Section 4.5. Piping and Transfer Systems

4.5.1. Scope

4.5.1.1. Application

1) This Section applies to piping and transfer systems for *flammable liquids* and *combustible liquids*.

2) Except where otherwise stated in this Part, this Section shall not apply to the following:

a) tubing or casings and piping for oil or gas wells,

b) transmission pipelines,

c) piping for vehicles, aircraft, watercraft and portable or stationary engines,

d) piping systems in *fuel-dispensing stations* and *distilleries*, and

e) piping that falls within the scope of the applicable provincial or territorial codes regulating boilers and *pressure vessels*.

4.5.2. Materials for Piping, Valves and Fittings

4.5.2.1. Materials

1) Materials for piping systems containing *flammable liquids* or *combustible liquids* shall be suitable for the maximum anticipated working pressures and operating temperatures and for the chemical properties of the contained liquid.

2) Except as provided in Sentence (3), the use of the following materials for piping systems referred to in Sentence (1) shall not be permitted:

a) materials that are subject to failure from internal stress or rupture by mechanical damage, or

b) combustible or low-melting-point materials that are subject to failure even in moderate fires.

3) Non-metallic piping systems are permitted to be used for underground installations, provided they conform to CAN/ULC-S660, "Nonmetallic Underground Piping for Flammable and Combustible Liquids."

4) Metallic piping systems are permitted to be used for underground installations, provided they conform to CAN/ULC-S667, "Metallic Underground Piping for Flammable and Combustible Liquids."

5) Except as provided in Sentence (6), where steel piping is used, it shall conform to

a) API 5L, "Line Pipe,"

b) ASTM A 53/A 53M, "Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless," or

c) CSA Z245.1, "Steel Pipe."

6) Where service pressures exceeding 875 kPa (gauge) may occur, piping and fittings shall be designed in conformance with ASME B31.3, "Process Piping."

7) Underground piping systems shall include piping in tank sumps, *transition sumps* and *dispenser sumps*.

4.5.2.2. Special Materials

1) Where problems of corrosion, contamination, or sanitation or standards of purity require special materials, it is permitted to use non-metallic materials for piping, valves and fittings in conformance with Clause 1.2.1.1.(1)(b) of Division A.

4.5.3. Corrosion Protection of Piping Systems

4.5.3.1. Corrosion Protection

1) Underground metallic piping systems in contact with the soil or groundwater shall be protected against corrosion in conformance with

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

b) NACE SP0169, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems."

4.5.4. Identification of Piping Systems

4.5.4.1. Identification

1) Pipelines for *flammable liquids* or *combustible liquids* shall be marked with the contents of the line, and these markings shall be maintained in a clearly legible form.

2) Piping for *flammable liquids* or *combustible liquids* shall not be painted red.

3) Transfer points in piping systems for *flammable liquids* and *combustible liquids* shall be identified in conformance with CFA 1990, "Using the Canadian Fuels Colour-Symbol System to Mark Equipment and Vehicles for Product Identification."

4.5.4.2. Documentation

1) Documentation on the piping systems for *flammable liquids* or *combustible liquids*, including the tank and pumping arrangements, shall be made available to the fire department upon request.

2) Documents referred to in Sentence (1) shall be kept at two separate locations so that one copy remains readily available in the event the other is inaccessible due to fire.

4.5.5. Joints in Piping Systems

4.5.5.1. Threaded Joints

1) Threaded joints in piping systems for *flammable liquids* or *combustible liquids* shall be made using joint compound or polytetrafluoroethylene tape conforming to CAN/ULC-S642, "Compounds and Tapes for Threaded Pipe Joints."

4.5.5.2. Welded Piping

1) Welding of piping for *flammable liquids* or *combustible liquids* shall conform to Section 5.2. and to the appropriate provincial or territorial regulations or municipal bylaws, or in the absence of such regulations, to API 1104, "Welding of Pipelines and Related Facilities."

2) Flanged joints for piping shall be provided in welded systems at intervals that will facilitate dismantling and avoid subsequent in-place cutting and welding operations.

4.5.5.3. Flanged Joints

1) Except as permitted in Sentence (2), flanged joints for piping shall be made with forged or cast steel flanges designed, constructed and installed in conformance with ASME B16.5, "Pipe Flanges and Flanged Fittings: NPS ½ Through NPS 24 Metric/Inch Standard."

2) Bronze flanges for 50 mm diameter or smaller size piping referred to in Article 4.5.5.2. are permitted to be used where copper and brass piping is permitted.

4.5.5.4. Bolting Materials

1) Bolting materials for flanged connections in steel piping systems for *flammable liquids* or *combustible liquids* shall be of alloy steel equivalent to ASTM A 193/A 193M, "Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications," Grade B-7.

4.5.5.5. Gaskets

1) Gaskets in flanged connections shall be of a material resistant to the liquid being carried and capable of withstanding temperatures of at least 650°C without damage that would impair their function.

4.5.5.6. Mechanical Connections

(See Note A-4.5.5.6.)

1) Mechanical connections in underground piping systems shall

a) be readily accessible for inspection and maintenance,

b) not be in direct contact with the soil, and

c) be provided within a *transition sump*.

4.5.5.7. Penetrations into Sumps

1) All penetrations into a sump shall be situated at least 50 mm from the bottom of the sump. (See Note A-4.5.5.7.(1).)

4.5.6. Location and Arrangement of Piping

4.5.6.1. Construction

1) Except for vent risers and vertical fill piping systems, underground piping systems shall be of double-walled construction.

4.5.6.2. Location

1) Piping shall be installed outdoors whenever possible and located so it will not create a hazard to *buildings* or equipment.

2) Where piping for *flammable liquids* or *combustible liquids* is installed within a *building*, the length of piping shall be as direct and as short as practicable.

3) It is not permitted to use any portion of a piping system in a manner that could damage it or for any purpose other than the transfer of product.

4) Vent piping and connections for filling and emptying *storage tanks* shall be located in conformance with Section 4.3.

4.5.6.3. Supports for Aboveground Outdoor Piping

1) Aboveground outdoor piping shall be supported and arranged to prevent excessive vibration and stress on equipment connected to it.

2) Where vehicular, watercraft or floatplane impact or physical damage is possible, protective guarding devices shall be provided for aboveground outdoor piping.

3) Aboveground piping systems shall be supported such that they are not in direct contact with the surface of the ground.

4.5.6.4. Arrangement of Aboveground Outdoor Piping

1) Aboveground outdoor piping shall not be located

a) on the exterior of walls except on those of *noncombustible construction*, or

b) above windows.

2) Aboveground outdoor piping shall not be located above roofs except above roofs of impermeable and *noncombustible construction*, with provision for accidental spillage provided in conformance with Subsection 4.1.6.

3) Where aboveground piping crosses roadways or railway sidings, ample overhead clearance and warning signs indicating the clearance height shall be provided.

4) Piping passing though the secondary containment walls of an aboveground *storage tank* shall be designed to prevent excessive stress resulting from settlement or fire exposure.

4.5.6.5. Arrangement of Underground Piping

1) Underground piping shall be located so it will not be damaged as a result of vibrations or settling of an adjacent *building* or structure.

2) Underground piping shall be located not less than 300 mm away from the foundations of any *building* or structure, except where such piping enters the *building* as permitted in Article 4.5.6.8.

3) Piping passing under railway tracks shall be installed in conformance with TC 2001, "Standards Respecting Pipeline Crossings Under Railways."

4) Piping adjacent to railway tracks shall be installed in conformance with TC General Order No. O-32, C.R.C., c1148, "Flammable liquids Bulk Storage Regulations."

4.5.6.6. Installation of Underground Piping

1) Underground piping shall be

a) supported on

   i) undisturbed or compacted soil, or

   ii) not less than 150 mm of clean sand, pea gravel or clean crushed stone, and

b) backfilled on the top and sides with not less than

   i) 300 mm of pea gravel or clean crushed stone, or

   ii) 300 mm of clean sand, free of cinders and stones, and compacted in layers not more than 300 mm thick.

4.5.6.7. Piping in Service Tunnels

1) Piping for *flammable liquids* or *combustible liquids* shall not be located in service tunnels that are used for pedestrian traffic other than maintenance personnel.

4.5.6.8. Piping at Entrances to Buildings

1) Piping for *flammable liquids* or *combustible liquids* shall be located aboveground where the piping enters a *building*.

2) Piping referred to in Sentence (1) shall be provided with inside and outside shut-off valves.

3) Where piping referred to in Sentence (1) passes through a wall that would restrict the expansion or contraction of the piping, pipe sleeves shall be provided at the wall penetration to facilitate such movement.

4.5.6.9. Indoor Piping

1) Indoor piping for *flammable liquids* or *combustible liquids* shall either be supported overhead or be located in trenches conforming to Article 4.5.6.10.

2) Piping referred to in Sentence (1) shall not be installed under combustible flooring.

3) Piping in trenches referred to in Sentence (1) shall be covered with noncombustible material.

4.5.6.10. Piping in Trenches

1) Where indoor piping for *flammable liquids* or *combustible liquids* is installed in trenches, a trapped drainage system shall be provided.

2) When piping referred to in Sentence (1) contains Class I liquids, the trench shall be provided with ventilation designed to prevent the accumulation of flammable vapours in accordance with Sentence 6.9.1.2.(2) of Division B of the British Columbia Building Code.

4.5.6.11. Overhead Piping

1) Overhead piping for *flammable liquids* or *combustible liquids* shall be installed close to the ceiling or beams or along walls not less than 1.8 m above the floor to protect it against mechanical damage.

2) Where practicable, overhead piping referred to in Sentence (1) shall be supported from *building* framing members.

3) In *buildings* of steel frame construction, piping referred to in Sentence (1) shall be fastened to steel beams or columns by pipe hangers attached to the flanges.

4) Piping under concrete ceilings shall be suspended with the use of through bolts or expansion shields.

4.5.6.12. Supports for Overhead Piping

1) Piping shall be supported on pipe hangers or other supports so that allowable stresses in the pipe are not exceeded. (See Note A-4.5.6.12.(1).)

2) Anchors of the expansion shield type used to suspend piping shall not be used to suspend piping from unsound or lightweight concrete or from gypsum assemblies.

4.5.6.13. Protection of Pipe Risers

1) Exposed pipe risers shall be protected against mechanical damage by

a) installing such risers

i) adjacent to walls or pilasters,

ii) between flanges of steel columns, or

iii) within securely anchored larger perforated pipe, and

b) providing mechanical guards where the risers are exposed to mobile equipment.

4.5.6.14. Provision for Expansion and Contraction

1) In the design of piping systems for *flammable liquids* or *combustible liquids*, provision shall be made for the expansion and contraction of the piping system and of the product it conveys.

2) To prevent excessive stresses resulting from vibration, settling or temperature changes

a) flexible non-metallic hose connectors conforming to CAN/ULC-S633, "Flexible Underground Hose Connectors for Flammable and Combustible Liquids," are permitted to be used where necessary in underground piping systems carrying *flammable liquids* or *combustible liquids*,

b) flexible non-metallic pipe and fittings conforming to CAN/ULC-S660, "Nonmetallic Underground Piping for Flammable and Combustible Liquids," are permitted to be used where necessary in underground piping systems carrying *flammable liquids* or *combustible liquids*,

c) flexible metallic pipe and fittings conforming to CAN/ULC-S667, "Metallic Underground Piping for Flammable and Combustible Liquids," are permitted to be used where necessary in underground piping systems carrying *flammable liquids* or *combustible liquids*, or

d) flexible metallic hose connectors conforming to ULC/ORD-C536, "Flexible Metallic Hose," are permitted to be used where necessary in aboveground and underground piping systems carrying *flammable liquids* or *combustible liquids*.

4.5.7. Valves in Piping Systems

4.5.7.1. Design

1) Except as provided in Sentences (2) and (3), valves in piping systems for *flammable liquids* or *combustible liquids* shall be designed to accommodate the temperatures and pressures of those systems and shall conform to ULC/ORD-C842, "Guide for the Investigation of Valves for Flammable and Combustible Liquids."

2) Every hose nozzle valve shall conform to CAN/ULC-S620, "Hose Nozzle Valves for Flammable and Combustible Liquids."

3) Every emergency valve shall conform to ULC-S651, "Emergency Valves for Flammable and Combustible Liquids."

4.5.7.2. Shut-off Valves

1) Shut-off valves shall be provided in all *flammable liquid* or *combustible liquid* piping and pumping systems.

2) Where practicable, valves referred to in Sentence (1) shall be located outdoors or be immediately accessible from outdoors.

3) Except as permitted in Sentence (4), steel shut-off valves shall be provided

a) at connections to all aboveground *storage tanks*,

b) on supply piping where it enters *buildings* or structures,

c) on branch lines from the main supply line,

d) on supply lines at dispensing locations,

e) to isolate one part of a piping system from another, and

f) to isolate meters and air eliminators.

4) Stainless steel, monel metal or lined steel bodied valves are permitted to be used when special conditions warrant their use.

4.5.7.3. Diaphragm Valves

1) Diaphragm valves shall have no direct connections between the liquid and air sections that might permit leakage of the liquid past the packing into the air lines.

4.5.7.4. Globe Valves

1) Globe valves shall be arranged so that the packing is on the low pressure side.

4.5.7.5. Indicating Valves

1) Rising stem or other indicating valves shall be used where necessary to determine whether the valves are open or shut.

4.5.7.6. Identification

1) All valves shall be identified in conformance with CFA 1990, "Using the Canadian Fuels Colour-Symbol System to Mark Equipment and Vehicles for Product Identification."

2) Every identification tag shall be kept clean so that its colour and inscription are easily recognizable.

4.5.8. Heating of Piping Systems

4.5.8.1. Design

1) Heating equipment for piping systems containing *flammable liquids* or *combustible liquids* shall be designed not to overheat or create an ignition source for the liquids being heated.

4.5.8.2. Steam Heating

1) *Flammable liquid* and *combustible liquid* piping is permitted to be heated by steam lines provided the minimum steam temperature and pressure to make the liquid fluid are used and Sentences (2) and (3) are complied with.

2) A pressure regulator shall be provided in the steam line with a relief valve on the downstream side of the regulator.

3) Piping and steam lines shall be enclosed in insulation conforming to the British Columbia Building Code.

4.5.8.3. Electrical Heating Cables

1) Electrical heating cables including electrical induction heating shall conform to Subsection 4.1.4.

4.5.8.4. Thermal Electrical Conduction Heating

1) Thermal electrical conduction heating conforming to Sentence (2) is permitted to be used by passing a low-voltage alternating current through the pipe.

2) Systems permitted in Sentence (1) shall be installed and tested as complete units and shall conform to the following:

a) unheated sections of piping shall be isolated from heated sections by means of nonconductive fittings,

b) thermostatic controls, high temperature limit controls and fuses shall have the lowest practical rating to ensure satisfactory operation,

c) all parts of the piping and fittings shall be enclosed by insulating coverings of a type that will prevent accidental grounding of the systems, and

d) switches, transformers, contactors and other spark-producing equipment shall be located in an area not subject to flammable vapours.

3) Upon completion of installation, systems permitted in Sentence (1) shall be tested to ensure that all components are functioning as intended.

4.5.8.5. Open Flames

1) The use of open flames as a heat source shall not be permitted for heating piping for *flammable liquids* or *combustible liquids*.

4.5.9. Methods of Transfer in Piping Systems

4.5.9.1. Location of Outdoor Pumps

1) Pumps for *flammable liquid* or *combustible liquid* piping systems installed aboveground and outside of *buildings* shall be located not less than

a) 3 m from the property line, and

b) 1.5 m from *building* openings.

4.5.9.2. Pump Houses and Pump Rooms

1) Pumps located indoors shall be in rooms built in conformance with Subsection 4.2.9. (See Note A-4.5.9.2.(1).)

2) Pump houses and pump rooms shall not be used for any purpose other than to serve the pumping equipment.

4.5.9.3. Pits

1) Pits for subsurface pumps for piping systems or for piping connected to submersible pumps shall be designed to withstand the forces to which they may be subjected without causing damage to the system.

2) Pits provided in conformance with Sentence (1) shall not be larger than necessary for inspection and maintenance and shall be provided with a cover.

4.5.9.4. Control Switches

1) Pumps for piping systems shall be provided with duplicate control switches to shut down the pumps in case of emergency, with one located in the operating area and the other at a remote location.

4.5.9.5. Hydraulic Transfer Systems

1) Where *flammable liquids* or *combustible liquids* are transferred by water pressure as a result of displacement, such system shall not be used for liquids that are miscible in water.

2) All *pressure vessels* for hydraulic transfer systems referred to in Sentence (1) shall be constructed, installed and tested in conformance with ASME BPVC-2013, "Boiler and Pressure Vessel Code."

3) Hydraulic transfer systems referred to in Sentence (1) shall be designed to prevent water pressure in excess of the design pressure of the tank or piping.

4) Operating pressures shall be controlled by a constant-level float valve or a pressure-regulating valve on the water supply side of the hydraulic transfer system referred to in Sentence (1).

5) Hydraulic transfer systems referred to in Sentence (1) shall be arranged so that there is no water pressure on the system except when liquid is being discharged.

6) Check valves shall be provided for both water and *flammable liquid* or *combustible liquid* piping to prevent backflow in hydraulic transfer systems referred to in Sentence (1).

4.5.9.6. Inert Gas Transfer Systems

1) Where *flammable liquids* or *combustible liquids* are transferred as a result of displacement by the expansion of nitrogen, carbon dioxide or other inert gases, all *pressure vessels* involved shall be constructed, installed and tested in conformance with ASME BPVC-2013, "Boiler and Pressure Vessel Code."

2) Pressure regulators for inert gas transfer systems referred to in Sentence (1) shall be provided in the gas line to control the pressure of the gas at the minimum pressure required to force the liquid through the piping system at the required rate.

3) A relief valve with a slightly higher setting than the pressure required in Sentence (2) shall be provided on the downstream side of the regulator or on the tank.

4) Means of automatically shutting off the gas supply and bleeding the gas pressure in the event of fire shall be provided on all inert gas transfer systems referred to in Sentence (1).

4.5.9.7. Non-Inert Gas Transfer

1) Except as permitted in Sentence (2), the transfer of *flammable liquids* or *combustible liquids* in a closed piping system by means of compressed air or other non-inert gas pressure shall not be permitted.

2) A non-inert gas pressure is permitted to be used in a closed piping system referred to in Sentence (1) provided

a) it is the vapour or gas of the *flammable liquid* or *combustible liquid* being transferred, or

b) it is a vapour or gas that will not support combustion reaction and is non-reactive with the *flammable liquid* or *combustible liquid* being transferred.

4.5.10. Operating Procedures for Piping Systems

4.5.10.1. Procedures

1) Standard procedures for normal operation and for emergencies shall be given in printed form to all employees engaged in the operation of equipment for the transfer of *flammable liquids* or *combustible liquids* and shall be posted for convenient reference.

4.5.10.2. Training

1) All employees concerned with transfer operations involving *flammable liquids* or *combustible liquids* shall be trained in

a) the procedures referred to in Article 4.5.10.1.,

b) the importance of constant attendance during all loading or unloading operations,

c) extinguishing procedures for fires involving *flammable liquids* and *combustible liquids*, and

d) the *flammable liquid* and *combustible liquid* colour coding and identification system required in Article 4.5.7.6.

2) Employees engaged in the operation of equipment for the transfer of *flammable liquids* or *combustible liquids* shall be trained in the location, function and operation of valves used for the operation of fire protection equipment and manual emergency shut-off valves.

4.5.10.3. Emergency Valves

1) Signs indicating the location of valves used for the operation of fire protection equipment and manual emergency shut-off valves shall be posted in conspicuous locations.

4.5.10.4. Portable Extinguishers

1) At least one portable extinguisher having a rating of 80-B:C shall be provided in the vicinity of pumps and ancillary equipment used for the transfer of *flammable liquids* or *combustible liquids*.

4.5.10.5. Visual Inspections

1) A visual inspection routine for the prompt detection of obviously abnormal conditions shall be established and shall be performed at least once each shift.

2) A visual inspection shall be made at least once during each day of operation of all aboveground piping systems, pumps and other ancillary equipment, to detect leakage, and any leakage shall be repaired as quickly as practicable.

3) Where necessary, flammable vapour indicators shall be used to detect leakage.

4) Open flames and spark-producing devices shall not be used for leakage detection referred to in Sentence (2).

4.5.10.6. Operational Tests

1) To ensure proper operation, frequent inspections and tests shall be made of all safety shut-off valves and other fire safety devices, with particular attention directed to normally open, fusible-link-operated valves, float valves and automatic controls.

4.5.10.7. Maintenance

1) Except as provided in Sentence (6), maintenance shall not be carried out on piping systems while they are under pressure.

2) If connections or piping are to be opened, the system shall be drained of *flammable liquids* and *combustible liquids*.

3) Where equipment for handling *flammable liquids* or *combustible liquids* has to be repaired, it shall be removed and taken to maintenance areas when possible.

4) Tags shall be attached to all valves on piping systems that are shut off for maintenance purposes to indicate that such valves are not to be opened.

5) Piping that has been used for the transfer of *flammable liquids* or *combustible liquids* shall be removed or capped when it is no longer intended to be used.

6) The maintenance of pressurized piping systems shall be carried out in conformance with good engineering practice. (See Note A-4.5.10.7.(6).)