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 heating systems, including requirements for combustion air, and air-conditioning systems serving only one *dwelling unit*.

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 Article 9.33.4.1. and Subsection 9.10.10.)

3) **Reserved**.

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) **reserved**, 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) Aspects of heating and air-conditioning systems not specifically addressed in this Subsection, including ducting, and mechanical heating and refrigeration equipment, 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 CHC Handbook on Hydronic Heating Systems, the Hydronics Institute Manuals, the SMACNA Manuals and the TECA Quality First 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 CSA B214, "Installation Code for Hydronic Heating Systems."

9.33.4.3. Reserved

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.

9.33.4.5. Protection from Freezing

1) Equipment forming part of a heating or air-conditioning system that may be adversely affected by freezing temperatures and that is located in an unheated area shall be protected from freezing.

9.33.4.6. 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.

9.33.4.7. Structural Movement

1) Mechanical systems and equipment shall be designed and installed to accommodate the maximum amount of structural movement provided for in the construction of the *building*.

2) Where the *building* is in a location where the spectral response acceleration, $S_a(0.2)$, is greater than 0.55, heating and air-conditioning equipment with fuel or power connections shall be secured to the structure to resist overturning and displacement. (See Note A-9.31.6.2.(3).)

9.33.4.8. Asbestos

1) Asbestos shall not be used in air distribution systems or equipment.

9.33.4.9. Contaminant Transfer

1) Systems serving garages, and systems serving other occupied parts of a *dwelling unit* but located in or running through a garage, shall be designed and constructed in a manner such that means are not provided for the transfer of contaminants from the garage into other spaces in the *dwelling unit*.

9.33.4.10. Noise Control

1) Heating and air-conditioning equipment shall be installed and located so that the noise generated by this equipment conforms with the Vancouver Noise Control By-law.

9.33.5. Heating and Air-conditioning Appliances and Equipment

9.33.5.1. Capacity of Heating Appliances

1) The required capacity of heating *appliances* located in a *dwelling unit* and serving only that *dwelling unit*, shall be determined 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.

9.33.5.2. Installation Standards

1) Except as provided in Articles 9.33.5.3. and 9.33.5.4., the installation of heating and air-conditioning equipment, including mechanical refrigeration equipment, and including provisions for mounting, clearances and air supply, shall conform to

a) the Safety Standards Act and the following of its regulations:
   i) the Gas Safety Regulation,
   ii) the Electrical Safety Regulation, and
   iii) the Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation,
b) CSA B139, "Installation Code for Oil-Burning Equipment," and
c) CSA C448 Series, "Design and Installation of Earth Energy Systems."

(See also Sentence 9.33.5.3.(1).)

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

(See Note A-9.33.5.3.)

1) The design, construction and installation, including the provision of combustion air, of solid-fuel-burning *appliances* and equipment, including *stoves*, *cooktops*, ovens and *space heaters*, shall conform to CSA B365, "Installation Code for Solid-Fuel-Burning Appliances and Equipment."

2) For the purposes of Sentence (1), solid-fuel-burning boiler appliances that are approved for use under section 10 of the Safety Standards Act satisfy section 3.1 of CAN/CSA-B365 "Installation Code for Solid-Fuel-Burning Appliances and Equipment."

(See also Subclause 9.33.5.2.(1)(a)(ii).)

9.33.5.4. Fireplaces

1) Fireplaces shall conform to Section 9.22.

9.33.6. Air Duct Systems

9.33.6.1. Application

1) The design, construction and installation of air duct distribution systems serving heating systems in which the rated heat input does not exceed 120 kW shall conform to this Subsection.

2) Air duct distribution systems in which the rated heat input exceeds 120 kW shall conform to Part 6 and Subsection 3.6.5.

9.33.6.2. Materials in Air Duct Systems

1) Except as provided in Sentences (2) to (6) and in Article 3.6.4.3., all ducts, duct connectors, associated fittings and *plenums* used in air duct systems shall be constructed of steel, aluminum alloy, copper, clay or similar *noncombustible* material.

2) Ducts, associated fittings and *plenums* are permitted to contain *combustible* material provided they

a) conform to the appropriate requirements for Class 1 duct materials in CAN/ULC-S110, "Test for Air Ducts,"

b) conform to Article 3.1.5.18. and Subsection 3.1.9.,

c) are not used in vertical runs serving more than 2 *storeys*, and

d) are not used in air duct systems in which the air temperature may exceed 120°C.

3) Duct sealants shall have a *flame-spread rating* of not more than 25 and a smoke developed classification of not more than 50.

4) Duct connectors that contain *combustible* materials and that are used between ducts and air outlet units shall

a) conform to the appropriate requirements for Class 1 air duct materials in CAN/ULC-S110, "Test for Air Ducts,"

b) be limited to 4 m in length,

c) be used only in horizontal runs, and

d) not penetrate required *fire separations*.

5) *Combustible* ducts that are part of a duct system carrying only ventilation air and that are contained entirely within a *dwelling unit* need not comply with the requirements of Sentences (1) to (4).

6) Except as provided in Sentences 9.33.6.13.(2) and (3), ducts that are part of a return-air duct system and that are contained entirely within a *dwelling unit* need not comply with the requirements of Sentences (1) to (4).

7) Materials referred to in Sentences (1) to (6), when used in a location where they may be subjected to excessive moisture, shall

a) have no appreciable loss of strength when wet, and

b) be corrosion-resistant.

9.33.6.3. Tape

1) Tape used for sealing duct joints in air ducts, *plenums* and other parts of air duct systems shall meet the flame-resistance requirements for fabric in CAN/ULC-S109, "Flame Tests of Flame-Resistant Fabrics and Films."

9.33.6.4. Coverings, Linings, Adhesives and Insulation

1) Coverings, linings and associated adhesives and insulation of air ducts, *plenums* and other parts of air duct systems shall be of *noncombustible* material when exposed to heated air or radiation from heat sources that would result in the exposed surface exceeding a temperature of 120°C.

2) Except as provided in Sentence (3), when *combustible* coverings and linings, including associated adhesives and insulation, are used, they shall have

a) a *flame-spread rating* of not more than 25 on any exposed surface or any surface that would be exposed by cutting through the material in any direction, and

b) a smoke developed classification of not more than 50.

3) The outer covering of ducts, *plenums* and other parts of air duct systems used within an assembly of *combustible construction* are permitted to have

a) an exposed surface *flame-spread rating* of not more than 75, and

b) a smoke developed classification greater than 50.

4) *Combustible* coverings and linings described in Sentences (2), (3) and (6) shall not flame, glow, smoulder or smoke when tested in accordance with the method of test in ASTM C 411, "Hot-Surface Performance of High-Temperature Thermal Insulation," at the maximum temperature to which the coverings and linings are to be exposed in service.

5) Except as provided in Sentences (6) and (7), foamed plastic insulation shall not be used as part of an air duct or for insulating an air duct.

6) Foamed plastic insulation conforming to Article 9.25.2.2. is permitted to be used to insulate a galvanized steel, stainless steel or aluminum air duct, provided

a) the foamed plastic insulation applied to supply ductwork is not less than 3 m from the *furnace* bonnet,

b) the temperature within the ductwork where the insulation is installed is not greater than 50°C,

c) duct joints are taped with a product conforming to Sentence 9.33.6.3.(1),

d) return air *plenums* are separated from the foamed plastic insulation, and

e) the foamed plastic insulation is protected

i) by one of the interior finishes described in Subsections 9.29.4. to 9.29.9.,

ii) provided the *building* does not contain a Group C *major occupancy*, by sheet metal that is mechanically fastened to the supporting assembly independent of the insulation, is not less than 0.38 mm thick and has a melting point of 650°C or more, or

iii) by any thermal barrier that meets the requirements of Clause 3.1.5.15.(2)(e).

7) Foamed plastic insulation is permitted to be used in a ceiling space that acts as a return air *plenum* provided the foamed plastic insulation is protected from exposure to the *plenum* in accordance with Sentence 3.1.5.14.(4).

8) *Combustible* coverings and linings of ducts, including associated adhesives and insulation, shall be interrupted

a) at the immediate area of operation of heat sources in a duct system, such as electric resistance heaters or fuel-burning heaters or *furnaces*, and

b) where the duct penetrates a *fire separation*.

9) Linings of ducts shall be installed so that they will not interfere with the operation of volume or balancing dampers or of *fire dampers*, *fire stop flaps* and other closures.

9.33.6.5. Galvanized Steel or Aluminum Supply Ducts

1) Galvanized steel or aluminum *supply ducts* shall conform to Table 9.33.6.5.

2) The design of fittings for ducts shall conform to ANSI/SMACNA 006, "HVAC Duct Construction Standards – Metal and Flexible," except that metal thicknesses shall conform to Table 9.33.6.5.

Table 9.33.6.5.
Minimum Metal Thickness of Ducts
Forming Part of Article 9.33.6.5.

Type of Duct	Maximum Diameter, mm	Maximum Width or Depth, mm	Minimum metal thickness, mm	
			Duct Material	
			Galvanized Steel	Aluminum
Round ducts serving single *dwelling units*	125 or less	–	0.254	0.30
Round	350	–	0.33	0.30
	Over 350	–	0.41	0.41
Rectangular, enclosed	–	350	0.33	0.30
	–	Over 350	0.41	0.41
Rectangular, not enclosed, for single *dwelling units*, with required clearance up to 12 mm	–	350	0.33	0.41
	–	Over 350	0.41	0.48
Rectangular, not enclosed, with required clearance of more than 12 mm	–	350	0.41	0.41
	–	Over 350	0.48	0.48

9.33.6.6. Construction of Ducts and Plenums

1) Where the installation of heating *supply ducts* in walls and floors creates a space between the duct and construction material, the space shall be fire stopped with *noncombustible* material at each end.

2) Ducts shall be securely supported by metal hangers, straps, lugs or brackets, except that, where zero clearance is permitted, wooden brackets are permitted to be used.

3) All round duct joints shall be tight-fitting and lapped not less than 25 mm.

4) Rectangular duct connections shall be made with S and drive cleats or equivalent mechanical connections.

5) Duct systems shall have no openings other than those required for the proper operation and maintenance of the system.

9.33.6.7. Installation of Ducts and Plenums

1) Air duct systems serving garages shall not be interconnected with other parts of the *dwelling unit*.

2) Trunk *supply ducts* shall not be nailed directly to wood members.

3) Branch ducts shall be supported at suitable spacings to maintain alignment and prevent sagging.

4) Ducts passing through unheated spaces shall have all joints taped or otherwise sealed to ensure that the ducts are airtight throughout their length.

5) *Combustible* ducts in concrete slabs-on-ground that are connected to a *furnace* supply *plenum* shall be located not closer than 600 mm to that *plenum* and not less than 600 mm from its connection to a riser or register.

6) Ducts in or beneath concrete slabs-on-ground shall be watertight and corrosion-, decay-, and mildew-resistant.

7) Underground ducts shall

a) be constructed to provide interior drainage from and access to all low points, and

b) not be connected directly to a sewer.

9.33.6.8. Clearances of Ducts and Plenums

1) The clearance of *furnace plenums* from *combustible* material shall conform to the appropriate standards in Sentence 9.33.5.2.(1).

2) Where the *plenum* clearance required in Sentence (1) is 75 mm or less, the clearance between a *supply duct* and *combustible* material shall

a) be equal to the required *plenum* clearance within 450 mm of the *plenum*, and

b) be not less than 12 mm at a distance of 450 mm or more from the *plenum*, except that this clearance may be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the *supply duct* from direct radiation from the *furnace* heat exchanger. (See Note A-3.6.5.6.(2).)

3) Where the *plenum* clearance required in Sentence (1) is more than 75 mm but not more than 150 mm, the clearance between a *supply duct* and *combustible* material shall be

a) equal to the required *plenum* clearance within a horizontal distance of 1.8 m of the *plenum*, and

b) not less than 12 mm at a horizontal distance of 1.8 m or more from the *plenum*, except that this distance may be reduced to zero beyond a bend or offset in the duct sufficiently large to shield the remainder of the duct from direct radiation from the *furnace* heat exchanger. (See Note A-3.6.5.6.(3).)

4) Where the *plenum* clearance required in Sentence (1) is more than 150 mm, the clearance between a *supply duct* and *combustible* material shall be

a) equal to the required *plenum* clearance within a horizontal distance of 1 m of the *plenum*,

b) not less than 150 mm within a horizontal distance between 1 m and 1.8 m from the *plenum*, and

c) not less than 25 mm at a horizontal distance of 1.8 m or more from the *plenum*, except that this distance may be reduced to 8 mm beyond a bend or offset in the duct sufficiently large to shield the remainder of the *supply duct* from direct radiation from the *furnace* heat exchanger. (See Note A-3.6.5.6.(4).)

5) Where a register is installed in a floor directly over a pipeless *furnace*, a double-walled register box with not less than 100 mm between walls, or a register box with the warm-air passage completely surrounded by the cold-air passage, shall be permitted in lieu of the clearances listed in Sentences (2), (3) and (4).

9.33.6.9. Adjustable Dampers and Balance Stops

1) All branch *supply ducts* that are not fitted with diffusers with adjustable balance stops shall be supplied with adjustable dampers and fitted with devices to indicate the positions of the dampers.

9.33.6.10. Warm-Air Supply Outlets and Return Inlets – General

1) Supply outlets and return openings in the *dwelling unit*, when located less than 2 m above the floor, shall be protected by grilles having openings of a size that will not allow the passage of a 15 mm diam sphere.

2) *Combustible* grilles, diffusers and other devices for the supply and return air openings installed in walls and ceilings shall have a *flame-spread rating* of

a) not more than 200 in bathrooms, and

b) not more than 150 in rooms or spaces other than bathrooms.

9.33.6.11. Warm-Air Supply Outlets

1) In a *dwelling unit*, a warm-air supply outlet shall be provided in each finished room that is located adjacent to unheated space.

2) Except as provided in Sentence (3), when a room described in Sentence (1) is located adjacent to exterior walls, such outlet shall be located so as to bathe at least one exterior wall or window with warm air, except in bathrooms, utility rooms or kitchens, where this may not be practical.

3) Where the heating system is also designed to provide ventilation air, ceiling outlets or outlets located high on interior walls are permitted to be installed, provided the outlets are designed for this purpose and are installed with diffusers.

4) At least one warm-air supply outlet shall be provided for each 40 m^2 of floor surface area in unfinished *basements* serving *dwelling units*, and it shall be located so as to provide adequate distribution of warm air throughout the *basement*.

5) At least one warm-air supply outlet shall be provided for each 80 m^2 of floor surface area in heated crawl spaces serving *dwelling units*, and it shall be located so as to provide adequate distribution of warm air throughout the crawl space.

6) Except for pipeless *furnaces*, the capacity of warm-air supply outlets serving *dwelling units* shall be not less than the design heat loss from the area served and shall not exceed 3 kW per outlet.

7) In *basements* and heated crawl spaces, the calculated heat gain from the *supply ducts* and *plenum* surfaces is permitted to be considered in calculating the design heat loss.

8) The temperature of supply air at warm-air supply outlets shall not exceed 70°C.

9) Warm-air supply outlets located in finished areas shall be provided with diffusers and adjustable openings and shall not be located on a *furnace plenum*.

9.33.6.12. Return-Air Inlets

1) Return-air inlets shall not be installed in an enclosed room or crawl space that provides combustion air to a *furnace*.

2) Except for unfinished areas and floor levels which are less than 900 mm above or below an adjacent floor level which is provided with a return-air inlet, at least one return-air inlet shall be provided in each floor level in a *dwelling unit*.

3) Provision shall be made for the return of air from all rooms by leaving gaps beneath doors, using louvred doors or installing *return duct* inlets.

9.33.6.13. Return-Air System

(See Note A-9.33.6.13.)

1) The return-air system shall be designed to handle the entire air supply.

2) Where any part of a *return duct* will be exposed to radiation from the *furnace* heat exchanger or other radiating part within the *furnace*, such part of a *return duct* directly above or within 600 mm of the outside *furnace* casing shall be *noncombustible*.

3) *Return ducts* serving solid-fuel-burning *furnaces* shall be constructed of *noncombustible* material.

4) *Combustible return ducts* shall be lined with *noncombustible* material

a) below floor registers,

b) at the bottom of vertical ducts, and

c) under *furnaces* having a bottom return.

5) Spaces between studs or joists used as *return ducts* shall be separated from the unused portions of such spaces by tight-fitting metal stops or wood blocking.

6) A vertical *return duct* shall have openings to return air on not more than one floor.

7) The return-air system shall be designed so that the negative pressure from the circulating fan cannot

a) affect the *furnace* combustion air supply, nor

b) draw combustion products from joints or openings in the *furnace* or *flue pipe*.

9.33.6.14. Filters and Odour Removal Equipment

1) Air filters for air duct systems shall conform to the requirements for Class 2 air filter units as described in CAN/ULC-S111, "Fire Tests for Air Filter Units."

2) When electrostatic-type filters are used, they shall be installed so as to ensure that the electric circuit is automatically de-energized when filter access doors are opened or, in *dwelling units*, when the *furnace* circulation fan is not operating.

3) When odour removal equipment of the adsorption type is used it shall be

a) installed to provide access so that adsorption material can be reactivated or renewed, and

b) protected from dust accumulation by air filters installed on the inlet side.

9.33.7. Radiators and Convectors

9.33.7.1. Recessed Radiators and Convectors

1) Every steam or hot water radiator and convector located in a recess or concealed space or attached to the face of a wall of *combustible construction* shall be provided with a *noncombustible* lining or backing.

9.33.7.2. Surface Temperature

1) The exposed surface temperature of a steam or hot water radiator shall not exceed 70°C unless precautions are taken to prevent human contact.

9.33.8. Piping for Heating and Cooling Systems

9.33.8.1. Piping Materials and Installation

1) Piping shall be made from materials designed to withstand the effects of temperatures and pressures that may occur in the system. (See Articles 3.1.5.19., 3.1.9.1. and 9.10.9.6. for fire safety requirements.)

2) Every pipe used in a heating or air-conditioning system shall be installed to allow for expansion and contraction due to temperature changes.

3) Supports and anchors for piping in a heating or air-conditioning system shall be designed and installed to ensure that undue stress is not placed on the supporting structure.

9.33.8.2. Insulation and Coverings

1) Insulation and coverings on pipes shall be composed of material suitable for the operating temperature of the system to withstand deterioration from softening, melting, mildew and mould.

2) Insulation and coverings on pipes in which the temperature of the fluid exceeds 120°C

a) shall be made of *noncombustible* material, or

b) shall not flame, glow, smoulder or smoke when tested in accordance with ASTM C 411, "Hot-Surface Performance of High-Temperature Thermal Insulation," at the maximum temperature to which such insulation or covering is to be exposed in service.

3) Except as provided in Sentence (6), where *combustible* insulation is used on piping in a horizontal or *vertical service space*, the insulation and coverings on such pipes shall have a *flame-spread rating* throughout the material of not more than

a) 25 in *buildings* of *noncombustible construction*, and

b) 75 in *buildings* of *combustible construction*.

4) Except as provided in Sentence (6), insulation and coverings on piping located in rooms and spaces other than the *service spaces* described in Sentence (3) shall have a *flame-spread rating* not more than that required for the interior finish for the ceiling of the room or space.

5) Pipes that are exposed to human contact shall be insulated so that the exposed surface does not exceed 70°C. (See Note A-6.5.1.1.(3).)

6) No *flame-spread rating* or smoke developed classification limitations are required where *combustible* insulation and coverings are used on piping when such piping is

a) located within a concealed space in a wall,

b) located in a floor slab, or

c) enclosed in a *noncombustible* raceway or conduit.

9.33.8.3. Clearances

1) Clearances between *combustible* material and bare pipes carrying steam or hot water shall conform to Table 9.33.8.3.

Table 9.33.8.3.
Clearance between Steam or Hot Water Pipes and Combustible Material
Forming Part of Sentence 9.33.8.3.(1)

Steam or Water Temperature (T), °C	Minimum Clearance, mm
T ≤ 95	no clearance required
95 < T ≤ 120	15
T > 120	25

9.33.8.4. Protection

1) Where a pipe carrying steam or hot water at a temperature above 120°C passes through a *combustible* floor, ceiling or wall, the construction shall be protected by a sleeve of metal or other *noncombustible* material not less than 50 mm larger in diameter than the pipe.

2) Unprotected steam or hot water pipes that pass through a storage space shall be covered with not less than 25 mm thickness of *noncombustible* insulation to prevent direct contact with the material stored.

9.33.9. Refrigerating Systems and Equipment for Air-conditioning

9.33.9.1. Cooling Units

1) Where a cooling unit is combined with a fuel-fired furnace in the same duct system, the cooling unit shall be installed

a) in parallel with the heating *furnace*,

b) upstream of the *furnace*, provided the *furnace* is designed for such application, or

c) downstream of the *furnace*, provided the cooling unit is designed to prevent excessive temperature or pressure in the refrigeration system.

9.33.10. Chimneys and Venting Equipment

9.33.10.1. Requirement for Venting

1) Except as provided in Articles 9.33.10.2. and 9.33.10.3., the products of combustion from oil-, gas- and solid-fuel-burning *appliances*, including *stoves, cooktops,* ovens and *space heaters,* shall be vented in conformance with the applicable *appliance* installation standard listed in Sentences 9.33.5.2.(1) and 9.33.5.3.(1).

9.33.10.2. Factory-Built Chimneys

1) Factory-built chimneys serving solid-fuel-burning *appliances*, and their installation, shall conform to CAN/ULC-S629-M, "650°C Factory-Built Chimneys." (See Note A-9.33.10.2.(1).)

9.33.10.3. Masonry or Concrete Chimneys

1) *Masonry or concrete chimneys* shall conform to Section 9.21.

9.33.10.4. Location of Exhaust Vents Serving Buildings Containing Not More than Two Principal Dwelling Units

1) Exhaust Vents from heating and air conditioning equipment and similar appliances, other than direct vented fireplaces, shall be directed

a) vertically through the roof of a *building*, with the discharge located at least 1.5 m away from any property line, or

b) horizontally through an exterior wall which faces a *street* or a *lane*, with the discharge located at least 3 m away from any property line.