Submit a comment

Proposed Change 2061

Code Reference(s):	**NBC20 Div.B 1.1.3.1. (first printing)** **NBC20 Div.B 6.2.1. (first printing)** **NBC20 Div.B 9.33.2.1. (first printing)** **NBC20 Div.B 9.33.3. (first printing)** **NBC20 Div.B 9.33.5. (first printing)**
Subject:	Overheating
Title:	Overheating in New Dwelling Units
Description:	This proposed change requires new dwelling units to be provided with mechanical cooling in locations where the outside summer design temperature exceeds 26°C.

This change could potentially affect the following topic areas:

- [x] Division A
- [ ] Division C
- [ ] Building operations
- [x] Small Buildings
- [ ] Fire Protection
- [ ] Accessibility
- [ ] Building Envelope
- [x] Heating, Ventilating and Air Conditioning
- [x] Division B
- [ ] Design and Construction
- [x] Housing
- [ ] Large Buildings
- [ ] Occupant safety in use
- [ ] Structural Requirements
- [ ] Energy Efficiency
- [ ] Plumbing
- [ ] Construction and Demolition Sites

Problem

As a result of global warming, overheating in buildings has become a greater health and safety concern. Overheating in dwelling units has become an area of health concern in all regions including those with temperate summers. The health and well-being of occupants who are directly exposed to high indoor air temperatures are affected.

These elevated indoor temperatures may strain the human physiological system and lead to serious health injury or death. Research has shown that overheating can lead to discomfort and sleep disturbances, and that older adults, children and people with certain health conditions may be more susceptible to the negative effects of overheating. Proactive measures to address overheating in new dwelling units should be introduced in the National Building Code of Canada (NBC).

Currently Sentence 9.33.3.1.(1) of Division B of the NBC requires residential buildings to be equipped with heating facilities to maintain a minimum indoor air temperature in winter. There is presently no corresponding requirement to limit the maximum indoor air temperature in summer. This may present an unacceptable risk of overheating and the associated health consequences in dwelling units.

Justification

This proposed change establishes a maximum outside summer design temperature of 26°C, determined using the July 2.5% dry values listed in Appendix C of the NBC, as the threshold above which mechanical cooling facilities must be provided in new dwelling units to minimize the adverse effects of overheating on occupant health and safety. This maximum temperature balances simplicity, practicality and public health concerns related to the vulnerable population affected by indoor temperatures above 26°C, while recognizing considerations about diverse regional climates and temperatures across Canada.

Establishing 26°C as the maximum indoor air temperature aligns with recommendations from the BC Centre for Disease Control (report to the chief coroner), studies by the University of Ottawa and the National Research Council, and is supported by the World Health Organization as an appropriate threshold for the protection of vulnerable populations.

Multiple studies and guidelines highlight the link between indoor temperature control and the reduction of heat-related illness and mortality. Keeping indoor temperatures below this limit helps reduce cardiovascular strain, prevent dehydration, and limit heat build-up in buildings, and thereby lowers the risk of heat exhaustion or heat stroke.

Based on the method provided in CSA F280, "Determining the required capacity of residential space heating and cooling appliances," the indoor temperature of 26°C is applicable to the sizing of the required cooling facilities. This calculation is not applied to dwelling units in locations with an outside summer design temperature not greater than 26°C as other alternatives, such as natural ventilation, can be used to reduce heat effects.

PROPOSED CHANGE AS SUBMITTED TO THE SPRING 2024 PUBLIC REVIEW

[1.1.3.1.] 1.1.3.1. Climatic and Seismic Values

[1] 1) Except as provided in Sentences (2) and (4), 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*.

[2] 2) Where they have not been established by the *authority having jurisdiction*, the climatic values required for the design of *buildings* shall

be in conformance with Sentences (3) and (4) and the values listed in Appendix C. (See Note A-1.1.3.1.(2).)

[3] 3) The outside winter design temperatures determined from Appendix C shall be those listed for the January 2.5% values. (See Note A-1.1.3.1.(3).)

[4] --) The outside summer design temperatures determined from Appendix C shall be those listed for the July 2.5% dry values.

[5] 4) Where they have not been established by the *authority having jurisdiction*, the seismic values required for the design of *buildings* under Part 4 and Part 9 shall be in conformance with Appendix C. (See Note A-1.1.3.1.(4).)

[6.2.1.] 6.2.1. General

[6.2.1.1.] 6.2.1.1. Good Engineering Practice

[6.2.1.2.] --- Indoor Design Temperatures

[1] --) Indoor design temperatures for mechanical heating and cooling facilities in *dwelling units* shall conform to Article 9.33.3.1.

[6.2.1.3.] 6.2.1.2. Outdoor Design Conditions

[6.2.1.4.] 6.2.1.3. Expansion, Contraction and System Pressure

[6.2.1.5.] 6.2.1.4. Structural Movement

[6.2.1.6.] 6.2.1.5. Installation Standards

[6.2.1.7.] 6.2.1.6. Installation – General

[6.2.1.8.] 6.2.1.7. Asbestos

[9.33.2.1.] 9.33.2.1. Required Heating and Cooling Systems

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

[2] --) Except as provided in Article 9.33.5.1.-2025 or good engineering practice as described in Article 6.2.1.1., *dwelling units* intended for use during summer seasons on a continuing basis shall be equipped with cooling facilities conforming to this Section. (See Note A-9.33.2.1.(2).)

Note A-9.33.2.1.(2) Passive Cooling Measures.

Passive cooling measures, such as exterior shading, building orientation, insulation, low solar heat gain windows, and thermal mass, can reduce cooling loads and help to

achieve the indoor air temperature specified in Sentence 9.33.3.1.(2).

[9.33.3.] 9.33.3. Design Temperatures

[9.33.3.1.] 9.33.3.1. Indoor Design Temperatures

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

[a] a) 22°C in all living spaces,

[b] b) 18°C in unfinished *basements*,

[c] c) 18°C in common *service rooms*, ancillary spaces and *exits* in houses with a *secondary suite*, and

[d] d) 15°C in heated crawl spaces.

[2] --) Except as provided in Sentence (3), at the outside summer design temperature, permanently installed cooling facilities shall be capable of maintaining an indoor air temperature of not more than 26°C in at least one living space in each *dwelling unit*.

[3] --) Optional comfort cooling facilities shall be designed using the indoor design temperature specified in CSA F280, "Determining the required capacity of residential space heating and cooling appliances", or applicable documents referenced in Article 9.33.4.1.

[9.33.3.2.] 9.33.3.2. Outdoor Design Temperatures

[9.33.5.] 9.33.5. Heating and Cooling ~~Air-conditioning~~ Appliances and Equipment

[9.33.5.1.] 9.33.5.1. Capacity of Heating and Cooling Appliances

[1] 1) The required capacity of heating and cooling *appliances* located in a *dwelling unit*, and serving only that *dwelling unit* or part of that *dwelling unit*~~,~~ shall be determined, using design temperatures conforming to Subsection 9.33.3., in accordance with ~~CSA F280, "Determining the required capacity of residential space heating and cooling appliances",except that the design temperatures shall conform to Subsection 9.33.3.~~

[a] --) CSA F280, "Determining the required capacity of residential space heating and cooling appliances", or

[b] --) good engineering practice as described in Article 6.2.1.1.

[9.33.5.2.] 9.33.5.2. Installation Standards

[1] 1) Except as provided in Articles 9.33.5.3. and 9.33.5.4., the installation of heating and cooling~~air-conditioning~~ *appliances* and equipment, including mechanical refrigeration equipment, and including provisions for mounting, clearances and air supply, shall conform to applicable provincial or territorial regulations or municipal bylaws or, in the absence of such regulations or bylaws, to

[a] a) CSA B51, "Boiler, pressure vessel, and pressure piping code",
[b] b) CSA B52, "Mechanical refrigeration code",
[c] c) CSA B139 Series, "Installation code for oil-burning equipment",
[d] d) CSA B149.1, "Natural gas and propane installation code",
[e] e) CSA C22.1, "Canadian Electrical Code, Part I", or
[f] f) CAN/CSA-C448 Series, "Design and installation of earth energy systems".

(See also Sentence 9.33.5.3.(1).)

[9.33.5.3.] 9.33.5.3. Design, Construction and Installation Standard for Solid-Fuel-Burning Appliances

[9.33.5.4.] 9.33.5.4. Fireplaces

REVISED PROPOSED CHANGE FOLLOWING SPRING 2024 PUBLIC REVIEW

[1.1.3.1.] 1.1.3.1. Climatic and Seismic Values

[6.2.1.] 6.2.1. General

[6.2.1.1.] 6.2.1.1. Good Engineering Practice

[6.2.1.2.] --- Indoor Design Temperatures

[6.2.1.3.] 6.2.1.2. Outdoor Design Conditions

[6.2.1.4.] 6.2.1.3. Expansion, Contraction and System Pressure

[6.2.1.5.] 6.2.1.4. Structural Movement

[6.2.1.6.] 6.2.1.5. Installation Standards

[6.2.1.7.] 6.2.1.6. Installation – General

[6.2.1.8.] 6.2.1.7. Asbestos

[9.33.2.1.] 9.33.2.1. Required Heating and Cooling Systems

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

[2] --) Except as provided in Sentence (3)~~Article 9.33.5.1.-2025 or good~~

~~engineering practice as described in Article 6.2.1.1.~~, *dwelling units* intended for use during the summer months~~seasons~~ on a continuing basis shall be equipped with cooling facilities conforming to this Section, where the outside summer design temperature for the *building* location is greater than 26°C. ~~(See Note A-9.33.2.1.(2).)~~

[3] --) *Dwelling units* need not be equipped with cooling facilities, where it can be demonstrated through good engineering practice that the maximum indoor air temperature stated in Sentence 9.33.3.1.(2)-2025 will not be exceeded when the *dwelling unit* is subjected to the outside summer design temperature for the *building* location. (See Note A-9.33.2.1.(3).)

~~Note A-9.33.2.1.(2) Passive Cooling Measures.~~

~~Passive cooling measures, such as exterior shading, building orientation, insulation, low solar heat gain windows, and thermal mass, can reduce cooling loads and help to achieve the indoor air temperature specified in Sentence 9.33.3.1.(2).~~

Note A-9.33.2.1.(3) Alternative Measures for the Mitigation of Overheating.

The installation of cooling facilities is the initial prescriptive solution for locations where the outside summer design temperature exceeds 26°C and is intended to limit the risk that the indoor temperature will exceed 26°C.

Beyond cooling facilities, measures such as exterior shading, interior shading, building form and orientation, upgraded thermal insulation, increased airtightness, and fenestration and doors with low solar heat gain coefficients can be incorporated into the design to limit heat gain within a dwelling unit. Such measures may reduce or eliminate the need for the cooling facilities referred to in Sentence 9.33.2.1.(2).

Good engineering practice could include the use of computer programs that simulate time steps of one hour or less and are compliant with ANSI/ASHRAE 140, "Standard Method of Test for the Evaluation of Building Energy Analysis Computer Programs".

[9.33.3.] 9.33.3. Design Temperatures

[9.33.3.1.] 9.33.3.1. Indoor Design Temperatures

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

[a] a) 22°C in all living spaces,

[b] b) 18°C in unfinished *basements*,

[c] c) 18°C in common *service rooms*, ancillary spaces and *exits* in houses with a *secondary suite*, and

[d] d) 15°C in heated crawl spaces.

[2] --) Except as provided in Sentence (3), at the outside summer design temperature, ~~permanently installed~~required cooling facilities shall be capable of maintaining an indoor air temperature of not more than 26°C ~~in at least one living space~~ in each *dwelling unit*.

[3] --) Optional comfort cooling facilities shall be designed using the indoor design temperature specified in CSA F280, "Determining the required capacity of residential space heating and cooling appliances", or applicable documents referenced in Article 9.33.4.1.

[9.33.3.2.] 9.33.3.2. Outdoor Design Temperatures

[9.33.5.] 9.33.5. Heating and Cooling Appliances and Equipment

[9.33.5.1.] 9.33.5.1. Capacity of Heating and Cooling Appliances

[1] **1)** The required capacity of heating and cooling *appliances* located in a *dwelling unit*~~,~~ and serving only that *dwelling unit* ~~or part of that *dwelling unit*~~ shall be determined~~, using design temperatures conforming to Subsection 9.33.3.,~~ in accordance with CSA F280, "Determining the required capacity of residential space heating and cooling appliances", using design temperatures conforming to Subsection 9.33.3.

[a] --) ~~CSA F280, "Determining the required capacity of residential space heating and cooling appliances", or~~

[b] --) ~~good engineering practice as described in Article 6.2.1.1.~~

[9.33.5.2.] 9.33.5.2. Installation Standards

[9.33.5.3.] 9.33.5.3. Design, Construction and Installation Standard for Solid-Fuel-Burning Appliances

[9.33.5.4.] 9.33.5.4. Fireplaces

Impact analysis

Refer to the supporting document for the complete impact analysis.

The proposed change described in PCF 2061 is recommending that the National Building Code of Canada mandate the addition of an acceptable upper indoor temperature that must be maintained in a dwelling unit by the addition of mechanical cooling in locations where the outside summer design temperature exceeds 26°C. This report summarizes the impact analysis for implementing mechanical cooling.

The benefits of reducing indoor air temperatures by installing two ductless mini-split air conditioning (DMSAC) units in Part 9 dwelling units, and apartment type dwelling units, followed a pattern typical of preventive interventions, with the direct costs incurred up front and a delay before the full benefits are experienced. The direct benefits included the number of overheating related deaths prevented and any treatment costs avoided following the reduction in indoor air temperatures. The results of the analysis were presented in two parts:

1. Example case: two DMSAC units in dwelling units, including apartment type

dwelling units, built in 1 year.

2. Full analysis: two DMSAC units in dwelling units, including apartment type dwelling units, built over a 20-year period, the lifespan of the DMSAC units.

The methodology used to estimate the benefits provided by installing two DMSAC units in each dwelling unit, including apartment type dwelling units, was defined as follows:

- Two estimates (lower and upper) of current overheating related deaths associated with extreme heat events (estimated using a cutoff of 2.5th temperature percentile)
- Expected 100% effectiveness of the DMSAC in new dwelling units, assuming use by the occupants, in reducing illness and death associated with extreme heat events only
- 20-year service life of the DMSAC

The annual cost for the 12 months period between July 1, 2021 and June 30, 2022 for installing two 9000 BTU/h DMSAC units in 221,492 dwellings of all types, including apartment type dwellings, is estimated to be $936,190,427. The estimated operational costs over the 1-year period is estimated to be $86,247,035. It is estimated that the lifespan of a DMSAC will be 20 years with minimal maintenance. The total cost of both the initial installation and operation costs at the end of the 20-year time period is estimated to be $2,661,131,127. The total treatment costs for illnesses related to overheating during extreme heat events over the 20-year time period is estimated to range between $2,430,920 and $14,853,880 for the lower and upper estimates, respectively. The cumulative number of overheating related deaths prevented over 20-year period during extreme heat events was estimated to be 2,520 and 17,290 for the lower and upper estimates, respectively, in the residents of all dwellings completed over 20 years following the installation of the DMSAC.

The impact analysis on installing two DMSAC units in a dwelling unit, including apartment type dwellings, demonstrates that the main benefit would be preventing 2,520 to 17,290 overheating associated deaths during extreme heat events in Canada over 20 years should the proposed change be adopted. Although the costs incurred to install two DMSAC units in all dwelling types, including apartment type dwellings, always exceeds the treatment cost savings from preventing cases requiring overheating related illness treatment during extreme heat events, the cumulative cost per overheating death prevented decreased steeply to a value lower than the Treasury Board of Canada Secretariat VSL. For the direct cost comparison, this occurs 2 to 20 years after implementation, and for the combination of direct and indirect costs, this occurs 3 years after implementation for the lower estimate but did not drop below this threshold within the 20-year time horizon for the upper estimate.

Enforcement implications

This proposed change could be enforced by the infrastructure currently available to enforce the Codes.

Who is affected

- Homeowners and occupants would see an increase in the cost of the construction and operation of their dwelling unit if they had not intended to install cooling facilities.
- Builders would need to incorporate the proposed change into the construction process for dwelling units.
- Architects, engineers, designers and contractors.
- Authorities having jurisdiction would need training to understand how to apply the new requirements.

Supporting Document(s)

Impact Analysis for PCF 2061: Overheating in New Dwelling Units (whole_home_impact_analysis_for_pcf_2061_nov_26_final.pdf)

OBJECTIVE-BASED ANALYSIS OF NEW OR CHANGED PROVISIONS

[1.1.3.1.] -- ([4] --) no attributions

[6.2.1.1.] 6.2.1.1. ([1] 1) ([a] a) to ([e] e) [F31,F51-OP1.1]

[6.2.1.1.] 6.2.1.1. ([1] 1) ([a] a) to ([c] c),([e] e) to ([i] i) [F40,F50,F51,F52,F54,F63-OH1.1]

[6.2.1.1.] 6.2.1.1. ([1] 1) ([a] a) to ([c] c),([e] e) to ([h] h) [F50,F51,F52,F54,F63-OH1.2,OH1.3]

[6.2.1.1.] 6.2.1.1. ([1] 1) [F31,F50,F51,F52,F54,F63-OS3.2,OS3.4]

[6.2.1.1.] 6.2.1.1. ([1] 1) ([d] d) [F01-OS1.1]

[6.2.1.2.] -- ([1] --) no attributions

[6.2.1.3.] 6.2.1.2. ([1] 1) no attributions

[6.2.1.3.] 6.2.1.2. ([2] 2) [F40,F50-OH1.1]

[6.2.1.3.] 6.2.1.2. ([3] 3) [F40,F43,F44,F50-OH1.1]

[6.2.1.3.] 6.2.1.2. ([3] 3) [F44-OS3.4]

[6.2.1.4.] 6.2.1.3. ([1] 1) [F20-OS3.2]

[6.2.1.5.] 6.2.1.4. ([1] 1) [F23-OS3.1]

[6.2.1.5.] 6.2.1.4. ([1] 1) [F51,F63,F50-OH1.1,OH1.2,OH1.3]

[6.2.1.6.] 6.2.1.5. ([1] 1) [F43-OS1.1]

[6.2.1.6.] 6.2.1.5. ([1] 1) [F43-OS3.4]

[6.2.1.6.] 6.2.1.5. ([1] 1) [F43-OP1.1]

[6.2.1.7.] 6.2.1.6. ([1] 1) [F82-OS1.1]

[6.2.1.7.] 6.2.1.6. ([1] 1) [F82-OS3.4]

[6.2.1.7.] 6.2.1.6. ([1] 1) [F82-OP1.1]

[6.2.1.7.] 6.2.1.6. ([2] 2) [F31-OS3.1]

[6.2.1.7.] 6.2.1.6. ([3] 3) [F81-OS3.2,OS3.3,OS3.4]

[6.2.1.7.] 6.2.1.6. ([3] 3) [F81-OS1.1]

[6.2.1.8.] 6.2.1.7. ([1] 1) [F43-OH1.1]

[9.33.2.1.] 9.33.2.1. ([1] 1) [F51,F52-OH1.2] [F63-OH1.1]

[9.33.2.1.] 9.33.2.1. ([1] 1) [F63-OS2.3]

[9.33.2.1.] -- ([2] --) [F51-OH1.2]

[9.33.2.1.] -- ([3] --) [F51-OH1.2]

[9.33.3.1.] 9.33.3.1. ([1] 1) [F51-OH1.2]

[9.33.3.1.] -- ([2] --) [F51-OH1.2]

[9.33.3.1.] -- ([3] --) [F51-OH1.2]

[9.33.3.2.] 9.33.3.2. ([1] 1) no attributions

[9.33.5.1.] 9.33.5.1. ([1] 1) [F63-OH1.1] [F51-OH1.2]

[9.33.5.1.] 9.33.5.1. ([1] 1) [F63-OS2.3]

[9.33.5.2.] 9.33.5.2. ([1] 1) [F01-OP1.1] Applies to heating equipment.

[9.33.5.2.] 9.33.5.2. ([1] 1) [F41,F63,F50-OH1.1] [F51,F52-OH1.2]

[9.33.5.2.] 9.33.5.2. ([1] 1) [F63-OS2.3] Applies to heating equipment.

[9.33.5.2.] 9.33.5.2. ([1] 1) [F44-OS3.4] Applies to heating equipment.

[9.33.5.2.] 9.33.5.2. ([1] 1) [F01-OS1.1] Applies to heating equipment.

[9.33.5.3.] 9.33.5.3. ([1] 1) [F41,F43-OH1.1] [F51-OH1.2]

[9.33.5.3.] 9.33.5.3. ([1] 1) [F51-OS2.3]

[9.33.5.3.] 9.33.5.3. ([1] 1) [F43-OS3.4]

[9.33.5.3.] 9.33.5.3. ([1] 1) [F01-OS1.1]

[9.33.5.3.] 9.33.5.3. ([1] 1) [F01-OP1.1]

[9.33.5.4.] 9.33.5.4. ([1] 1) no attributions