trade-off option presented in Sentence 9.36.2.11.(4) allows the trading of a credit based on the difference between the reference (prescriptive) and actual (proposed) window and door area. This credit can be used to reduce the required effective thermal resistance of all ceiling or floor assemblies (attics).

$$\frac{\left(A_{w,r(17\%)} - A_{w,p(\max.\ 15\%)}\right)}{R_{w,r}} \geq \sum_{i=1}^{n} \frac{A_{i,c/f,r}}{R_{i,c/f,r}} - \sum_{i=1}^{n} \frac{A_{i,c/f,p}}{R_{i,c/f,p}}$$

where

$R_{i,c/f,r}$ = effective thermal resistance of ceiling/floor assembly i of the reference case,
$A_{i,c/f,r}$ = area of ceiling/floor assembly i of the reference case,
$R_{i,c/f,p}$ = effective thermal resistance of ceiling/floor assembly i of the proposed case,
$A_{i,c/f,p}$ = area of ceiling/floor assembly i of the proposed case,
$A_{w,r\,(17\%)}$ = area of windows constituting 17% of gross wall area (see Article 9.36.2.3.),
$R_{w,r}$ = effective thermal resistance of windows (see Article 9.36.2.7.),
$A_{w,p\,(max.15\%)}$ = area of windows constituting 15% or less of gross wall area (see Article 9.36.2.3.),
n = total number of ceiling/floor assemblies, and
i = 1, 2, 3,…, n.

The sum of $A_{i,c/f,p}$ must equal the sum of $A_{i,c/f,r}$. The sum of the areas of all other building envelope assemblies must remain the same in both the proposed and reference cases.

Trading Window Area for Reduced Attic Insulation

Sentence 9.36.2.11.(4) applies where a proposed design has a fenestration and door area to gross wall area ratio (FDWR) of 15% or less. The resulting reduction in energy loss due to the fact that there are fewer windows is traded for a reduction in R-value for a specific area in the attic where it is impossible to install the required insulation level due to roof slope.

Example

<table>
<tr><td colspan="4">A designer wants to use a FDWR of 12% in the proposed design in order to be able to install less insulation in the 100 m² of attic space.</td></tr>
<tr><td rowspan="2">Assemblies Being Traded</td><td rowspan="2">Area of Each Assembly (A)</td><td colspan="2">Reference Design Values (FDWR 17%)</td></tr>
<tr><td>RSI values (R)</td><td>A/R Values</td></tr>
<tr><td>Attic</td><td>100 m²</td><td>8.67 (m²·K)/W</td><td>11.5 W/K</td></tr>
<tr><td>Windows</td><td>25 m²</td><td>0.63 (m²·K)/W</td><td>39.7 W/K</td></tr>
<tr><td colspan="2"></td><td colspan="2">Total A/R value: 51.2 W/K</td></tr>
<tr><td rowspan="2">Assemblies Being Traded</td><td rowspan="2">Area of Each Assembly (A)</td><td colspan="2">Proposed Design Values (FDWR 12%)</td></tr>
<tr><td>RSI values (R)</td><td>A/R Values</td></tr>
<tr><td>Attic</td><td>100 m²</td><td>8.67 (m²·K)/W</td><td>11.5 W/K</td></tr>
<tr><td>Windows</td><td>18 m²</td><td>0.63 (m²·K)/W</td><td>28.6 W/K</td></tr>
<tr><td colspan="2"></td><td colspan="2">Total A/R value: 40.1 W/K</td></tr>
<tr><td colspan="4">To determine the reduction in RSI value permitted for the attic insulation in the proposed design, first calculate the difference between the two A/R values:
51.2 W/K – 40.1 W/K = 11.1 W/K
This residual A/R value can now be used as a credit towards the A/R value of the attic insulation in the proposed design:
11.1 W/K + 11.5 W/K = 22.6 W/K
Adding this increased A/R value for the proposed attic to the A/R value for the proposed window area will now give a total A/R value that is less than or equal to that of the reference design:
22.6 W/K + 28.6 W/K = 51.2 W/K
To determine the new RSI value of the attic insulation, divide the area of the attic by its new increased A/R value:
100 m²/22.6 W/K = 4.42 (m²·K)/W</td></tr>
<tr><td colspan="4">Because Clause 9.36.2.11.(6)(b) limits the reduction of a traded RSI value for opaque building envelope assemblies—in this case, an attic—to 60% of the minimum RSI value permitted by Article 9.36.2.6., this new RSI value of 4.42 (m²·K)/W for the attic is too low (60% x 8.67 = 5.20 (m²·K)/W). Therefore, the full potential trade-off for this example cannot be used.</td></tr>
<tr><td rowspan="2">Assemblies Being Traded</td><td rowspan="2">Area of Each Assembly (A)</td><td colspan="2">Proposed Design Trade-off Values (FDWR 12%)</td></tr>
<tr><td>RSI values (R)</td><td>A/R Values</td></tr>
<tr><td>Attic</td><td>100 m²</td><td>5.20 (m²·K)/W</td><td>19.2 W/K</td></tr>
<tr><td>Windows</td><td>18 m²</td><td>0.63 (m²·K)/W</td><td>28.6 W/K</td></tr>
<tr><td colspan="2"></td><td colspan="2">Total A/R value: 47.8 W/K (< 51.2 W/K)</td></tr>
</table>

A-9.36.2.11.(6)(a) Reduction in Thermal Resistance of Ceilings in Buildings with Low Ceilings. Sentence 9.36.2.11.(4) allows insulation in attics under sloped roofs to be reduced to less than the prescriptive level required for the exterior walls, which may be less than 55% of the required values for the attic insulation.

A-9.36.3.2.(1) Load Calculations. Subsection 9.33.5. requires that heating systems serving single dwelling units be sized in accordance with CAN/CSA-F280-M, "Determining the Required Capacity of Residential Space Heating and Cooling Appliances." The HRAI Digest is also a useful source of information on the sizing of HVAC systems for residential buildings.

A-9.36.3.2.(2) Design and Installation of Ducts. The following publications contain useful information on this subject:

- the ASHRAE Handbooks
- the HRAI Digest
- the ANSI/SMACNA 006, "HVAC Duct Construction Standards – Metal and Flexible"

A-9.36.3.2.(5) Increasing the Insulation on Sides of Ducts. Table A-9.36.3.2.(5) can be used to determine the level of insulation needed on the sides of ducts that are 127 mm deep to compensate for a reduced level of insulation on their underside.

Table A-9.36.3.2.(5)
RSI Required on Sides of Ducts where RSI on Underside is Reduced

RSI Required for Exterior Walls,[1] (m²·K)/W	RSI[2] on Underside of 127 mm Deep Duct, (m²·K)/W	Width of Duct, mm						
		304	356	406	457	483	508	533
		RSI Required on Sides of Ducts, (m²·K)/W						
2.78	2.11	4.47	4.98	5.61	6.43	6.94	n/a	n/a
	2.29	3.74	3.97	4.23	4.52	4.69	4.86	5.05
	2.64	2.97	3.00	3.03	3.07	3.09	3.10	3.12
2.96	2.11	5.70	6.75	8.25	n/a	n/a	n/a	n/a
	2.29	4.56	5.02	5.58	6.27	6.68	n/a	n/a
	2.64	3.46	3.57	3.67	3.78	3.84	3.90	3.97
3.08	2.29	5.26	5.96	6.88	n/a	n/a	n/a	n/a
	2.64	3.85	4.02	4.20	4.40	4.50	4.62	4.73
3.85	3.43	4.67	4.84	5.03	5.23	5.34	5.45	5.56

Notes to Table A-9.36.3.2.(5):

(1) See Article 9.36.2.6.

(2) See Appendix Note A-9.36.1.2.(3) for the formula to convert metric RSI values to imperial R values.

A-9.36.3.3.(4) Exemption. The exemption in Sentence 9.36.3.3.(4) typically applies to heat-recovery ventilators and ventilation systems that are designed to run or are capable of running continuously for specific applications. See also Sentence 9.32.3.13.(8).

A-9.36.3.4.(1) Piping for Heating and Cooling Systems. CAN/CSA-B214, "Installation Code for Hydronic Heating Systems," the ASHRAE Handbooks, the HRAI Digest, and publications of the Hydronics Institute are useful sources of information on the design and installation of piping for heating and cooling systems.

A-9.36.3.4.(2) High-Temperature Refrigerant Piping. Piping for heat pumps is an example of high-temperature refrigerant piping.

A-9.36.3.5.(1) Location of Heating and Air-conditioning Equipment. Locating certain types of equipment for heating and air-conditioning systems—for example, heat-recovery ventilators or furnaces—outdoors or in an unconditioned space may result in lower efficiencies and higher heat loss. Where components of a system are intended to be installed outside— for example, portions of heat pump systems and wood-fired boilers—efficiency losses, if any, have already been accounted for in their design.

A-9.36.3.6.(7) Heat Pump Controls for Recovery from Setback. The requirements of Sentence 9.36.3.6.(7) can be achieved through several methods:

- installation of a separate exterior temperature sensor,
- setting a gradual rise of the control point,
- installation of controls that "learn" when to start recovery based on stored data.

A-9.36.3.8. Application. Article 9.36.3.8. is intended to apply to any vessel containing open water in an indoor setting, not only swimming pools and hot tubs; however, it does not apply to bathtubs. In the context of this Article, the terms "hot tub" and "spa" are interchangeable.

A-9.36.3.8.(4)(a) Heat Recovery from Dehumidification in Spaces with an Indoor Pool or Hot Tub. Sentence 9.36.3.8.(4) is not intended to require that all air exhausted from a swimming pool or hot tub area pass through a heat-recovery unit, only sufficient air to recover 40% of the total sensible heat. Most heat-recovery units can recover more than 40% of the sensible heat from the exhausted air, but because it may not be cost-effective to reclaim heat from all exhaust systems, the overall recovery requirement is set at 40%.

A-9.36.3.9.(1) Heat Recovery in Dwelling Units. Whereas Section 9.32. addresses the effectiveness of mechanical ventilation systems in dwelling units from a health and safety perspective, Section 9.36. is concerned with their functioning from an energy efficiency perspective.

The requirements of Subsection 9.32.3. can be met using one of several types of ventilation equipment, among them heat-recovery ventilators (HRVs), which are typically the system of choice in cases where heat recovery from the exhaust component of the ventilation system is required. As such, Article 9.36.3.9. should be read in conjunction with the provisions in Subsection 9.32.3. that deal with HRVs.

A-9.36.3.9.(3) Efficiency of Heat-Recovery Ventilators (HRVs). HRVs are required to be tested in conformance with CAN/CSA-C439, "Rating the Performance of Heat/Energy-Recovery Ventilators," under different conditions to obtain a rating: to be rated for colder locations, HRVs must be tested at two different temperatures, as stated in Clause 9.36.3.9.(3)(b), whereas their rating for locations in mild climates relies only on the 0°C test temperature, as stated in Clause 9.36.3.9.(3)(a).

The performance of an HRV product and its compliance with Sentence 9.36.3.9.(3) can be verified using the sensible heat recovery at the 0°C and/or –25°C test station (i.e. location where the temperature is measured) published in the manufacturer's literature or in product directories, such as HVI's Certified Home Ventilating Products Directory.

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

A-9.36.3.10.(1) Unit and Packaged Equipment. The minimum performance values stated in Table 9.36.3.10. were developed based on values and technologies found in the Model National Energy Code of Canada for Houses 1997, the NECB, federal, provincial and territorial energy efficiency regulations as well as in applicable standards on equipment typically installed in housing and small buildings.

In some cases—after a review of current industry practices (industry sales figures)—the performance requirements were increased from regulated minimums where it could be shown that the cost and availability of the equipment are acceptable. Some of the performance requirements are based on anticipated efficiency improvements in the energy efficiency regulations and revisions to standards.

A-9.36.3.10.(3) Multiple Component Manufacturers. Where components from more than one manufacturer are used as parts of a heating, ventilating or air-conditioning system, the system should be designed in accordance with good practice using component efficiency data provided by the component manufacturers to achieve the overall efficiency required by Article 9.36.3.10.

A-9.36.4.2.(1) Unit and Packaged Equipment. The minimum performance values stated in Table 9.36.4.2. were developed based on values and technologies found in the Model National Energy Code of Canada for Houses 1997, the NECB, federal, provincial and territorial energy efficiency acts as well as in applicable standards on equipment typically installed in housing and small buildings.

In some cases—after a review of current industry practices (industry sales figures)—the performance requirements were increased from regulated minimums where it could be shown that the cost and availability of the equipment are acceptable.

A-9.36.4.2.(3) Exception. Components of solar hot water systems and heat pump systems are examples of service water heating equipment that is required to be installed outdoors.

A-9.36.4.6.(2) Required Operation of Pump. The water in indoor pools is pumped through filtration equipment at rates that will help prevent the build-up of harmful bacteria and algae based on water volume and temperature, frequency of pool use, number of swimmers, etc.

A-9.36.5.2. Use of Terms "Building" and "House". Although the word "house" is used in the terms "proposed house" and "reference house," it is intended to include other types of residential buildings addressed by Subsection 9.36.5. The terms "proposed building" and "reference building" used in the NECB apply to other types of buildings.

A-9.36.5.3.(2) Concept of Comparing Performance. Comparing the performance of a reference house to that of a proposed house is one way to benchmark the performance of a proposed house in relation to Code requirements. There are other ways to benchmark energy consumption models: for example, by setting a quantitative energy target or using a benchmark design. In the performance compliance option presented in Subsection 9.36.5., the user must demonstrate that their design results in a similar level of performance to that of the prescriptive requirements— an approach that is consistent with the concept of objective-based codes.

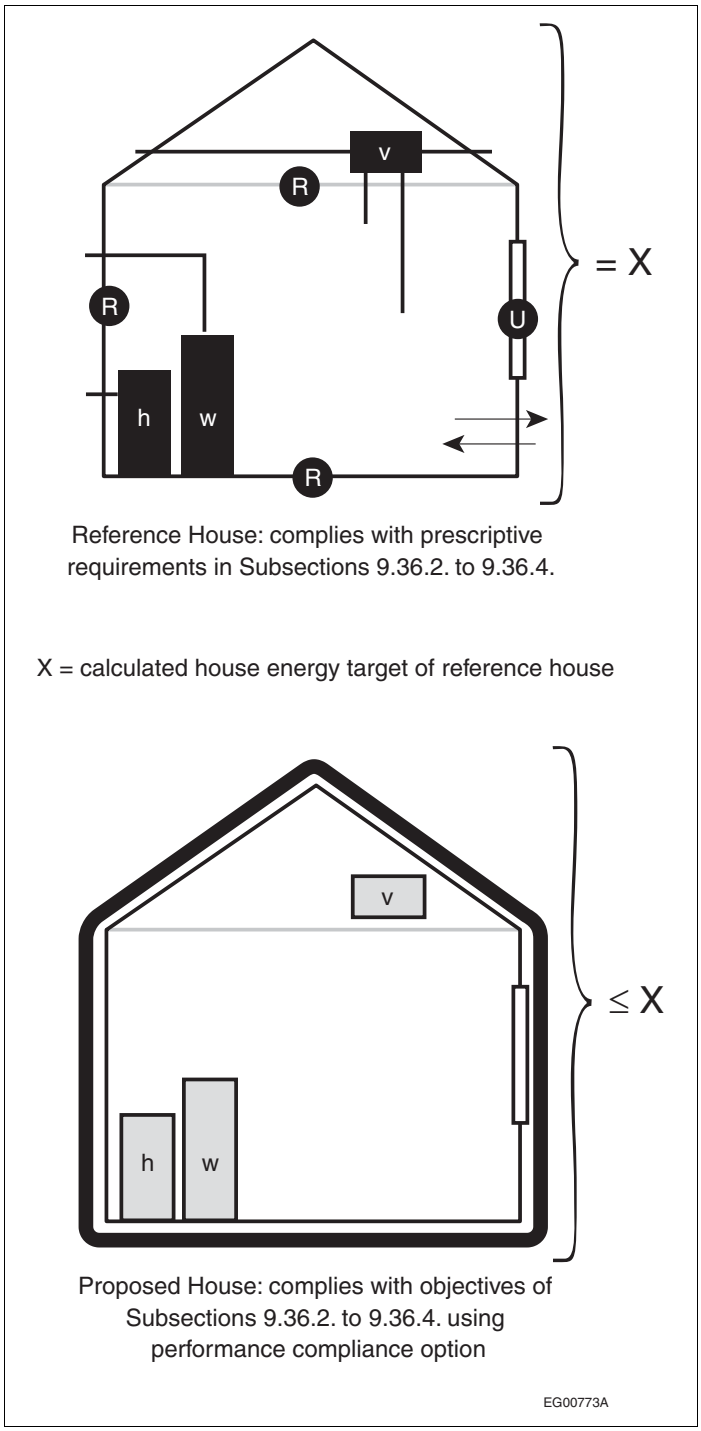


Figure A-9.36.5.3.(2)
Energy consumption of proposed house versus that of reference house

A-9.36.5.4.(1) Calculation Procedure. It is important to characterize actual heat transfer pathways such as areas of fenestration, walls, floors, ceilings, etc. An accurate geometric model of a house, including volume, captures such information, but modeling can be carried out with other calculations.

A-9.36.5.4.(2) Space-Conditioning Load. Supplementary heating systems form part of the principal heating system and must be able to meet the space-conditioning load of the house.

A-9.36.5.4.(7) Thermostatic Control. The thermostat's response to temperature fluctuations described in Sentence 9.36.5.4.(7) represents a thermostat deadband of ±0.5°C.

A-9.36.5.5.(1) Source of Climatic Data. Climatic data sources include the Canadian Weather Year for Energy Calculations (CWEC) and the Canadian Weather Energy and Engineering Data Sets (CWEEDS). The CWEC represent average heating and cooling degree-days which impact heating and cooling loads in buildings. The CWEC follow the ASHRAE WYEC2 format and were derived from the CWEEDS of hourly weather information for Canada from the 1953-1995 period of record. The CWEC are available from Environment Canada at http://climate.weatheroffice.gc.ca/prods_servs/index_e.html.

Where climatic data for a target location are not available, climatic data for a representative alternative location should be selected based on the following considerations: same climatic zone, same geographic area or characteristics, heating degree-days (HDD) of the alternative location are within 10% of the target location's HDD, and the January 1% heating design criteria of the alternative location is within 2°C of the target location's same criteria (see Appendix C). Where several alternative locations are representative of the climatic conditions at the target location, their proximity to the target location should also be a consideration.

A-9.36.5.6.(6) Contents of the House. In the context of Subsection 9.36.5., "contents of the house" refers to cabinets, furniture and other elements that are not part of the building structure and whose removal or replacement would not require a building permit.

A-9.36.5.6.(11) Application. Sentence 9.36.5.6.(11) is not intended to apply to the fenestration area to wall area ratio.

A-9.36.5.7.(1) Consumption of HVAC systems. The energy consumption of HVAC systems typically includes the distribution system and the effect of controls.

A-9.36.5.7.(5) Zoned Air Handlers. Zoned air handler systems may also have duct and piping losses.

A-9.36.5.8.(5) Water Delivery Temperature. A value of 55°C is used in the energy model calculations; Article 2.2.10.7. of Division B of the NPC contains different requirements relating to water delivery temperature.

A-9.36.5.9.(1) Modeling the Proposed House.

Completeness of the Energy Model Calculations

The specifications for a building typically include the following inputs and variables, among others, which are needed for modeling:

- space-heating and domestic hot water (DHW) systems
- air-, ground- and water-source heat pumps
- central air-conditioning systems
- primary and secondary DHW systems
- efficiencies of heating and cooling equipment
- solar gain through windows facing each cardinal direction
- sloped glazing, including skylights
- overhangs, taking into account the hourly position of the sun with respect to each window and overhang on a typical day each month
- the various levels of thermal mass
- slab-on-grade, crawl space (open, ventilated or closed), basement and walkout foundations, taking into account dimensions, thermal resistance and placement of insulation, soil conductivity, depth of water table, and weather/climate, and
- heat transfer between the three zones of the house, i.e. the attic, main floor and foundation

Opaque Building Envelope Assemblies

In the context of Sentence 9.36.5.9.(1), the term "opaque building envelope assembly" includes above-ground assemblies and those that are in contact with the ground.

A-9.36.5.10.(2) Assembly Type. Sentence 9.36.5.10.(2) sets a limit on the size of building envelope assemblies that have to be considered separately in the energy model calculations. In this context, assembly type is intended to mean either walls, roof, fenestration, exposed floors, or foundation walls and is intended to include the respective assembly type areas of the entire building.

A-9.36.5.10.(9)(c)(ii) Equivalent Leakage Area (ELA). The ELA is the size of an imaginary hole through which the same amount of air would pass that passes through all of the unintended openings in the building envelope if the pressure across all those openings were equal. This value is needed in the calculation because it is a good indicator of the airtightness of the house: a leaky house will have a large ELA and a very tight house will have a small ELA. For example, an energy-efficient house might have an ELA as low as 200 cm^2 whereas a very leaky house can have an ELA of more than 3000 cm^2.

A-9.36.5.10.(11) Timing of the Airtightness Test. The blower door test described in CAN/CGSB-149.10, "Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method," should be carried out once the building is substantially completed. Sufficient time should be allotted before completion to allow for subsequent air sealing in the event the desired airtightness is not achieved. Interim testing while the air barrier is still accessible for service can also be helpful.

A-9.36.5.11.(9) Part-Load Performance of Equipment.

Measured Data

Where available, the measured part-load performance data are provided by the equipment manufacturer.

Modeled Part-Load Performance Data

Part-load performance ratings differ depending on the equipment. The intent of Sentence 9.36.5.11.(9) is to indicate that the same modeled data source should be used for both the proposed and reference houses.

A-9.36.5.11.(10) Sensible Heat Recovery.

Treatment of Humidity in the Calculations

The calculations using sensible heat do not take latent heat (humidity) into account.

Energy-Recovery Ventilators

Energy-recovery ventilators can be used in lieu of heat-recovery ventilators.

A-9.36.5.11.(11) Circulation Fans. Sentences 9.36.5.11.(12) to (19) calculate the energy consumption of the circulation fan. The results are intended to be used in energy model calculations only and are not intended to address the performance of the ventilation system. The actual sizing of ventilation systems must comply with Section 9.32.

A-9.36.5.12.(2) Assumptions Relating to Drain-Water Heat Recovery. Energy savings associated with drain water heat recovery depend on the duration of showers and the vertical drop in the drain pipe. Similar to the service water heating load distribution, the length of showers depends on occupant behaviour. The values provided in Sentence 9.36.5.12.(2) are intended to be used in the energy model calculations only and take into consideration the loads stated in Table 9.36.5.8. The efficiency of a drain-water heat-recovery unit must be modelled using the same physical configuration intended for installation.

A-9.36.5.14.(10) Above-Ground Gross Wall Area. The determination of above-ground gross wall area is consistent with the prescriptive requirements of Article 9.36.2.3. in that it is based on the measurement of the distance between interior grade and the uppermost ceiling and on interior areas of insulated wall assemblies.

A-9.36.5.15.(5) Sizing of Heating and Cooling Systems. The intent of Sentence 9.36.5.15.(5) is that the cooling system be sized only for the portion of the house that is cooled.

Article 9.33.5.1. references CAN/CSA-F280-M, "Determining the Required Capacity of Residential Space Heating and Cooling Appliances," which contains a number of different methods for determining the capacity of heating appliances. The intent of Sentence 9.36.5.15.(5) is that the equipment be sized according to the methods for total heat output capacity and nominal cooling capacity without being oversized.

A-9.36.5.15.(6) Default Settings. The default settings in energy performance modeling software for houses are an appropriate source of part-load performance values of equipment.

A-9.36.5.15.(8) Treatment of Humidity in the Calculations. The calculations using sensible heat do not take latent heat (humidity) into account.

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Conversion Factors

To Convert	To	Multiply by
°C	°F	1.8 and add 32
kg	lb.	2.205
kPa	lbf/in.^{2}(psi)	0.1450
kPa	lbf/ft.^{2}	20.88
kW	Btu/h	3.412
L	gal. (imp.)	0.2200
L/s	gal./min (gpm)	13.20
lx	ft.-candle	0.09290
m	ft.	3.281
m^2	ft.^{2}	10.76
m^3	ft.^{3}	35.31
mm	in.	0.03937
m^3/h	ft.^{3}/min (cfm)	0.5886
m/s	ft./min	196.8
MJ	Btu	947.8
N	lbf	0.2248
ng/(Pa·s·m^2)	Btu/h	3.412