Section 4.3. Tank Storage

4.3.1. Design, Construction and Use of Storage Tanks

4.3.1.1. Application

1) This Section applies to *storage tanks* for *flammable liquids* and *combustible liquids*.

4.3.1.2. Atmospheric Storage Tanks

1) Except as permitted in Sentence (3) and in Section 4.10., *atmospheric storage tanks* shall be built in conformance with the following:

a) except as provided in Sentence (2), API 12B, "Bolted Tanks for Storage of Production Liquids,"

b) except as provided in Sentence (2), API 12D, "Field Welded Tanks for Storage of Production Liquids,"

c) except as provided in Sentence (2), API 12F, "Shop Welded Tanks for Storage of Production Liquids,"

d) API 650, "Welded Tanks for Oil Storage,"

e) CAN/ULC-S601, "Shop Fabricated Steel Aboveground Tanks for Flammable and Combustible Liquids,"

f) CAN/ULC-S602, "Aboveground Steel Tanks for Fuel Oil and Lubricating Oil,"

g) CAN/ULC-S603, "Steel Underground Tanks for Flammable and Combustible Liquids,"

h) CAN/ULC-S603.1, "External Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids,"

i) CAN/ULC-S615, "Fibre Reinforced Plastic Underground Tanks for Flammable and Combustible Liquids,"

j) CAN/ULC-S652, "Tank Assemblies for the Collection, Storage and Removal of Used Oil,"

k) CAN/ULC-S653, "Aboveground Steel Contained Tank Assemblies for Flammable and Combustible Liquids,"

l) ULC-S655, "Aboveground Protected Tank Assemblies for Flammable and Combustible Liquids,"

m) CAN/ULC-S677, "Fire Tested Aboveground Tank Assemblies for Flammable and Combustible Liquids," or

n) ULC/ORD-C80.1, "Non-metallic Tank for Oil Burner Fuels and Other Combustible Liquids."

2) Tanks built in conformance with Clause (1)(a), (b) or (c) shall be

a) used only for the storage of crude petroleum and oil field production liquids, and

b) provided with emergency venting that (see Note A-4.3.1.2.(2)(b))

i) conforms to API 2000, "Venting Atmospheric and Low-Pressure Storage tanks," and

ii) is compatible with the design features of the tank.

3) When necessitated by possible contamination of the liquid to be stored or possible rapid corrosion of the tank, *storage tanks* need not conform to Sentence (1), provided that they are designed and built in conformance with good engineering practice for the material being used. (See Note A-4.3.1.2.(3).)

4) *Atmospheric storage tanks* shall not be used for the storage of *flammable liquids* or *combustible liquids* at temperatures at or above their boiling points.

4.3.1.3. Low Pressure Storage Tanks and Pressure Vessels

1) *Low pressure storage tanks* shall be constructed in conformance with

a) API 620, "Design and Construction of Large, Welded, Low-Pressure *Storage tanks*," or

b) ASME BPVC-2013, "Boiler and Pressure Vessel Code."

2) *Pressure vessels* shall be constructed in conformance with the British Columbia Power Engineers, Boiler, Pressure Vessel and Refrigeration Safety Regulation.

3) *Low pressure storage tanks* and *pressure vessels* are permitted to be used as *atmospheric storage tanks*.

4.3.1.4. Operating Pressure

1) The normal operating pressure of a *storage tank* shall not exceed its design pressure.

4.3.1.5. Corrosion Protection

1) Aboveground *storage tanks* and their integral fittings that are subject to corrosion shall be protected by any means against exposure to conditions that would initiate corrosion.

4.3.1.6. Floating Roofs

1) Except for perimeter sealing material, floating roof assemblies or internal floating covers installed in *storage tanks* shall be constructed of metal or other materials and designed in conformance with one of the tank construction standards listed in this Subsection.

4.3.1.7. Identification

1) A *storage tank* and its filling and emptying connections shall be identified in conformance with CFA 1990, "Using the Canadian Fuels Colour-Symbol System to Mark Equipment and Vehicles for Product Identification."

4.3.1.8. Overfill Protection

1) Except as required in Sentence (2), a *storage tank* shall be prevented from being overfilled by providing

a) continuous supervision of the filling operations by personnel qualified to supervise such operations, or

b) an overfill protection device conforming to CAN/ULC-S661, "Overfill Protection Devices for Flammable and Combustible Liquid Storage tanks" (see Note A-4.3.1.8.(1)(b)).

2) Tight-filled *storage tanks* shall be prevented from being overfilled by providing a positive shut-off device conforming to CAN/ULC-S661, "Overfill Protection Devices for Flammable and Combustible Liquid Storage tanks" (See Note A-4.3.1.8.(2).)

4.3.1.9. Installation and Use

1) Unless otherwise specified in this Code, a *storage tank* shall be installed and used in conformance with the applicable installation and use provisions of the design document to which the *storage tank* was built as required by this Section.

4.3.1.10. Reuse

1) A *storage tank* that has been taken out of service shall not be reused for the storage of *flammable liquids* or *combustible liquids* unless it has been

a) refurbished so as to conform to one of the standards listed in Sentence 4.3.1.2.(1), or

b) refurbished in conformance with Sentence (2) or (3).

2) A *storage tank* is permitted to be refurbished for aboveground use in conformance with good engineering practice such as that described in

a) API 653, "Tank Inspection, Repair, Alteration, and Reconstruction," and

b) STI SP031, "Repair of Shop Fabricated Aboveground Tanks for Storage of Flammable and Combustible Liquids."

3) A *storage tank* is permitted to be refurbished for underground use in conformance with good engineering practice such as that described in CAN/ULC-S669, "Internal Retrofit Systems for Underground Tanks for Flammable and Combustible Liquids." (See Note A-4.3.1.10.(3).)

4) A riveted *storage tank* shall not be relocated.

4.3.2. Installation of Outside Aboveground 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.

Table 4.3.2.1.
Location of Aboveground Storage Tanks
Forming Part of Sentences 4.3.2.1.(2), (3) and (4), and 4.9.2.1.(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

3) 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.

4) 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 Note A-4.3.2.1.(4).)

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* is in conformance with ULC-S655, "Aboveground Protected Tank Assemblies for Flammable and Combustible Liquids."

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 containments 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 firefighting purposes.

2) An access route constructed in conformance with Subsection 3.2.5. of Division B 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 firefighting 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 Note A-4.3.2.5.)

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 that described in

a) NFPA 11, "Low-, Medium-, and High-Expansion Foam,"

b) NFPA 15, "Water Spray Fixed Systems for Fire Protection," and

c) NFPA 69, "Explosion Prevention Systems."

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.

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) Where the clearance below the base of the tank exceeds 300 mm, tank supports shall have a minimum *fire-resistance rating* of 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 Division B of the British Columbia Building Code, and

b) Appendix A2 of CAN/ULC-S601, "Shop Fabricated Steel Aboveground Tanks for Flammable and Combustible Liquids."

4.3.3.3. Protection against Flooding

1) When aboveground *storage tanks* are located in an area that is subject 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

1) *Atmospheric* and *low pressure storage tanks* shall be provided with normal and emergency venting in conformance with

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) Except at *distilleries* covered in Section 4.10., vent piping materials and construction shall conform to Subsections 4.5.2., 4.5.3. and 4.5.5.

4.3.5.2. Location of Vent Pipe Outlets

1) Normal 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) Normal vent pipe outlets for *storage tanks* of 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.

3) Emergency vent outlets for *storage tanks* shall discharge outside *buildings* not less than 1.5 m from any *building* opening and from any combustible component of any *building*'s exterior wall.

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) Each connection to an aboveground *storage tank* through which the liquid can normally flow shall be provided with an internal or external shut-off valve located as close as practical to the shell of the tank.

2) Each connection to an aboveground *storage tank* that is below the liquid level and through which liquid does not normally flow shall be provided with a liquid-tight closing device.

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) A membrane providing the level of impermeability required in Clause (1)(b) shall

a) conform to CAN/ULC-S668, "Liners Used for Secondary Containment of Aboveground Flammable and Combustible Liquid Tanks," and

b) if it is combustible, be covered with a noncombustible material that will prevent the membrane from failing in the event that 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 Note A-4.1.6.1.(1).)

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* located in the contained space.

3) When the secondary containment is designed to prevent the entry of precipitation and water used for firefighting 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

1) Except as provided in Sentence (2), no part of a secondary containment wall shall be less than 1.5 m from a *storage tank* shell.

2) The distance required in Sentence (1) is permitted to be waived, provided the *storage tank*

a) has a capacity of not more than 80 000 L and is constructed in accordance with

i) Clauses 4.3.1.2.(1)(j), (k) or (m), incorporating secondary containment, or

ii) Clause 4.3.1.2.(1)(e) for double-walled *storage tanks*, or

b) conforms to ULC-S655, "Aboveground Protected Tank Assemblies for Flammable and Combustible Liquids."

3) Aboveground *storage tanks* shall be protected by posts or guardrails where they are exposed to potential collision damage.

4.3.7.5. Access to Storage Tanks and Ancillary Equipment

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 firefighting as specified in Article 4.3.2.4.

(See Note A-4.3.7.5.(1).)

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 Note A-4.3.7.5.(2).)

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 an internal visual examination, and the secondary containment is not sloped so as to permit liquid to flow to a specific location that can be monitored, a monitoring device shall be provided to indicate 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

c) 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. Construction

1) *Storage tanks* installed underground shall be of double-walled construction and shall be built in conformance with the underground *storage tank* standards identified in Sentence 4.3.1.2.(1).

4.3.8.2. Location

1) Underground *storage tanks* shall be located so that loads from *building* foundations and supports are not transmitted to the tank.

2) Underground *storage tanks* shall be separated by a horizontal distance of not less than

a) 600 mm from adjacent underground tanks or structures,

b) 1 m from a *building* foundation or a *street* line, and

c) 1.5 m from other property lines.

4.3.8.3. 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 provided there is not less than 600 mm of ground cover over the portion of the tank above adjacent ground level, or

b) 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.

4.3.8.4. Damage Repair

1) Underground *storage tanks* that are in the process of being installed shall be inspected, and any damage to the tank shell, protective coating, fittings or anodes shall be repaired before they are lowered into the excavation.

2) Damage to *storage tank* shells shall not be repaired on site.

4.3.8.5. 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 tank shell, protective coating, fittings or anodes.

2) Any method of handling that might result in damage to the protective coating of the tank shall not be used.

4.3.8.6. Installation

1) Underground steel *storage tanks* shall be installed in conformance with Appendix A of CAN/ULC-S603.1, "External 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 CAN/ULC-S615, "Fibre Reinforced Plastic Underground Tanks for Flammable and Combustible Liquids."

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 evenly distribute the weight of the tank on the supporting base.

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) Underground *storage tanks* shall be protected against hydrostatic forces which can cause the uplift of the tanks once they are empty. (See Note A-4.3.8.9.(1).)

2) Where anchors and ground straps are used to resist the 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 tank's shell, protective coating, fittings or anodes.

4.3.9. Sumps

4.3.9.1. Installation

1) A *dispenser sump* shall be provided under a dispenser, unless the dispenser is located on top of an aboveground *storage tank*.

2) A *spill containment sump* shall be provided at every underground *storage tank* fill point.

3) A *transition sump* shall be provided for all mechanical pipe connections located below *grade*.

4) A *turbine sump* shall be provided for all turbine pump assemblies located below *grade* or above *grade* where they are not readily visible.

5) In addition to the requirements of Article 4.3.9.2., the sumps referred to in Sentences (1) to (4) shall be installed in conformance with the sump manufacturer's instructions.

4.3.9.2. Construction

1) *Dispenser sumps* shall conform to the construction and performance requirements of ULC/ORD-C107.21, "Under-Dispenser Sumps."

2) *Spill containment sumps* shall conform to the construction and performance requirements of ULC/ORD-C58.19, "Spill Containment Devices for Underground Flammable Liquid Storage tanks."

4.3.9.3. Leak Detection Monitoring

1) Where *dispenser sumps*, *turbine sumps* and *transition sumps* referred to in Article 4.3.9.1. are used in underground applications, they shall be provided with an electronic monitoring device to indicate the presence of liquid.

4.3.10. Corrosion Protection of Underground Steel Storage Tanks

4.3.10.1. Corrosion Protection

1) Underground steel *storage tanks* and integral fittings subject to corrosion shall be

a) protected in conformance with CAN/ULC-S603.1, "External Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids," or

b) protected by impressed current in conformance with NACE SP0285, "External Corrosion Control of Underground Storage tank Systems by Cathodic Protection."

4.3.11. Vents for Underground Storage Tanks

4.3.11.1. 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.

4.3.11.2. Materials and Construction

1) Except at *distilleries* covered in Section 4.10., vent piping materials and construction shall conform to Subsections 4.5.2., 4.5.3. and 4.5.5.

4.3.11.3. 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.

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.

6) Vent piping shall be tested for leaks at the commissioning stage in conformance with Clause 4.4.1.2.(1)(a).

4.3.11.4. 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.

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.

4.3.12. Openings Other than Vents in Underground Storage Tanks

4.3.12.1. Connections

1) Connections for all openings in underground *storage tanks* shall be liquid- and vapour-tight.

4.3.12.2. 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.

4.3.12.3. 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) The fill point of an underground *storage tank* shall not be located higher than the discharge point of the tank's vent.

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 *storage 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*.

6) If a fill piping system has an offset component from the fill point on the *storage tank*, all fill pipes shall be

a) double-walled,

b) sloped to the *storage tank*, and

c) electronically monitored for leak detection in conformance with Section 4.4.

(See Note A-4.3.12.3.(6).)

7) Where the fill point is below the normal liquid level in the *storage tank*,

a) the fill line shall be equipped with a manual or automatic valve located at the fill point to prevent spillage when the fill cap is removed, and

b) if the *storage tank* contains *flammable liquids* or *combustible liquids*, the fill line drop tube shall be equipped with a method to prevent siphoning of the tank's content should a leak occur in the fill line.

4.3.13. Installation of Storage Tanks inside Buildings

4.3.13.1. Occupancy

1) Except as provided in Article 4.3.13.2., *storage tanks* inside *buildings* shall

a) conform to Subsections 4.3.13. to 4.3.15.,

b) be permitted in *industrial occupancies*, and

c) be permitted in all *occupancies* where *combustible liquids* are stored and used as fuel for oil-burning equipment, emergency generators and fire pumps.

4.3.13.2. 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."

4.3.13.3. 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.

4.3.13.4. 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 4.3.14., and

b) located in conformance with Tables 4.3.13.4.-A and 4.3.13.4.-B (see Note A-4.3.13.4.(1)(b)).

Table 4.3.13.4.-A
Indoor Tank Storage in Industrial Occupancies
Forming Part of Sentences 4.3.13.4.(1) and (2), and 4.3.13.8.(1)

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

Notes to Table 4.3.13.4.-A:
(1) See Subsection 4.3.14.
(2) See Article 4.2.7.6.

Table 4.3.13.4.-B
Indoor Tank Storage in Occupancies Using Oil-Burning Equipment, Emergency Generators and Fire Pumps
Forming Part of Sentences 4.3.13.4.(1) and 4.3.13.5.(1) and (2)

Class of Liquid	Storage Level	Quantity per Protected Storage Room[1], L	
		Individual Tank	Aggregate
Classes II and IIIA	*First storey*[2]	> 2 500[3]	200 000
		> 20 000[4]	
	Basement and *storeys* above the *first storey*	> 2 500[3]	20 000
		> 20 000[4]	45 000

Notes to Table 4.3.13.4.-B:
(1) See Article 4.2.7.6.
(2) For *industrial occupancies* where the tanks are located in a separate storage room from the equipment, refer to Table 4.3.13.4.-A.
(3) See Sentence 4.3.13.5.(1).
(4) See Sentence 4.3.13.5.(2).

2) When quantities greater than those 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 4.3.13.4.-A,

b) they are located on the *first storey*, and

c) the installation conforms to Articles 4.3.13.9. to 4.3.13.12. and Article 4.3.14.4.

4.3.13.5. Storage Tank Construction

1) *Storage tanks* with an individual capacity exceeding 2 500 L but not exceeding 20 000 L that are used in conformance with Table 4.3.13.4.-B shall be

a) of double-walled construction in conformance with Clause 4.3.1.2.(1)(e) or a minimum of 300 deg. secondarily contained construction, and

b) monitored for leakage in conformance with Sentence 4.4.2.1.(7).

2) *Storage tanks* with an individual capacity exceeding 20 000 L that are used in conformance with Table 4.3.13.4.-B shall

a) conform to Clause 4.3.1.2.(1)(l), and

b) be monitored for leakage in conformance with Sentence 4.4.2.1.(7).

4.3.13.6. Piping Systems

1) Piping systems serving oil-burning equipment, diesel-engine-driven emergency generators and fire pumps shall conform to CSA B139, "Installation Code for Oil-Burning Equipment."

4.3.13.7. Fire Compartments

1) *Fire compartments* regulated by this Subsection shall be separated from the remainder of the *building* by a *fire separation* having a *fire-resistance rating* of not less than 2 h.

4.3.13.8. Mixed Storage

1) When 2 or more classes of liquids are stored in a single storage room referred to in Sentence 4.3.13.4.(1), the total quantity permitted for each class of liquid shall be calculated as follows:

$$\frac{q_{I}}{Q_{I}} + \frac{q_{II\ +\ IIIA}}{Q_{II\ +\ IIIA}} \leq 1$$

where

q_I = the actual quantity of Class I liquids present,

$q_{II\ +\ IIIA}$ = the actual quantity of Class II and IIIA liquids present,

Q_I = the maximum quantity of Class I liquids permitted in Table 4.3.13.4.-A,

Qii + iiia = the maximum quantity of Class II and IIIA liquids permitted in Table 4.3.13.4.-A.

4.3.13.9. Storage Tanks outside Storage Rooms

1) Where *storage tanks* for *flammable liquids* or *combustible liquids* are located outside of storage rooms conforming to Subsection 4.3.14.,

a) provision shall be made to contain a spill equal to at least 100% of the volume of the largest *storage tank*, or to drain away spilled *flammable liquids* or *combustible liquids*, and

b) the area in which the *storage tanks* are located shall be ventilated (see Note A-4.3.13.9.(1)(b)).

4.3.13.10. Vents

1) Except as provided in Sentence (2), normal and emergency vents for *storage tanks* in *buildings* shall be provided in conformance with Subsections 4.3.4. and 4.3.5. (See Note A-4.3.13.10.(1).)

2) The use of weak roof-to-side shell seams, designed to rupture before the allowable design stress of the *storage tank* is reached, shall not be permitted as a means of emergency venting of *storage tanks* inside *buildings*.

4.3.13.11. Supports, Foundations and Anchorage

1) Except as provided in Sentence (2), where *storage tanks* for *flammable liquids* or *combustible liquids* are installed inside *buildings*, the supports, foundations and anchorage for such *storage tanks* shall be in conformance with Subsection 4.3.3.

2) Where a *storage tank* is suspended, rather than supported on a foundation, supports shall be designed and installed in conformance with good engineering practice. (See Note A-4.3.13.11.(2).)

4.3.13.12. Bonding and Grounding

1) Where *storage tanks* for *flammable liquids* or *combustible liquids* are installed inside *buildings*, tanks, piping and discharge equipment shall be bonded and grounded.

4.3.14. Rooms for Storage Tanks

4.3.14.1. Design and Construction

1) Rooms for *storage tanks* inside *buildings*, referred to in Sentence 4.3.13.4.(1), shall be

a) separated from the rest of the *building* by a *fire separation* having a *fire-resistance rating* of at least 2 h,

b) designed to contain a spill equal to at least 100% of the volume of the largest *storage tank*, or to drain away spilled *flammable liquids* or *combustible liquids*,

c) made liquid-tight where the walls join the floor, and

d) used for no other purposes than the storage and handling of *flammable liquids* or *combustible liquids*.

4.3.14.2. Clearances

1) A minimum clear space of 550 mm shall be maintained between the walls of a room described in Article 4.3.14.1. and the sides of any *storage tanks* within the room.

4.3.14.3. Explosion Venting

1) Where Class IA or IB liquids are dispensed within a storage room, the room shall be designed to prevent critical structural and mechanical damage from an internal explosion in conformance with NFPA 68, "Explosion Protection by Deflagration Venting." (See Note A-3.2.8.2.(1)(d).)

4.3.14.4. Hose Stations and Portable Extinguishers

1) In *buildings* not required to be equipped with a standpipe and hose system by the British Columbia Building Code, hose stations shall be provided in the vicinity of the storage room, such that all parts of the room are within reach of a hose stream. (See Note A-4.3.14.4.(1).)

2) Portable extinguishers for Class B fires shall be provided.

4.3.14.5. Placards

1) Placards conforming to Article 3.2.7.14., identifying the liquids stored as *flammable liquids* or *combustible liquids* and the capacities of the *storage tanks*, shall be posted in a conspicuous location outside of the room, and that information shall be included in the fire safety plan required in Article 4.1.5.5.

4.3.15. Openings Other than Vents in Storage Tanks inside Buildings

4.3.15.1. Connections

1) Connections for all openings in *storage tanks* in *buildings* shall be liquid- and vapour-tight.

2) Connections to *storage tanks* through which liquid can flow shall be provided with valves located as close as practicable to the tank.

4.3.15.2. Openings for Liquid Level Measurement

1) Openings that are independent of the fill pipe and are used for measuring the liquid level in *storage tanks* containing Class I or II liquids shall be equipped with a vapour-tight cap which shall be opened only when measuring the liquid level.

2) Openings referred to in Sentence (1) shall be protected against overflow and vapour pressure by means of a spring-loaded check valve.

4.3.16. Out of Service

4.3.16.1. Underground Storage Tanks

1) The removal, abandonment in place, disposal or temporary taking out of service of an underground *storage tank* shall be in conformance with good engineering practice. (See Note A-4.3.16.1.(1).)

4.3.16.2. Aboveground Storage Tanks

1) When an aboveground *storage tank* will be out of service or unsupervised for a period not exceeding 180 days, the piping from the tank shall be capped or the valves that are necessary to achieve similar isolation of the tank shall be closed and securely locked.

2) Where a *storage tank* referred to in Sentence (1) contains *flammable liquids* or *combustible liquids*, the liquid level in the tank shall be measured and compared with subsequent readings taken at intervals not greater than one month.

3) When an aboveground *storage tank* will be out of service or unsupervised for a period exceeding 180 days, all liquid and vapours shall be removed from the *storage tank* and its connected piping.

4.3.16.3. Disposal

1) Where a *storage tank* is to be permanently disposed of, sufficient openings shall be cut in the tank to render it unfit for further use.

4.3.16.4. Underground Piping Systems

1) The removal, abandonment in place, disposal or temporary taking out of service of an underground piping system shall be in conformance with good engineering practice. (See Note A-4.3.16.1.(1).)