



Delta Fire & Emergency Services

BC Fire Code

Underground and Above Ground Installation Requirements

Definition:

Storage tank means a vessel for flammable liquids or combustible liquids having a capacity of more than 230 L, and designed to be installed in a fixed location

4.3.2

Installation of Outside Above ground Storage Tanks

4.3.2.1 - Location

- 1) Every outside aboveground storage tank for the storage of flammable liquids or combustible liquids shall be located in conformance with Sentences (2) to (5) with respect to a property line or a building on the same property.
- 2) Except as provided in Sentences (6) and (7), every aboveground storage tank containing stable liquids and having a working pressure of not more than 17 kPa (gauge) shall be separated from a property line or a building on the same property by distances
 - a) half those in Table 4.3.2.1, where protection is provided against fire or explosion in the tank in conformance with Sentence 4.3.2.5.(2), or
 - b) equal to those in Table 4.3.2.1, where protection referred to in Clause (a) is not provided.

Location of Aboveground Storage Tanks

Forming Part of Sentences 4.3.2.1.(2), (3) and (4), and 4.8.2.1.(2) and (3)

Maximum Tank Capacity, L	Minimum Distance to a Property Line or to a Building on the Same Property, m
250 000	3
500 000	4.5
2 500 000	9
5 000 000	12
over 5 000 000	15

- 1) Every aboveground storage tank containing unstable liquids and having a working pressure of not more than 17 kPa (gauge) shall be separated from a property line or a building on the same property by distances
 - a) equal to those in Table 4.3.2.1, but not less than 7.5 m, where protection is provided against fire or explosion in the tank in conformance with Sentence 4.3.2.5.(2), or
 - b) 3 times those in Table 4.3.2.1, but not less than 15 m, where protection referred to in Clause (a) is not provided.
- 1) Every aboveground storage tank containing boil-over liquids shall be separated from a property line or a building on the same property by distances
 - a) 0.75 times those in Table 4.3.2.1, where protection is provided against fire or explosion in the tank in conformance with Sentence 4.3.2.5.(2), or
 - b) equal to those in Table 4.3.2.1, where protection referred to in Clause (a) is not provided. (See Appendix A.)

- 5) Where a storage tank containing stable liquids or unstable liquids has a working pressure greater than 17 kPa (gauge), the distances from a property line or a building on the same property shall be those specified in Sentences (2) and (3) multiplied by 1.5, but shall be not less than 7.5 m.
- 6) The minimum distance required in Sentence (2) from a storage tank containing only Class II or IIIA liquids to a building on the same property is permitted to be reduced to
 - a) 1.5 m provided the tank capacity is not more than 50 000 L, or
 - b) zero provided the tank capacity is not more than 2 500 L.
- 7) The minimum distance required in Sentence (2) is permitted to be waived provided the storage tank
 - a) is in conformance with ULC/ORD-C142.16, "Protected Aboveground Tank Assemblies for Flammable and Combustible Liquids," and
 - b) has a capacity of not more than 50 000 L.
 - 8) Where end failure of horizontal storage tanks may endanger adjacent property, the tanks shall be placed with the longitudinal axis parallel to such property.

4.3.2.2. —

Spacing between Storage Tanks

- 1) Except as required in Sentences (2) and (3) and in Article 4.3.2.3., the minimum distance between every combination of 2 aboveground storage tanks shall be 0.25 times the sum of their diameters, but shall be not less than 1 m.
- 2) The minimum distance between any 2 storage tanks, neither of which has a capacity of more than 250 000 L, shall be 1 m.
- 3) Where either of 2 aboveground storage tanks contains unstable liquids, the distance required in Sentences (1) and (2) shall be doubled.

4.3.2.3. —

Clearances from Liquefied Petroleum Gas Cylinders and Tanks

- 1) The minimum separation between a flammable liquid or combustible liquid storage tank and a liquefied petroleum gas cylinder or tank shall be 6 m.
- 2) Secondary confinements for flammable liquid and combustible liquid storage tanks shall not contain any liquefied petroleum gas cylinder or tank, and the centre line of the secondary containment wall shall be not less than
 - a) 3 m away from a liquefied petroleum gas cylinder, and
 - b) 6 m away from a liquefied petroleum gas tank.

4.3.2.4. —

Fire Department Access

- 1) Except as provided in Sentences (2) and (3), storage tanks for flammable liquids or combustible liquids shall be spaced so that each storage tank is accessible for fire fighting purposes.
- 2) An access route constructed in conformance with Subsection 3.2.5. of the British Columbia Building Code shall be provided in outdoor storage areas to permit the approach of fire department vehicles to within 60 m travelling distance of any storage tank.
- 3) Where fire fighting access to storage tanks containing Class I or II liquids is not provided, fire extinguishing measures conforming to Sentence 4.3.2.5.(2) shall be provided.

4.3.2.5. —

Fire Protection Systems

(See Appendix A.)

- 1) Where the diameter of a storage tank exceeds 45 m, the storage tank shall be provided with protection against fires or explosions in conformance with Sentence (2).
- 2) Protection against fires or explosions required for a storage tank shall consist of fixed protection systems designed in conformance with good engineering practice such as described in
 - a) NFPA 11, "Low Expansion Foam and Combined Agent Systems,"
 - b) NFPA 15, "Water Spray Fixed Systems for Fire Protection," and
 - c) NFPA 69, "Explosion Prevention Systems."

4.3.2.6. —

Leakage Testing

At the time of installation, aboveground storage tanks and associated piping shall be tested for leakage in conformance with Subsections 4.3.15. and 4.4.6.

4.3.3. — Supports, Foundations and Anchorage for Aboveground Storage Tanks

4.3.3.1. Foundations and Supports

- 1) Storage tanks shall rest on the ground or on foundations, supports or piling made of concrete, masonry or steel in conformance with
 - a) Appendix B of API 650, "Welded Steel Tanks for Oil Storage," and
 - b) Appendices C and D of API 620, "Design and Construction of Large, Welded, Low-Pressure Storage Tanks."
- 2) Tank supports shall be installed on firm foundations designed to minimize uneven settling of the tank and to minimize corrosion of the part of the tank resting on the foundation.
- 3) Except for steel saddles that are less than 300 mm high at their highest point, supports for storage tanks shall provide a fire-resistance rating of not less than 2 h.
- 4) Every aboveground storage tank shall be supported in a manner that will prevent the allowable design stress of the tank from being exceeded.

4.3.3.2. Earthquake Protection

- 1) In areas subject to earthquake forces, storage tanks, supports and connections shall be designed to resist such forces in conformance with
 - a) Part 4 of the British Columbia Building Code, and
 - b) Appendix A of ULC-S630, "Shop Fabricated Steel

Aboveground Vertical Tanks for Flammable and Combustible Liquids."

4.3.3.3. Protection against Flooding

- 1) When aboveground storage tanks are located in an area that may be subjected to flooding, the tanks shall be securely anchored to prevent floating.

4.3.4. — Normal and Emergency Venting for Aboveground Storage Tanks

4.3.4.1. Design and Installation

- provided with normal and emergency venting in conformance with
- 1) Atmospheric and low pressure storage tanks shall be
 - a) API 2000, "Venting Atmospheric and Low-Pressure Storage Tanks," or
 - b) the tank design standards listed in Sentence 4.3.1.2.(1).

4.3.4.2. Unstable Liquids

1) When unstable liquids are stored, the effects of heat or gas resulting from polymerization, decomposition, condensation or self-reactivity shall be allowed for in the determination of the total venting capacity.

4.3.5. —

Vent Piping for Aboveground Storage Tanks

4.3.5.1. Materials and Construction

- 1) Vent piping materials and construction shall conform to

Section 4.4.

4.3.5.2. Location of Vent Pipe Outlets

- 1) Vent pipe outlets for storage tanks of Class I liquids
 - a) shall be located outside buildings not less than
 - i) 3.5 m above the adjacent ground level, and
 - ii) 1.5 m from any building opening, and
 - b) shall discharge so that flammable vapours will not enter the building or be trapped near any part of the building.

- 2) Vent pipe outlets for Class II or IIIA liquids shall discharge outside buildings not less than
 - a) 2 m above the adjacent ground level, and
 - b) 1.5 m from any building opening.

4.3.5.3. Interconnection of Vent Piping

- 1) Except as provided in Sentence (2), 2 or more storage tanks are permitted to be connected to a common vent pipe for normal relief venting provided the vent pipe size is designed to vent the combined vapours produced in the connected tanks without exceeding the allowable stresses of the tanks.
- 2) Vent piping for storage tanks for Class I liquids shall not be connected to vent piping for storage tanks for Class II or IIIA liquids unless an effective arrangement is provided to prevent the vapours from the Class I liquids from entering the other tanks.

4.3.6. Openings Other than Vents in Aboveground Storage Tanks

4.3.6.1. Provision of Valves

- 1) Connections to aboveground storage tanks at any level below the highest level to which the liquid will rise shall be provided with valves located as close as practicable to the shell.

4.3.6.2. Materials

- 1) Valves and their connections to a storage tank shall be made of steel, except that when the chemical characteristics of the liquid stored are incompatible with steel, materials other than steel are permitted to be used.
- 2) Materials for valves and their connections to a storage tank shall be suitable for the pressures, stresses and temperatures that may be expected, including those of possible fire exposure.

4.3.6.3. Openings for Liquid Level Measurements

- 1) Openings for measuring liquid levels in storage tanks for Class I liquids shall be equipped with caps or covers which shall be opened only when measuring the liquid level.

4.3.6.4. Connections for Filling and Emptying

- 1) Except as provided in Sentence (3), connections used as part of normal operating conditions for filling or emptying storage tanks for flammable liquids and combustible liquids shall be located
 - a) outside buildings,
 - b) at a location free of sources of ignition, and
 - c) not less than 1.5 m away from building openings.
- 2) Connections for filling or emptying storage tanks shall be kept closed to prevent leakage when not in use.
- 3) A filling connection described in Sentence (1) is permitted to be located inside a building if
 - a) this is made necessary
 - i) by a process or activity located indoors and to which the tank is directly associated, or
 - ii) for the collection of used liquids, and
 - b) the fill piping is provided with means to prevent flammable vapours from returning to the building.

4.3.7. Secondary Containment for Aboveground Storage Tanks

4.3.7.1. General

- 1) The area surrounding a storage tank or group of storage tanks shall be designed to accommodate accidental spillage in conformance with Subsection 4.1.6.
- 2) Where barriers described in Sentence 4.1.6.1.(1) are provided to contain accidental spillage from aboveground storage tanks, they shall conform to the requirements for secondary containment in this Subsection.

- 3) A storage tank conforming to Sentence 4.3.7.4.(2) shall be considered as conforming to this Subsection provided it is used and maintained in conformance with Articles 4.3.7.8. and 4.3.7.9.

4.3.7.2. Construction

- 1) Except as provided in Sentence (2), the base and walls of a secondary containment shall be made of noncombustible materials, and shall be designed, constructed and maintained to
- a) withstand full hydrostatic head, and
 - b) provide a permeability of not more than 10-6 cm/s to the flammable liquids or combustible liquids contained in the storage tanks.
- 2) Where a membrane provides the level of impermeability required in Sentence (1), it shall
- a) conform to UL/ORD-C58.9, "Secondary Containment Liners for Underground and Aboveground Flammable and Combustible Liquid Tanks," and
 - b) when the membrane is combustible, be covered with a noncombustible material of such nature and thickness that the membrane will not fail when the secondary containment is exposed to fire.
- 3) Except as provided in Sentence (4), openings shall not be permitted in a secondary containment.
- 4) Where piping passes through a secondary containment, such passages shall conform to Sentences (1) and (2).

4.3.7.3. Capacity

(See A-4.1.6.1.(1) in Appendix A.)

- 1) Except as permitted in Sentence (3), a secondary containment for a single storage tank shall have a volumetric capacity of not less than 110% of the capacity of the tank.
- 2) Except as permitted in Sentence (3), a secondary containment for more than one storage tank shall have a volumetric capacity of not less than the sum of
- a) the capacity of the largest storage tank located in the contained space, and
 - b) 10% of the greater of
 - i) the capacity specified in Clause (a), or
 - ii) the aggregate capacity of all other storage tanks
- 3) When the secondary containment is designed to

located in the contained space.

prevent the entry of precipitation and water used for fire fighting purposes into the contained space, it shall have a volumetric capacity of not less than the capacity of the largest storage tank located in the contained space.

4.3.7.4. —

Clearances

secondary containment wall shall be less than 1.5 m from a storage tank shell.

2) It is permitted to waive the distance required in

Sentence (1) provided the storage tank

a) is constructed in accordance with

i) Clauses 4.3.1.2.(1)(i), (m), (o), (p) or (q), incorporating

secondary containment, or

ii) Clauses 4.3.1.2.(1)(e) or (i) for double-walled storage

tanks,

b) has a capacity of not more than 50 000 L, and

c) is protected by posts or guardrails when exposed to

collision damage.

Access to Storage Tanks and Ancillary Equipment

- 4.3.7.5. —
- 1) A secondary containment shall permit
- a) access to storage tanks, valves and ancillary equipment;
 - b) egress from the contained space, and

c)access for fire fighting as specified in Article 4.3.2.4.

(See Appendix A.)

- 2) Where a storage tank contains Class I liquids, provisions shall be made for the normal operation of valves and for access to the storage tank roof without entering the contained space created by the secondary containment when
 - a)the average height of the secondary containment exceeds 3.5 m, measured from the ground level of the interior of the contained area, or
 - b)the distance between the tank shell and the top inside edge of the secondary containment wall is less than the height of this wall.

(See Appendix A.)

4.3.7.6. —

Emergency Venting

- 1)Where the secondary containment is not open to the atmosphere, emergency venting shall be provided to relieve any buildup of internal pressure in the contained space when exposed to heat or fire.

4.3.7.7. —

Leak Detection

- 1)Where the contained space created by the secondary containment is not accessible for visual examination, a monitoring device shall be provided to indicate the presence of liquid in, or the loss of integrity of the secondary containment.

4.3.7.8. —

Drainage

- 1)Liquids, debris and precipitation shall not accumulate in the contained space created by the secondary containment.
- 2)Provisions shall be made for removing liquid from the secondary containment in conformance with Subsection 4.1.6.
- 3)Controls for the liquid removal system required in

Sentence (2) shall be

- a) normally closed,
- b) accessible under fire exposure conditions, and

- 2) located so they can be operated from outside the contained space.

4.3.7.9. —

Use of Secondary Containment

- 1) The contained space created by a secondary containment shall not be used for storage purposes.

4.3.8. —

Installation of Underground Storage Tanks

4.3.8.1. —

Location

- 1)Underground storage tanks shall be located so that
 - a)foundations of existing buildings will not be undermined
 - b)loads from building foundations and supports are not transmitted to the tank.
- 2)Underground storage tanks shall be located not less than

- a) 600 mm from adjacent tanks,
- b) 1 m from a building or street line, and

- 3) 1.5 m from other property lines.

Ground Cover

- 1)Except as required in Sentences (2) to (4), underground storage tanks shall be installed with not less than 600 mm of ground cover over the tank.
- 2)Except as required in Sentence (3), storage tanks subjected to vehicular traffic shall be installed not less than 1 m below finished ground level.
- 3)Either a 150 mm reinforced concrete slab or a 200 mm unreinforced concrete slab over not less than 450 mm of sand is permitted in lieu of the protection described in Sentence (2) provided the slab extends at least 300 mm beyond the storage tank.

- 4)Where subsurface conditions make it impracticable to install a storage tank totally below adjacent ground level, an underground storage tank shall be installed so that at least
- a) 75% of its mass is below adjacent ground level
 - b) 50% of its mass is below adjacent ground level provided there is not less than 600 mm of ground cover over the portion of the tank above adjacent ground level, or
 - c) 50% of its mass is below adjacent ground level provided there is not less than 1 m of ground cover over the portion of the tank above adjacent ground level.
- 4.3.8.3. — Damage Repair
- 1)Underground storage tanks in the process of being installed shall be inspected, and any damage to the protective coating or anodes shall be repaired before they are lowered into the excavation.
 - 2)Damage to storage tank shells shall not be repaired on site.
- 4.3.8.4. — Damage Prevention
- 1)Underground storage tanks shall be lowered into the excavation by the use of lifting lugs and hooks and, where necessary, spreader bars to prevent damage to the protective coating.
 - 2)Any method of handling that might result in damage to the protective coating of the tank shall not be used.
- 4.3.8.5. — Installation
- 1)Underground steel storage tanks shall be installed in conformance with Appendix B of CANULC-S603.1, "Galvanic Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids."
 - 2)Underground reinforced plastic storage tanks shall be installed in conformance with Appendix A of CAN4-S615-M, "Reinforced Plastic Underground Tanks for Petroleum Products."
- 3) Underground storage tanks shall not be placed in direct contact with reinforced concrete slabs but shall be separated by not less than 150 mm of sand or other suitable material to distribute evenly the weight of the tank on the supporting base.
- 4.3.8.6. — Leakage Testing
- 1)At the time of installation, underground storage tanks and associated piping shall be tested for leakage in conformance with Subsections 4.3.15. and 4.4.6.
- 4.3.8.7. — Filling
- 1)Flammable liquids or combustible liquids shall not be placed in an underground storage tank until
- a)the fill pipe and vent line have been installed in the tank, and
 - b) all other openings have been sealed.
- 4.3.8.8. — Spillage
- 1)If a spillage occurs, the escaped liquid and all soil contaminated by the spill shall be removed in conformance with Subsection 4.1.6.
- 4.3.8.9. — Anchorage
- 1) Where a high water table is anticipated, underground storage tanks shall be protected against uplift due to hydrostatic forces when the tanks are empty. (See Appendix A.)
 - 2)Where anchors and ground straps are used to resist uplift forces referred to in Sentence (1), they shall be
- a) electrically isolated from the tank, and
 - b) installed in such a manner that they do not damage the protective coating on the tank.
- 4.3.9. — Corrosion Protection of Underground Steel Storage Tanks
- 4.3.9.1. — Corrosion Protection

storage tanks and associated piping and fitting subject to corrosion shall be protected in conformance with CAN/ULC-S603.1, "Galvanic Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids."

1) Except as provided in Sentence (2), underground steel storage tanks and associated piping and fitting subject to corrosion shall be protected in conformance with CAN/ULC-S603.1, "Galvanic Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids."

permitted provided

2) A steel storage tank not conforming to Sentence (1) is

a) it conforms to ULC/ORD-C58.10, "Jacketed Steel Underground Tanks for Flammable and Combustible Liquids," or
b) it has corrosion protection conforming to good engineering practice such as described in PACE Report No. 87-1, "Impressed Current Method of Cathodic Protection of Underground Petroleum Storage Tanks" published by the Canadian Petroleum Products Institute.

Vents for Underground Storage Tanks

4.3.10. —
4.3.10.1. —

Vent Design

1) Underground storage tanks shall be provided with vent openings and piping of sufficient cross-sectional area designed to vent the tanks during the maximum filling or withdrawal rate without causing the allowable stress for the tank to be exceeded.

4.3.10.2. —

Materials and Construction

1) Vent piping materials and construction shall conform to

Section 4.4.

4.3.10.3. —

Installation

1) Vent pipe outlets from underground storage tanks for

Class I liquids

a) shall be located outside buildings higher than the fill

pipe openings but not less than

i) 3.5 m above the adjacent ground level,

ii) 1.5 m from any building opening, and

iii) 7.5 m from any dispenser, and

b) shall discharge so that flammable vapours will not enter building openings or be trapped near any part of the building.

2) Vent pipe outlets from underground storage tanks for Class II or IIIA liquids shall be located outside buildings at a height that is above the fill pipe opening but not less than 2 m above finished ground level.

3) Vent pipes from underground storage tanks for flammable liquids or combustible liquids shall not be obstructed by any device that may cause excessive back pressure, except that vent pipes from underground storage tanks for Class II or IIIA liquids are permitted to be fitted with return bends, coarse screens or other devices to minimize the entry of foreign material.

4) Vent piping shall enter the storage tank through the top of the tank and shall not extend into the tank more than 25 mm except when the vent is equipped with a vent alarm.

5) Vent piping shall be

a) installed so that any nominally horizontal run shall slope

towards the storage tank,

b) constructed without traps,

c) adequately supported to prevent sagging, and

d) where necessary, protected against mechanical

damage.

4.3.10.4. —

Interconnection of Vent Pipes

1) Except as permitted in Sentence (2), where vent piping connects 2 or more storage tanks, pipe sizes shall be designed to vent the combined vapours produced in the connected underground storage tanks without exceeding the allowable stresses of the tanks when being filled simultaneously.

- 2)Where it is not possible to fill the connected storage tanks referred to in Sentence (1) simultaneously, or where the connected vents have a vapour recovery system, the vent piping shall be sized to accommodate the maximum vapour flow possible in the system.
- 2) Vent piping for an underground storage tank containing a Class I liquid shall not be connected to the vent piping for a storage tank containing a Class II or IIIA liquid unless an effective method is provided to prevent the vapours from the Class I liquid storage tank from entering the other tank
- 3) Vent piping for an underground storage tank containing a Class I liquid shall not be connected to the vent piping for a storage tank containing a Class II or IIIA liquid unless an effective method is provided to prevent the vapours from the Class I liquid storage tank from entering the other tank.
- 4.3.11. —
4.3.11.1. —
Openings Other than Vents in Underground Storage Tanks
- 1)Connections for all openings in underground storage tanks shall be liquid and vapour tight.
- 4.3.11.2. —
Openings for Measuring Liquid Level
- 1)Openings for measuring liquid levels in underground storage tanks if independent of the fill pipe shall be equipped with a vapour-tight cap or cover which shall be opened only when measuring the liquid level.
- 4.3.11.3. —
Fill Piping and Discharge Piping
- 1)Fill piping and discharge piping shall enter underground storage tanks only through the top of the tank and discharge piping used in suction systems shall be sloped toward the storage tanks.
- 2)Remote fill outlets from an underground storage tank shall not be located higher than other outlets from the tank.
- 3)Except as provided in Sentence (5), connections used as part of normal operating conditions for filling or emptying storage tanks for flammable liquids and combustible liquids shall be located
- a) outside buildings
- b) at a location free of sources of ignition, and
- c)not less than 1.5 m away from building openings.
- 4)Connections for filling or emptying storage tanks described in Sentence (3) shall be kept closed to prevent leakage when not in use.
- 5)A filling connection described in Sentence (3) is permitted to be located inside a building if
- a) this is made necessary
- i) by a process or activity located indoors and to which the tank is directly associated, or
- ii) for the collection of used liquids, and
- b) the fill piping is provided with means to prevent flammable vapours from returning to the building.
- 4.3.12. —
4.3.12.1. —
Installation of Storage Tanks inside Buildings
- 1)Except as provided in Article 4.3.12.2., storage tanks shall not be permitted in other than industrial occupancies.
- 4.3.12.2. —
Stationary Combustion Engines
- 1)Installations using Class I liquids as fuel supplies for stationary engines inside buildings shall conform to NFPA 37, "Installation and Use of Stationary Combustion Engines and Gas Turbines."
- 4.3.12.3. —
Maximum Static Head
- 1) The static head imposed on a storage tank inside a building shall not exceed 70 kPa (gauge) at the bottom of the tank when the vent or fill pipe is filled with liquid unless the tank is designed for greater pressures.

4.3.12.4. —

Maximum Quantities and Location

- 1) Except as provided in Subsection 4.2.8. and in Sentence (2), storage tanks for flammable liquids or combustible liquids shall be a) located in dedicated storage rooms conforming to Subsection 4.3.13., and
- b) located in conformance with Table 4.3.12.4.
- 2) When quantities greater than are permitted for incidental use in Subsection 4.2.8. are required for special process operations, storage tanks for flammable liquids or combustible liquids are permitted to be located outside of a storage room referred to in Sentence (1), provided that
- a) total quantities per fire compartment are not more than one-half the quantities permitted in Table 4.3.12.4.,
- b) they are located on the first storey, and
- c) the installation conforms to Articles 4.3.12.7. to 4.3.12.10. and Article.

**Table 4.3.12.4.
Indoor Tank Storage
Forming Part of Sentences 4.3.12.4.(1) and (2), and 4.3.12.6.(1)**

Class of Liquid	Storage Level	Maximum Quantity per Storage Room(1), L One or More Tanks	
		Protected(2)	Unprotected Storage
Class I	First storey Storeys above the first storey Basement	40 000 7 500 Not Permitted	25 000 Not Permitted Not Permitted
Class II and IIIA	First storey Storeys above the first storey Basement	200 000 20 000 20 000	100 000 Not Permitted Not Permitted