Nova Scotia Standards for Construction and Installation for Petroleum Storage Tank Systems

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I. PURPOSE:

(a) The purpose of these Standards is to provide instructions for the construction, installation and operation of new or relocated petroleum storage tank systems.

(b) These Standards replace a similar document issued in July, 1991.

II. LEGISLATION:

(a) Section 2(z) of the *Petroleum Management Regulations* (2002-139) reads as follows:

"Standard" means a document produced by the Department entitled *Nova Scotia Construction, Installation and Operational Standards for Petroleum Storage Tank Systems*, as amended from time to time and available from the Department,.

(b) Section 6(1) of the *Petroleum Management Regulations* (2002-139) reads as follows:

A person responsible for, or a person who constructs, installs, or alters, a new or relocated storage tank system shall meet the minimum requirements set forth in the Standard.

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Scope

(1) The procedures outlined in this guideline shall identify the minimum construction and installation requirements for petroleum storage tank systems installed in Nova Scotia. This standard shall be used by both tank installers and inspectors to ensure all storage tank systems are installed in accordance with the *Petroleum Management Regulations*.

(2) This standard adopts the *National Fire Code of Canada*, 1995. Where this standard and the *National Fire Code* are deemed to conflict, the most stringent will prevail.

(3) All new installations must conform with the *Nova Scotia Guidelines for Site Sensitivity Determination for Petroleum Storage, Tank Installations*, 1997 edition.

(4) Installation requirements may be varied if:

(a) equal or superior requirements are specified by the manufacturer of the equipment;

(b) variance does not contravene the *Petroleum Management Regulations*;

(c) variance does not contravene the *National Fire Code*; and

(d) variance is approved in writing by an inspector or an Administrator before the installation begins.

PART A - ABOVEGROUND PETROLEUM STORAGE SYSTEMS

1. INTRODUCTION

Nova Scotia Environment and Labour must review for registration the application for any installation of an aboveground tank system having a capacity of 4000 litres (880 gal imp) or greater.

1.1 Prohibition

New aboveground petroleum storage facilities in excess of 25,000 litres (5500 gal Imp) shall not be constructed:

(a) within a 100 year floodplain, unless suitably elevated to prevent flooding; or

(b) within 300 metres (1000 ft) of surface water body which forms part of watershed used for municipal drinking water; or

(c) within 300 metres (1000 ft) of a major industrial or municipal well; or

(d) within a designated ecologically sensitive area.

2. GENERAL

2.0 (a) All new tank installations must meet the minimum requirements of the *National Fire Code* (NFC), latest edition. Interpretation of the Fire Code shall be provided by the Fire Marshal, Nova Scotia Environment and Labour, or their duly authorized representatives.

(b) All new or upgraded tank installations must have secondary containment.

(c) All portions of these systems which are underground must conform with the standards for underground storage tank systems.

(d) All storage tanks, components and accessories for which there is either a ULC Standard or Other Recognized Document (ORD) shall be certified by ULC.

2.1 Standards for Shop Fabricated Tanks

2.1.1 All such tanks shall be constructed, shop tested and installed in

accordance with:

(a) National Standard of Canada CAN4/ULC - S601, "Standard for Shop Fabricated Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids", latest edition; or

(b) National Standard of Canada CAN4/ULC - S630, "Standard for Shop Fabricated Steel Aboveground Vertical Tanks for Flammable and Combustible Liquids", latest edition; or

(c) ULC-S652, "Standard for Tank Assemblies for Collection of Used Oil"; or

(d) ULC-S653, "Standard for Aboveground Steel Contained Tank Assemblies for Flammable and Combustible Liquids"; or

(e) ULC/ORD-C142.3, "Contained Steel Aboveground Tank Assemblies for Flammable Liquids"; or

(f) ULC/ORD-C142.5, "Concrete Encased Steel Aboveground Tank Assemblies for Flammable and Combustible Liquids"; or

(g) ULC/ORD-C142.16, "Protected Aboveground Tank Assemblies for Flammable and Combustible Liquids"; or

(h) ULC/ORD-C142.23, "Aboveground Waste Oil Tanks"; or

(i) other recognized ULC standards.

2.1.2 When there is deemed to be a conflict between the provisions of the Nova Scotia Standard and the referenced document, the most stringent will apply.

2.2 Standard for Field Erected Tanks

All such tanks shall be constructed in accordance with American Petroleum Institute (API) Standard 650, "Welded Steel Tanks for Oil Storage", latest edition.

2.3 Vertical Tanks

2.3.1 (1) All such tanks on a prepared earthen pad shall include the following:

(a) Secondary containment

(b) A leak detection system which is ULC approved or is acceptable to an Administrator. An example is given in API Standard 650 Appendix I

(c) The support base must be constructed of compacted, clean free-draining granule material such as sand, gravel or crushed stone. The use of cinders, organic material and clays is prohibited. The soil pH must be neutral or alkaline.

(d) The support base must be constructed so as to provide for positive drainage of water away from the base.

(e) The support base must be constructed so as to leave a minimum of 250 mm (10 inches) above the general grade (dyke floor) after ultimate settlement.

(f) The exterior of the tank's base must be suitably prepared and coated with a corrosion resistant material and cathodically protected unless the total tank lot is protected with a fabricated membrane liner which is suitable for the product being stored. If cathodic protection is used, test wires must be connected to a test station at an accessible location.

(2) All such tanks on an impermeable base shall include the following:

(a) The support base shall be constructed so as to provide for positive drainage of water away from the base.

(b) The surface of the support base shall be covered with a mastic or sealant material prior to placement of the tank.

(c) The exterior of the base of the tank must be suitably prepared and coated with a corrosion resistant material.

(d) The base of the tank must be cathodically protected unless the pad is constructed of reinforced concrete and is coated with a sealant or the total tank lot is protected with a fabricated membrane liner which is suitable for the product being stored.

2.4 Horizontal Tanks

All such tanks must be mounted on a fire proof cradle which is so constructed to allow water to drain away from the tank and its supports. If the cradle is not an intrinsic part of the tank assembly (i.e., permanently attached), a rubber gasket must be placed between the cradle and the tank to prevent corrosion at the contact point.

The cradle for any such tank used for storage at a fixed location in excess of thirty days must be supported on a concrete base or equivalent.

2.5 Tank Level Sensing/Alarms

2.5.1 All tanks must have a mechanism to allow for measuring the amount of product in the tank. Dipping access will be sufficient.

2.5.2 All shop fabricated tanks, regardless of capacity, shall have overfill protection in the form of:

(a) an overfill protection device, compatible with the intended method of filling, that is designed, built and certified in conformance with ULC/ORD-C58.15, "Overfill Protection Devices for Flammable Liquid Storage Tanks"; or

(b) a system that, upon detecting high levels in the storage tank, will automatically shutdown the filling process or divert incoming flow to another vessel; or

(c) an audible and visual alarm indicating at a location where personnel are constantly on duty during product transfer operations and can divert or halt the flow of product.

2.5.3 Tanks having a capacity of 50,000 litres (11,000 gal Imp) or greater must have a high-level alarm system.

2.5.4 Tanks located in sensitive areas (Class A sites as described in *"Guidelines for Site Sensitivity Determination for Petroleum Storage Tank Installations"*) having a capacity of 50,000 litres (11,000 gal Imp) or greater must have an automatic shut down or a product diversion system. The high level alarms shall consist of both audible and visual alarms. These must indicate at a location where personnel are constantly on duty during product transfer operations and can divert or halt the flow of product.

3. SECONDARY CONTAINMENT

General

(1) All aboveground storage systems shall have secondary containment.

(2) Field-erected storage systems shall:

(a) if consisting of a single wall and single-bottom tank, be placed entirely within a dyked area, with a continuous impermeable barrier in the floor of the containment area and in the dyke walls; or

(b) if consisting of a single-wall, double-bottom tank, be placed entirely within a dyked area, with a continuous impermeable barrier in the floor of the containment area around the tank and in the dyke walls, but not underneath the storage tank. The impermeable barrier must be bonded to the tank. The interstitial space between the tank bottom layers shall be equipped with a ULC-approved leak detection system.

(3) Shop-fabricated storage systems having a single or combined capacity greater than 4000 L (880 gal Imp) shall have a secondary containment system in conformance with Sections 3.1 or 3.2.3.

3.1 Dykes

3.1.1 Field erected aboveground tanks shall be surrounded by a containment dyke with a minimum height of 600 mm (24 in) and constructed as follows:

(a) where a dyked area contains one storage tank, the dyked area shall retain not less than 110% of the capacity of the tank;

(b) where a dyked area contains more than one storage tank, the dyked area shall retain not less than 110% of the capacity of the largest tank or 100% of the capacity of the largest tank plus 10% of the aggregate capacity of all the other tanks, whichever is greater;

(c) where earthen walls 1m or more in height are used, the walls shall have a flat section on top not less than 600 mm (24 in) wide. The slope of the earthen wall shall not be less than 2 horizontal to 1 vertical;

(d) the base and walls of the dyke shall have an impermeable lining of clay, concrete, solid masonry or other material designed,

constructed and maintained to be liquid tight to a permeability of 10^{-6} cm/sec under a hydraulic head of 3 m;

(e) where the lining system is a reinforced flexible membrane it will be manufactured and installed in accordance with ULC standards;

(f) a method for the elimination of water accumulations inside the dyke shall be incorporated in the dyke design and construction;

(g) dyke floors shall be constructed and sloped to allow water to drain away from the storage tank and its supports;

(h) permanent stairways or ladders over the dyke shall be provided and maintained to allow access to the interior of the dyke;

(i) spacing between tanks and dyke walls must meet requirements of the *National Fire Code*;

(j) any piping passing from the inside to the outside of the dyked area shall pass over the dyke and be suitably supported to prevent undue stress and rupture. Pipes can be passed through the dyke providing adequate steps are taken to prevent seepage of spilled product and excess forces being exerted on the piping (ie. installation of a cut-off wall);

(k) all loading and unloading areas, delivery racks, etc shall be constructed outside of the dyked area. No provision shall be made to allow traffic inside the dyked area.

3.1.2 (1) (a) Earthen dykes shall be coated with gravel or asphalt to prevent erosion.

(b) Weed control shall be required to prevent degradation of barrier integrity.

(2) Concrete dykes shall be inspected yearly for frost damage or cracks and repaired promptly if problems are discovered.

3.2 **Impermeable Barriers**

(1) An impermeable barrier shall consist of steel plate, synthetic membrane liner, concrete, prepared soil barrier or other approved material whose function is to prevent the passage of spilled or leaked petroleum products. The barrier must have a permeability to water of 1×10^{-6} cm/s or less under a 3 m (10 ft) static head. The

barrier's composition must be fully compatible with petroleum products and resistant to degradation.

(2) Concrete impermeable barriers shall:

(a) be designed and installed according to good engineering practices to meet the expected loading without fracturing;

(b) have expansion joints located at least every 6m (20 ft);

(c) have expansion joints sealed with a sealant that is compatible with the products being stored;

(d) be resistant to degradation caused by exposure to petroleum products, salt or weather; and

(e) be sloped to allow collection of liquids in a sump.

(3) Clay impermeable barriers shall:

(a) be installed in accordance with good engineering practices to meet the expected loading without fracturing;

(b) be a minimum of 300 mm (12 in) thick;

(c) be chemically compatible with native or cover soil;

(d) be covered with a minimum of 300 mm (12 in) of material to prevent dryout;

(e) be sloped to allow collection of liquids in a sump; and

(f) not be installed in arid or semi-arid areas or regions where prolonged shortages of precipitation are likely to cause the clay to dry out and fracture.

(4) Steel impermeable barriers shall:

(a) be a minimum of 4.5 mm (0.18 in) thick;

(b) have corrosion protection designed and installed under the direction of a corrosion expert; and

(c) be sloped to allow collection of liquids in a sump.

(5) Synthetic membrane impermeable barriers shall:

(a) be designed, installed and certified in conformance with ULC/ORD-C58.9, "Secondary Containment Liners for Underground and Aboveground Flammable and Combustible Liquid Tanks";

(b) be installed in conformance with the manufacturer's installation requirements;

(c) be installed under the direct supervision of the membranes manufacturer's representative; and

(d) be sloped to allow collection of liquids in a sump.

(6) All collection sumps described above must be included within the protection of the impermeable barrier. Sizing of these sumps must be sufficient to permit collection of anticipated volumes of precipitation. Removal of collected precipitation or spillage from the sump must not compromise the integrity of the impermeable barrier or the dyke walls.

3.3 Intrinsic Secondary Containment (Double-Walled Tanks)

(1) Double walled tanks are considered acceptable for secondary containment and shall conform to the following:

(a) ULC/ORD - C142.3, "Contained Steel Aboveground Tank Assemblies for Flammable Liquids"; or

(b) ULC/ORD - C142.5, "Concrete Encased Steel Aboveground Tank Assemblies for Flammable Liquids"; or

(c) CAN/ULC - S601 Part B, "Double Wall Aboveground Storage Tank"; or

(d) ULC/ORD C142.23, "Aboveground Used Oil Tank".

(e) ULC/ORD - C142.16, "Protected Aboveground Tank Assemblies for Flammable and Combustible Liquid"; or

(f) other recognized ULC standards.

(2) If steel, the outer wall of a double walled tank shall be of a minimum thickness of ten (10) gauge.

(3) The interstitial space must be equipped with a monitoring system

capable of detecting and indicating leakage from the inner tank. This leak detection system and method shall be ULC certified.

(4) These tanks shall utilize appropriate vehicle barriers to prevent damage.

3.4 **Drainage and Collection Systems**

3.4.1 (1) The area immediately surrounding loading or unloading facilities at bulk plants shall be designed to drain to an oil separator or a storage tank and shall be on concrete flooring, and the collecting device shall be of sufficient size as to contain spills during loading or unloading. The minimum size shall contain a volume equal to two minutes of pumping at maximum rates of loading or unloading.

(2) Oil water separators shall be designed, constructed and operated in conformance with section C.4 of these standards.

4. PIPING

4.1 **Underground Piping**

All underground shall be designed, certified and installed in conformance with the requirements of section B.3 of these standards.

4.2 **Aboveground Piping**

4.2.1 **Materials**

(1) Fibreglass reenforced plastic (FRP) pipe is not acceptable for aboveground piping.

(2) All aboveground steel piping shall conform to:

(i) API 5L, "Line Pipe"; or
(ii) ASTM A 53, "Pipe, Steel, Black and Hot-Dipped, Zinc-Coasted, Welded and Seamless"; or
(iii) CSA Z245.1, "Steel Line Pipe".

(3) Aboveground steel piping shall be covered with a uniform weather proof coating which is compatible with the material being handled and is suitable for protection against external corrosion.

4.2.2 **Identification**

(1) Piping shall be marked with the contents of the line and these markings shall be maintained in a clearly legible form.

(2) Piping shall not be painted red.

(3) Transfer points in piping systems shall be identified in conformance with CPPI, "Using the CPPI Colour-Symbol System to Mark Equipment and Vehicles for Product Identification".

4.2.3 **Layout**

(1) Steel aboveground piping shall not be laid directly on the ground due to corrosion problems. Piping shall be shoed and suitably supported to prevent contact with the ground.

(2) Aboveground piping shall have suitable non-combustible supports to prevent uneven stresses and sagging.

(3) (a) Piping passing through secondary containment shall be designed to prevent undue stress on the piping from settlement or fire exposure.

(b) Piping passing through secondary containment shall not compromise the containment capacity. Preventative measures may include bonding of a flexible membrane to the piping.

(4) Where piping may be exposed to vehicular traffic or other potential physical damage, protective guarding devices shall be installed.

(5) (a) All piping located below the product level in the tank shall be equipped with either a manual or an automatic shut-off valve at the tank.

(b) These valves shall be closed when the tank is not in active service.

(c) Automatic shutoff valves shall fail closed if electricity or air flow is interrupted.

(6) All vertical fill pipes 100 mm (4 in) diameter or larger shall be equipped with a ULC-certified overfill containment device.

(7) Heating fuel tanks with a 50 mm (2 in) diameter fill pipe shall be equipped with a whistle valve in the vent pipe.

4.2.4 **Joints**

(1) Threaded joints in piping shall be minimized but where necessary shall be sealed using materials certified in conformance with CAN/ULC-S642-M, "Compounds and Tapes for Threaded Pipe Joints".

(2) Welding of piping shall conform with:

(i) API 1104, "Welding Pipelines and Related Facilities"; or
(ii) API RP 1107, "Recommended Pipeline Maintenance Welding Practices"; or,
(iii) as directed by Nova Scotia Environment and Labour.

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

(b) Flanged joints for piping shall be made with forged or cast steel flanges designed, constructed and installed in conformance with ANSI/ASME B16.5, "Pipe Flanges and Flanged Fittings".

(c) Bolting materials for flanged connections in steel piping shall be of alloy steel equivalent to ASTM A 193/A 193M, "Alloy Steel and Stainless Steel Bolting Materials for High Temperature Service", Grade B-7.

(d) Gaskets in flanged connections shall be of a material resistant to the liquid being carried and capable of withstanding temperatures of 650°C or greater without damage.

4.2.5 **Testing**

(1) Aboveground piping shall be tested for leakage before being put into service.

(2) Aboveground piping shall be subjected to a pneumatic test consisting of a pressure of 350 kPA (gauge) (50 psig) or 1.5 times maximum operating pressure, whichever is greater.

(3) Test pressures exceeding 700 kPa (gauge) (100 psig) shall not be used unless the piping system is specifically designed for such pressures.

(4) Where test pressures exceed design pressures for pumps or other similar components in the piping system being tested, such pumps or components shall be isolated from the remainder of the system while the test is being conducted.

(5) If, after the source of pressure is removed and steady temperature

conditions have been obtained, the test indicates a loss of pressure within 2 hours, the piping shall be considered to be leaking.

(6) Pressure measurements shall be obtained using instruments calibrated in increments of not more than:

4 kPA for test pressures up to 700 kPa (100 psi); and
1% of the test pressure for tests exceeding 700 kpa (100 psi)

(7) If a leak is detected in the piping system during the leakage test, the piping shall be repaired or replaced and then retested.

(8) During the pressure test, the piping and joints shall be soaped to assist in detecting leaks.

5. CORROSION PROTECTION

New tanks are anodic to old steel and need to be protected from older nearby tanks. Corrosion protection shall be provided in conformance with API RP651, "Cathodic Protection of Aboveground Petroleum Storage Tanks" or as designed and signed by a corrosion expert.

All tanks must be covered with a uniform weather proof coating that is compatible with the material being stored or handled.

6. LEAK DETECTION

All aboveground tank systems that are not equipped with interstitial leak detection shall use

(a) vertical groundwater monitoring wells has described in section C.8; or

(b) vapour monitoring as described in section C.7; or

(c) statistical inventory reconciliation, designed and certified by an expert in this field.

7. BULK PLANTS

7.1 Security

(1) All bulk storage tanks shall be enclosed by a security fence or be protected in an approved equivalent manner. Fences must be a

minimum of 1.8 m (6 ft) high and substantially constructed to discourage climbing. Fencing material shall be non-combustible.

(2) When bulk storage tanks are not in use or under competent supervision, the gates and other access ways shall be closed and locked, and the loading valves, filling and gauging pipes shall be closed, except those operated by electrical remote controls.

7.2 All aboveground pumps, loading/off-loading racks and truck spotting pads shall be underlain by an environmental slab constructed in such a manner as to collect all spillage and drips and direct them to an oil/water separator.

7.3 All bulk plants will have available on site and on file with the Department of the Environment an approved contingency plan for emergencies.

8. TANK BUILDINGS

Any aboveground tank system located in a building which has as its primary purpose the shelter and containment of said tank system shall require that the building:

(a) must be constructed of concrete, sheet metal or other non-combustible materials and located on a concrete base;

(b) floor must be of impermeable concrete and designed to prevent by means of dyking or curbs any spilled or leaked petroleum product from exiting from the building;

(c) must have explosion proof wiring and lighting;

(d) must have appropriate fire detection and suppression systems;

(e) must have all vent and fill pipes located outside the building; and

(f) shall comply with the *National Fire Code*.

9. RELOCATION/REFURBISHMENT

9.1.1 Field-Erected Tanks

(1) Field erected storage tanks that are reconstructed or relocated shall be:

(a) erected and tested in conformance with API Standard 653, "Tank Inspection, Repair, Alteration and Reconstruction", and

(b) endorsed by a professional engineer as meeting the requirements of clause (a).

(2) Field-erected storage tanks which have been structurally damaged shall not be used for petroleum storage unless:

(a) the tank has been repaired and tested in conformance with API Standard 653, "Tank Inspection, Repair, Alteration and Reconstruction"; and

(b) endorsed by a professional engineer as meeting the requirements of clause (a).

(3) Riveted aboveground storage tanks shall not be relocated for storage of any product. If no longer required for storage of petroleum products, riveted tanks shall be dismantled and disposed of in accordance with the requirements of section C.6 of these Standards, "Tank Removal/Abandonment".

9.2.1 **Shop-Fabricated Tanks**

(1) Shop fabricated aboveground storage tanks may be relocated for reuse aboveground for the storage of petroleum products if inspected and tested in accordance with:

(a) CAN/ULC-S601 (A), "Shop Refurbishing of Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids"; or

(b) CAN/ULC-S630 (A), "Shop Refurbishing of Steel Aboveground Vertical Tanks for Flammable and Combustible Liquids"; or

(c) the special acceptance procedures of ULC; or

(d) with the written authorization of an Administrator.

(2) The only exceptions to section 9.2.1 will be those tanks designed to be readily relocatable and constructed and certified in accordance with:

(a) ULC-S653, Standard for Aboveground Steel Contained Tank

Assemblies for Flammable and Combustible Liquids; or

(b) ULC/ORD-C142.3, "Contained Steel Aboveground Tank Assemblies for Flammable Liquids"; or

(c) ULC/ORD-C142.5, "Concrete Encased Steel Aboveground Tank Assemblies for Flammable and Combustible Liquids"; or

(d) ULC/ORD-C142.16, "Protected Aboveground Tank Assemblies for Flammable Combustible Liquids".

9.2.2 Shop-fabricated storage tanks which have been structurally damaged shall not be used for petroleum storage unless the tank has been repaired and tested in conformance with:

(a) CAN/ULC-S601(A), "Shop Refurbishing of Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids;

(b) CAN/ULC-S630(A), "Shop Refurbishing of Steel Aboveground Vertical Tanks for Flammable and Combustible Liquids; or

(c) the special acceptance procedures of ULC.

9.3.1 **Internal Lining Upgrade**

With the prior written approval of an Administrator, aboveground tanks may be upgraded to meet secondary containment requirements by the installation of internal lining.

(1) Prior to receiving approval, tanks to be upgraded must have a complete internal inspection performed by an inspection services company. Results of the inspection must be sent to the Administrator.

(2) Field-erected storage tanks shall be lined in conformance with API-RP652, "Lining of Aboveground Petroleum Storage Tank Bottoms".

(3) When shop-fabricated storage tanks are lined, the lining shall:

(a) meet the requirements of CAN/ULC-S616, "Standard

for the Testing of Liquid Protective Coating Materials as Required for ULC-S603.1 for Use in Connection with the Corrosion Protection of Underground Tanks";

(b) be applied in conformance with the lining manufacturer's installation requirements; and

(c) be installed under the direct supervision of the lining manufacturer's representative.

PART B - UNDERGROUND PETROLEUM STORAGE TANK SYSTEMS

1. GENERAL

Nova Scotia Environment and Labour must review for registration approval the application for any proposed installation, alteration, removal or decommissioning of an underground tank system having a nominal capacity of 2000 litres (440 gal Imp) or greater. The minimum installation requirements are outlined below pursuant to the site sensitivity assessment (ref. Guidelines for Site Sensitivity Determination for Petroleum Storage Tank Installations). In the event that no site sensitivity assessment is undertaken, the site is automatically classified as the most sensitive, Class A.

1.1 Class "A" Requirements (Sensitive)

If the site has been classified as Class "A":

(a) secondary containment with interstitial leak detection for both the tanks and associated piping shall be provided;

(b) acceptable leak detection shall be installed (a minimum of two observation wells in each tank excavation or acceptable alternative); and

(c) an acceptable overfill and spill protection device shall be installed.

1.2 Class "B" Requirements (Semi-Sensitive)

If the site has been classified as Class "B":

(a) any underground storage tank shall be at least single wall cathodically protected steel, or fibreglass reinforced plastic tank;

(b) the piping installed as part of an underground storage tank system shall be at least single wall cathodically protected steel or fibreglass reinforced plastic pipe, or where the piping is appliance supply piping, copper tubing installed in conformance with section 3 of this Standard;

(c) acceptable leak detection shall be installed (a minimum of two observation wells in each tank excavation or acceptable alternative); and

(d) an acceptable overfill and spill protection device shall be installed.

1.3 Secondary Containment Specifications

The technologies listed below are considered acceptable for secondary containment.

1.3.1 Double walled tank

(1) As a minimum, the internal wall of a double wall tank shall be designed and built in conformance with one of the Standards provided in Section B.2.

(2) The outer wall shall cover a minimum of 300 degrees of the circumferential surface area of the primary tank, including 100% coverage of the primary tank heads.

(3) The outer wall of a steel tank shall be of a minimum thickness of ten (10) gauge.

(4) There shall be no penetration of any kind through the jacket to the tank, except for top entry manholes and fittings required for filling, gauging and venting of the tank and monitoring the interstitial space.

(5) An interstitial leak detection system that is capable of detecting a perforation, or non-tightness in either wall of the tank, including the entry of water into the interstitial space shall be installed.

(6) The interstitial space shall be tested, in accordance with the instructions of the tank manufacturer, or as a minimum, at least annually.

(7) All double walled tanks shall be equipped with a manway where the product supply piping connects to the tank.

1.3.2 **Impermeable Barriers**

(1) This underlayment must have a permeability rate to water equal to or less than 1 x 10^{-6} cm/s and shall not deteriorate in an underground environment and in the presence of petroleum. The underlayment may consist of a synthetic membrane or any equivalent material. If a synthetic membrane is used, any seams shall be properly sealed and punctures or tears shall be repaired prior to backfilling.

The underlayment shall be manufactured and installed in conformance with ULC/ORD-C58.9, "Secondary Containment Liners for Underground and Aboveground Flammable and Combustible Liquid Tanks", latest edition.

(2) The underlayment shall be installed and backfilled in accordance with manufacturer's instructions (see section B.2.8 for details) and shall be complete with a top cover to prevent water from entering the liner.

1.3.3 **Vaults**

(1) A vault shall be water tight, impervious to leakage of petroleum product and able to withstand chemical deterioration and structural stresses from internal and external causes.

(2) The vault shall be a continuous structure with petroleum resistant waterstops and joints.

(3) The tanks and piping within a vault shall be supported, encased or bedded in a manner consistent with this standard and good engineering practices.

(4) The vault shall have interstitial leak detection capable of detecting product leaks and the intrusion of water into the vault and shall be accessible for visual inspection.

2. UNDERGROUND PETROLEUM STORAGE TANKS

New storage tank systems shall be constructed, shop tested and installed in accordance with one of the following standards:

(a) CAN 4 S603M, "Standard for Steel Underground Tanks for Flammable and Combustible Liquids", latest edition, with impressed current cathodic protection,

(b) CAN 4 S603.1M, "Standard for Galvanic Corrosion Protection for Steel Underground Tanks for Flammable or Combustible Liquids", latest edition;

(c) CAN 4 S615M, "Standard for Reinforced Plastic Underground Tanks for Petroleum Products", latest edition;

(d) ULC/ORD-C58.10, "Jacketed Steel Underground Tanks for Flammable and Combustible Liquids", latest edition;

2.1 **Site Preparation - All Tank Systems**

2.1.1 The following factors shall be considered in determining the size, shape and depth of the excavation:

(a) tank manufacturer's recommendation for depth of bedding and backfill,

(b) stability of the soil,

(c) requirements for compacting bedding and backfill,

(d) space for placing associated equipment,

(e) slope of piping,

(f) depth of cover, and

(g) anchoring pad requirements

2.1.2 Problems resulting from unstable soil and infiltration of water may require that tanks already in place be moved to correct movement caused by settlement or flotation.

2.1.3 Surface water present shall be prevented from entering the excavation by dyking or other means.

2.1.4 (1) Tanks shall be located away from existing structures and property boundaries in accordance with the minimum separation distances specified in the *National Fire Code*.

(2) Tanks shall be located to permit the eventual removal of the storage tanks when the tanks have reached the end of their useful lifetimes or the system is permanently withdrawn from service.

(3) No permanent structures shall be placed over an underground tank such that it prevents inspection or removal of the tank.

2.1.5 The tank excavation shall be large enough to provide at least 600 mm (24 in) clearance between the excavation walls and the tanks and 600 mm (24 in) between the tanks.

2.1.6 In unstable soil conditions the sides of the excavation shall be shored or the upper portions of the excavation walls cut back at a minimum slope as per the requirements of Nova Scotia Environment and Labour.

2.1.7 Soil stabilization material shall be used to line the excavation when using pea gravel or crushed stone to prevent the migration of the backfill material.

2.1.8 Excavations must be deep enough to allow a minimum of 150 mm (6 in) approved compacted backfill bed for steel tanks and 300 mm (12 in) approved compacted backfill bed for FRP tanks over the hole bottom or concrete slab.

2.1.9 (a) The depth of cover in areas subjected to traffic loads shall be:
- (i) a minimum of 900 mm (36 in) of approved backfill; or
- (ii) a minimum of 750 mm (30 in) of approved backfill plus 150 mm (6 in) of asphalt; or
- (iii) 450 mm (18 in) of approved backfill plus either 15 0mm (6 in) of reinforced concrete or 200 mm (8 in) of unreinforced concrete.

(b) Depth of cover in non-traffic areas shall be a minimum of 900 mm (36 in) of approved backfill.

2.1.10 Reinforced concrete, concrete or asphalt paving shall extend 600 mm (24 in) beyond the tank outline in all directions.

2.1.11 The maximum burial depth shall not exceed 2.1 metres (7 feet) over the top of the tank unless specifically tested for a greater depth of burial.

2.1.12 The tank area shall be barricaded to prevent any vehicle travel over the tanks until installation is complete.

2.2 Pre-installation Inspection & Testing of Steel Underground Tanks

2.2.1 To prevent damage to finished coatings and factory attached anodes, tanks shall be handled with care during transit, storage and installation. Do not drop, drag or roll tanks.

2.2.2 The tank shall only be moved using the lifting lugs attached to the tank. A spreader bar may be necessary to ensure the angle between the lifting line and the vertical does not exceed 60 degrees.

2.2.3 Chains, cables or other lines shall not be placed around the tank to move or lift it.

2.2.4 Tanks shall be stored in a secure area away from activity and chocked to prevent the tank from moving. If high winds are expected, the tank should be tied down to wooden stakes using 13 mm (1/2 in) diameter nylon rope or restraints of equal strength.

2.2.5 The tanks shall be inspected for damage to the coating and any damaged areas repaired with manufacturer supplied materials prior to installation. The manufacturer shall be contacted if the repair materials supplied with the tank are not sufficient to complete repairs.

2.2.6 The tank anodes shall be inspected against damage and tested to ensure electrical continuity between the tank and the anode.

2.2.7 Single-walled tanks shall be air pressure tested for tightness prior to installation in the following manner:

(a) remove all factory installed plugs and coat with a pipe thread sealant (use only cast iron plugs),

(b) replace all plugs and tighten to ensure no air is released during testing,

(c) pressurize the tank with air to between 21 and 35 kPa (3 to 5 psi) for a minimum of 2 hours,

(d) a pressure gauge with a maximum range of 70 to 105 kPa (10 to 15 psi) and incremented to 1 kPa (0.1 psi) in conjunction with a second pressure gauge or pressure relief device to prevent over pressurization shall be used,

(e) once the internal pressure is achieved, the compressed air

source shall be disconnected from the tank and a soap solution applied to joints, fittings and seams to aid in detecting leaks,

(f) if leaks are detected in seams or the shell, the supplier and/or manufacturer shall be notified,

(g) when the test is complete, the air pressure in the tank shall be released,

(h) if the tank is dropped or impacted after the initial test, it shall be retested through the same procedure.

2.2.8 Double walled steel tanks shall be tested prior to installation in accordance with the manufacturers specifications.

2.2.9 The vacuum applied to the interstitial space of a double walled steel tank is approximately 54 kPa (16 in) mercury which must be intact when it arrives on site. If the vacuum differs from this value the manufacturer shall be contacted immediately.

2.2.10 Under no circumstances shall an air test be put on a tank that has contained product unless the tank or piping has been purged and verified to be vapour free.

2.3 Placement & Backfilling of Steel Underground Tanks

2.3.1 Acceptable backfill/bedding material shall be a clean, washed, well granulated, free flowing non-corrosive, inert material such as sand, crushed rock or pea gravel, with a particle size of not larger than 19 mm (3/4 in).

2.3.2 The backfill material shall be free of debris, rock, ice, snow or organic material.

2.3.3 A petroleum-resistant barrier (i.e. 6mm polyethylene) shall be placed on a layer of backfill material on the floor only of the excavation and sloped to the sump(s) for the installation of the observation well(s).

2.3.4 The bottom of the excavation shall be covered with suitably graded, levelled and compacted backfill material to a depth of at least 150 mm (6 in).

2.3.5 The bedding layer shall extend a distance of at least 300 mm (12 in)

around the perimeter of the tank or the hold down pad, whichever is greater.

2.3.6 Backfill material shall be carefully placed along the bottom quadrant of the tank to prevent movement and ensure proper support.

2.3.7 The zinc reference electrode (if required) shall be placed in the backfill close to the bottom center portion of the tank.

2.3.8 Backfill materials shall be forced under the lower quadrant of the tank to prevent voids and achieve the degree of compaction required. Care must be taken not to damage the tank during this procedure.

2.3.9 Sand backfill shall be mechanically compacted to manufacturer's specified minimum compaction density.

2.3.10 The tank shall be lowered into the excavation by use of the lifting lugs provided and guide ropes to assist in the proper positioning of the tank.

Anchoring

2.3.11 Tanks shall be anchored where flooding occurs or could reasonably occur, high water tables exist, when surface water could flow into the hole, or when other water conditions could exist in an otherwise dryhole. When any doubt exists concerning the depth of the groundwater table, the tanks shall be anchored.

2.3.12 (a) Tanks shall be anchored by one of the following methods:

(i) concrete slab at grade and backfill,

(ii) reinforced concrete deadmen anchors, or

(iii) reinforced concrete hold down pad.

(b) The anchor will be of sufficient size and weight to effectively resist the total uplift force of the tank when empty and completely submerged in water.

2.3.13 Hold down pads shall extend 450 mm (18 in) beyond the dimensions of the tank or tanks and be a minimum of 300 mm (12 in) thick.

2.3.14 Tanks shall not be placed directly on a hold down pad.

2.3.15 The anchor bolts shall be properly aligned and extend no more than 600 mm (24 in) above the anchoring device.

2.3.16 Anchor straps and hardware shall be coated and shall be installed in such a manner that they do not interfere with the protective coating on the tank.

2.3.17 Metal anchor straps shall be separated from the tank by a 3 mm (1/8 in) thick neoprene band or equivalent non-conducting material.

2.3.18 All straps shall be tightened to give a snug fit before backfilling and care taken to prevent damage from over tightening.

2.3.19 After the tank has been positioned in the excavation, the coating shall be inspected visually and any damaged portions repaired using the manufacturer's patching kit.

2.3.20 Prior to backfilling all observation wells or alternative leak detection devices shall be placed in the tank excavation (see Section 4).

2.3.21 The backfill material shall be placed and compacted in layers of not greater than 300 mm (12 inches) in depth. Mechanical compaction is only required when using sand as backfill material.

2.3.22 The entire excavation shall be completely filled with acceptable backfill material.

2.3.23 Factory attached anodes shall be dampened with water during backfilling to assist in the initial tank monitoring (minimum of 20 litres (5 gal Imp of water).

2.3.24 The tank connection wire shall be connected to the wire lug terminal located on the tank and shall run to the terminals in a remote monitoring station.

2.3.25 All piping connections to the tank shall be made through the dielectric bushings supplied by the tank manufacturer (piping installations are reviewed in section 3).

2.3.26 The tank must be electrically isolated from the piping and other metal structures.

2.3.27 All unused, plugged openings shall be made leak tight.

2.3.28 All temporary or permanent piping shall be installed and/or plugged in a manner to prevent the intrusion of water or release of product

from the tank.

2.3.29 In wet hole conditions, the water levels in the excavation shall be reduced to the lowest practical level during construction.

2.3.30 The tank may be ballasted with water, however, the height of the ballast in the tank should never exceed the level of the backfill around the tanks.

2.3.31 The tank shall not be filled with product until the backfill is to the top of the tank, and tank tightness testing has been completed, or unless ballasting in wet hole conditions is required. If ballasting is required and water cannot be used, the installer must receive approval from an inspector before using product.

2.3.32 Surface waters shall be drained from the site using good engineering practices. This may include capping the site with asphalt, concrete or another impervious cover which is sloped to drainways leading away from the storage tanks.

2.3.33 The interstitial space shall be monitored by a leak detection system capable of measuring product releases from the tank. The leak detection device and method shall be ULC certified.

2.3.34 All fill pipes, monitoring wells, manways, air vents, and other appurtenances shall be fully protected from possible vehicle traffic damage by means of a barrier, curb or equivalent obstruction.

2.4 Cathodic Protection Testing of Steel Underground Tanks

2.4.1 All new steel underground tanks shall be tested for adequate corrosion protection by a properly trained corrosion protection system tester and in accordance with CAN4-S603.1, Standard for Galvanic Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids.

2.4.2 A high impedance, digital readout volt-ohm meter with at least 10 megohm impedance and a copper/copper sulphate reference electrode ($Cu/CuS0_4$) shall be used for all cathodic protection testing of the tank system.

2.4.3 Test wires shall be brought to the surface and fastened at an acceptable location of future test readings. Immediately after backfilling the tank must be tested to ensure it is electrically isolated form all piping and other metal structures. A voltage reading of less

than 100mV between the protected tank and other metal structures indicates the presence of a ground fault or short which must be corrected before any further work is performed.

2.4.4 The copper/copper sulphate electrode shall be placed on moist soil above the tank and shall be connected to the positive side of the volt-ohmmeter and the negative side of the meter connected to the tank.

2.4.5 A cathodic protection potential of at least 850 millivolts negative to the copper/copper sulphate electrode indicates the tank is adequately protected. If this reading is not achieved, corrective action must be taken before any further work is performed.

2.4.6 The installer of the tank system shall upon completion of the installation certify in writing to the owner that acceptable cathodic protection has been achieved.

2.4.7 Future maintenance checks on the cathodic protection system shall be conducted using the method identified above at periodic intervals as stipulated by the Department.

2.4.8 Impressed current systems for the cathodic protection of steel underground tanks shall be designed and installed by a corrosion specialist in accordance with PACE Report No. 87-1, "Guideline Specification for the Impressed Current Method of Cathodic Protection of Underground Petroleum Storage Tanks".

2.4.9 Any new storage tank added to an existing system that is protected by an impressed current system shall be electrically bonded to the impressed current system.

2.5 Pre-installation Inspection and Testing of Fibreglass Tanks

2.5.1 Fibreglass reinforced plastic underground storage tanks require the backfill material to provide as much as 90% of the tank support under certain stress conditions. The installing contractor must be positive he has the correct bed and backfill material and follow these instructions exactly.

2.5.2 (1) **Chock Tanks**

Tanks should not be dropped, rolled or impacted. Chock the tanks until ready for installation and tie them down if high winds are expected. Use minimum 13 mm (1/2 in) diameter nylon or hemp rope over each tank and tie to wooden stakes

of adequate size to prevent tanks from being moved by high winds.

(2) **Lifting Tanks**

Use installation lift lug(s) to lift tank. On larger tanks, use spreader bar to insure lift angle of at least 60 degrees at each lift lug. Guide the tank with guidelines. **Do not use chains or cables around tanks.** If tanks have to be moved, (do not roll) set on smooth ground, free of rocks and foreign objects and rechock. Capacity of lifting equipment must be checked before handling.

2.5.3 **Testing**

(1) All tanks must be vented as tanks are designed for operation at atmospheric pressure only.

(2) Pressure test single wall tanks:

(a) Remove all factory installed plugs and coat with a pipe thread sealant.

(b) Replace all plugs and tighten to ensure no air is released during testing.

(c) Pressure test tank at 35 KPA (5 psi) maximum for 2 hours (or in accordance with manufacturer's instructions) to ensure that there is no evidence of leaks as indicated by loss of pressure.

(d) A pressure gauge with a maximum range of 70 - 105 KPA (10 - 15 psi) and incremented to 1 KPA (0.1 psi) shall be used in conjunction with a second pressure gauge or pressure relief device to prevent over pressurization.

(e) Apply a soap solution to the external surface of the tank piping connections of the tank to assist in detecting leaks.

(f) If leaks are detected in seams or the shell, the supplier and/or manufacturer shall be notified.

(g) After the test is complete, release the air slowly.

(3) Pressure test double wall tanks in accordance with manufacturers instructions.

(4) Do not approach ends of tanks or manways that are under pressure. Tanks under pressure shall not be left unattended.

(5) If tanks are dropped or impacted after initial test, retest tanks and soap areas of impact to check for damage. If damage has occurred do not attempt repairs. Contact the tank manufacturer.

(6) An air test cannot be used on a tank that has contained product unless that tank has been purged and verified to be vapour free.

2.6 Placement and Backfilling of Fibreglass Tanks

2.6.1 Bed and Backfill Material

(1) Gravel

Tanks require bed/backfill material consisting of a clean naturally-rounded aggregate with particle size not less than 3 mm (1/8 in) or more than 19 mm (3/4 in) in diameter. Use this description when specifying or ordering because material is known by different names in different areas. This material is commonly called pea gravel.

(2) Stone or Gravel Crushings

Washed stone or gravel crushings with angular particle size not less than 3mm (1/8 in) or more than 13mm (1/2 in) in diameter are acceptable as an alternate backfill material. This material must meet ASTM C-33 paragraph 7.1 requirements for quality and soundness.

(3) Backfill material must be clean and free flowing and have no particles that will pass through a #8 sieve.

(4) In freezing conditions backfill must be dry, free of ice and be free flowing. Thaw or break up all frozen lumps.

(5) Do not use other backfill materials. In areas where specified materials are not available, contact the tank manufacturer for information on approved alternate materials.

(6) Sand is not acceptable for backfill for fibreglass tanks.

2.6.2 **Size**

(1) **Stable Walls**

Stable wall excavations are those which normally can be made vertical from bed to grade without use of shoring or sheet piling. The excavation must be large enough to allow a minimum of 600 mm (24 in) between tanks at ribs and a minimum of 600 mm (24 in) from ends and sides of tanks to hole walls. (It is recommended that 600 mm (24 in) distance be used to provide ample working room for placement of initial backfill).

(2) **Unstable Wall**

Unstable excavations are made in those soils having less than 36 kPa (750 lbs/sq ft.) cohesion as calculated from an unconfined compression test; or soils with an ultimate bearing capacity of less than 168 kPa (3500 lbs/sq. ft). The excavation must be large enough to allow minimum of 1/2 the tank diameter [minimum of 600 mm (24 in)] from ends and sides of tanks to hole walls. A qualified soil testing laboratory can provide data and recommendations.

2.6.3 **Burial Depth and Cover**

The depth of the tank excavation shall take into account the size of the tank as well as the following factors:

(a) **Excavation Depth**

Burial holes must be deep enough to allow a minimum of 300mm (12 in) approved backfill bed over the hole bottom or concrete slab.

(b) **Cover Depth**

Tank must have a cover depth as specified in Section

B.2.1.9.

(c) **Pad Dimensions**

Reinforced concrete, concrete or asphalt paving at the surface must extend at least 600mm (24 in) beyond tank outline in all directions.

(d) **Maximum Burial Depth**

Depth of cover for single wall tanks of 3 m (10 ft.) or less in diameter in both traffic and no-traffic conditions must not exceed 2.1 m (7 ft.) over tank top. Depth of cover for double wall tanks must not exceed 1 m (3 ft). For larger tanks, use manufacturer's instructions.

(e) A petroleum-resistant barrier shall be placed on a layer of backfill material on the floor only of the excavation and sloped to the sump(s) for the installation of the monitoring well(s).

2.6.4 **Installation Procedure - Dry Excavation**

(1) Anchoring is recommended if high water table exists in the area, or if water problems could develop after tank is installed.

(2) **Bed**

The installer shall provide a minimum of 300 mm (12 in) of specified backfill bed over the hole bottom or concrete slab. The bed must be smooth and level. Place tanks in hole on backfill bed. Do not place fibreglass tanks directly on concrete slab or grout tanks in wet concrete. Do not place the tanks on timbers, beams or cradles.

(3) **High Water**

Tanks, whether strapped or not, must never be left on the bed without backfill to the top of tank if there is any chance of more than 300 mm (12 in) of water in the hole.

(4) **Backfilling**

(a) When backfilling, use the same specified materials as the bedding. Be sure the backfill is free of large rocks, debris or foreign materials that could damage the tank. Avoid impacting tanks during backfilling.

(b) At the start of backfilling care must be taken to push approved backfill material completely beneath the tank bottom, between the ribs and under the end caps to provide the necessary support.

(c) A board or similar device should be used to push backfill under the tank. After the backfill is 600 mm (24 in) up the side of the tank use a shovel handle to work the backfill into all voids. This is a critical step as neither stone nor gravel will flow under the tank.

(d) Tanks installed with backfill to the top of the tank but without backfill to grade should be filled with water to prevent "float-out".

(e) Continue backfilling in 300 mm (12 in) lifts at least half way up the tank wall. Do not add water or product in the tank before backfill material is even with top of tank.

(f) Complete backfilling to the top of the tank with approved backfill.

(5) **Levelling to grade**

When piping is complete, continue backfilling with approved backfill to grade or at least 300 mm (12 in) over top of ribs. The balance can be a readily compacted backfill separated by a soil stabilization fabric. Bricks or blocks used to support piping must be removed prior to filling to grade. Do not use rock, shale or debris for fill.

(6) **Barricade**

Tank area must be barricaded to prevent any vehicle travel over the tanks until installation is complete. (See Section B.2.6.3, Burial Depth and Cover).

(7) **Oversized Hole**

Use specified bed and backfill materials to completely fill oversized holes.

2.6.5 **Installation Procedure - Wet Excavation**

Anchor

(1) (a) Anchoring is mandatory where high water tables exist or are likely to exist (60 cm or more above the bottom of the excavation), when surface water is likely to flow into the excavation or when other significant water intrusion problems could occur.

(b) Tanks shall be anchored by one of the following methods:

i) concrete slab at grade and backfill,

ii) reinforced concrete deadmen anchors, or

iii) reinforced concrete hold down pad.

(c) Anchoring systems must be designed and constructed in accordance with instructions from the manufacturer or a registered professional engineer or hydrogeologist. For design purposes, the tank must be assumed empty and completely submerged beneath water.

(2) **Water Level**

(a) Water Level should be maintained at the lowest practical level during installation. A system of well-points and pumps is the recommended method to minimize water level in the hole. The number of well points required will depend on the water flow rate into the hole. The hole bottom must be level, free of rocks and debris and covered with at least 300 mm (12 in) of specified backfill material.

(b) If extremely difficult water conditions at site are suspected (underground stream, surface run off location, etc.) increase

the bed thickness to 450 mm (18 in).

(3) **Level Tanks**

While levelling tanks insure that minimum distances between tanks are maintained. When anchoring, place straps over tanks and follow procedures in Section B.2.6.5 (6).

(4) **Ballast**

If the water level in the excavation cannot be lowered, you will need to ballast the tanks with water. Place the tanks in the hole, adding only enough ballast to sink them. Ballast level in the tanks must never exceed the water level in the hole during installation. While adding ballast, use only lifting cable to keep tanks in position. Tanks should be free to roll slightly. The lifting cable must be carefully tended.

(5) **Backfilling**

Distribute backfill evenly around tanks and continue procedures outlined for the dry hole installation (see Section 2.6.4).

(6) **Straps**

Use the manufacturer recommended hold-down straps on top of all designated ribs. Anchor points at the bottom of the hole must be aligned with designated rib ± 25 mm (1 in). Do not use straps or cables between ribs of tanks. All straps should be tightened to give "snug" fit of strap to the tank. Anchor the bolts in concrete and attach ends of the straps. Note: Anchor bolt must not project more than 500 mm (20 in) from pad.

(7) **Additional Ballasting**

Once backfill is complete to the top of the tank, always continue to pump water from the excavation. If this is not possible, fill the strapped tank with water and leave until the installation is complete, including the traffic surface.

2.7 Additional Requirements for Fibreglass Tanks

2.7.1 Piping

(1) The maximum internal pipe or pump length (from top of fitting) shall provide a minimum of 100 mm (4 in) clearance from the bottom of the tank.

(2) The pump and attached piping must be free to move with the tank. Use a spill containment chamber around fill pipe at grade where asphalt or concrete pad is used. Do not place brick or other spacing material on top of tanks.

(3) Refer to Section B.3 for piping details.

2.7.2 Manway Access Tanks

Manway tank access to grade can be provided by a flanged fibreglass extension tube or by means of a concrete or corrugated metal sleeve of 750 mm (30 in) or 900 mm (36 in) diameter. This sleeve must have a minimum of 150 mm (6 in) clearance from the tank top. External loads must not be transmitted to the manway extension or the tank. Consult the manufacturer for details.

2.7.3 Adding Tanks to Existing Installations

Tanks can be added to existing installations. It is important to remember that fibreglass tanks require good foundation support from surrounding soil and are not self-supporting under fuel or overburden loads. The following guides are suggestions to reduce loads from soil or product on uncovered tanks so no damage will occur. Final selection of method will depend on local site conditions and shall be the responsibility of the installer.

(1) **Isolated Bury (Preferred)**

Install tanks in separate hole which is a minimum of 900 mm (36 in) from edge of original tank installation hole. Undisturbed soil between the new excavation and the original hole must be maintained. Keep surface loads off existing tanks.

(2) **Bury in Same Hole (Alternate)**

(a) Lower the product level in existing tanks to less than 1/4 tank capacity.

(b) Remove the surface pad, if one exists, to lower backfill.

(c) Excavate for the new tanks, leaving as much backfill as possible around the existing tanks.

(d) During installation, the existing tanks must not be allowed to move. Shoring may be required to retain the backfill.

(e) Install the new tanks as described earlier in these instructions, leaving a minimum of 600 mm (24 in) and preferably 900 mm (36 in) between new tanks and existing tanks.

(f) Backfill material should be of specified type and separated from existing fill with a soil stabilization fabric. Do not use clay, loam, silt, stone screening, stone dust, slag, sand or cinders.

2.7.4 **Tank Deflection Measurements**

Measuring the inside diameter of tanks is mandatory in order to monitor the quality of an installation. Detailed instructions for measuring tanks are supplied by the manufacturer. Any measurement varying in excess $\pm$ 1% of nominal tank internal diameter shall be reported immediately to the manufacturer and all work stopped.

2.8 Installation of Impervious Underlayments for Secondary Containment

2.8.1 Impervious underliners must be handled and installed with care to prevent the liner from being punctured and in accordance with manufacturers instructions.

2.8.2 Prior to installation of the liner, all sharp rocks and objects must be

removed from the excavation and a filter fabric material placed between the liner and native soil.

2.8.3 A layer of backfill (minimum of 150 mm [6 inch]) shall be placed and levelled in the excavation prior to installing the liner.

2.8.4 Once the liner is installed in the excavation, a 150 mm (6 inch) layer of backfill material shall be placed to cover and protect the liner from damage.

2.8.5 The tank system shall be installed as previously detailed in this standard and must be anchored.

2.8.6 In order to prevent slumping, the liner shall be installed and backfilled to the top of the tanks during same working day.

2.8.7 All piping shall be double walled or installed and enclosed in a trench liner sloped to a collection sump to facilitate leak detection.

2.8.8 Surface waters shall be drained from the site using good engineering practices. This may include capping the site with asphalt, concrete or other impervious cover which is sloped to drain water away from the storage tanks.

2.8.9 The underlayment shall extend to the surface and at least 1.5 m (5 ft) beyond the boundaries of the excavation at grade and sloped to the sump at a rate of 20 mm per metre (1 inch per 4 feet). At least two observation wells shall be positioned in the sump and extend to the surface of the excavation to allow detection of leakage and removal of water or product accumulation.

3. UNDERGROUND PRODUCT/PRODUCT TRANSFER LINES

3.1 General

3.1.1 Standards

Piping systems are an essential part of new storage tank systems and shall be constructed, shop tested and installed in accordance with one of the following standards:

(a) CAN 4 S603-M, "Standard for Steel Underground Tanks for

Flammable and Combustible Liquids", latest edition, with impressed current cathodic protection;

(b) CAN 4 S603-.1M, "Standard for Galvanic Corrosion Protection for Steel Underground Tanks for Flammable or Combustible Liquids", for Sacrificial anode systems;

(c) ULC/ORD-C107.7, "Standard for Glass Fibre Reinforced Plastic Pipe and Fittings for Flammable Liquids";

(d) ULC/ORD-C107.4, "Standard for Ducted Flexible Piping Systems for Flammable and Combustible Liquids";

(e) CAN/ULC-S633-M90, "Standard for Flexible Underground Hose Connectors for Flammable and Combustible Liquids";

(f) API 5L, "Line Pipe";

(g) ASTM A53, "Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless";

(h) CSA Z245.1, "Steel Line Pipe";

(i) for service pressures exceeding 875 KPa (gauge), ANSI/ASME B31.3, "Chemical Plant and Petroleum Refinery Piping";

(j) other applicable standards.

3.1.2 **Pumps and Valves**

(1) Delivery system utilizing pumps located other than at the dispenser shall be equipped with a shear valve below the dispenser and a line leak detection system.

(2) All suction pipe installations require an extractor valve located at the tank and a vertical check valve under the dispenser.

(3) All submerged turbine or remote pumping equipment shall have a system that will indicate when the pump is running. This indicator system shall be located in plain view at the operators console.

(4) After installation is complete, remove interior check from extractor valve and retain in case future testing is required.

3.1.3 **Containment**

(1) Underground piping up to 75 mm nominal pipe diameter shall have secondary containment.

(2) Underground piping larger than 75 mm nominal pipe diameter shall have:

(i) secondary containment with interstitial leak detection; or

(ii) leak detection in conformance with sections B.3.15.1 or B.3.15.2.

3.2 **Pipe and Trench Layout**

3.2.1 Product transfer lines shall be run in a single trench between the tank site and the dispenser island(s). Similarly, vent lines between the tank site and the structure to which the line will be attached shall be in a single trench where applicable.

3.2.2 Trench excavations shall be large enough such that they provide a minimum width of two times the pipe diameter between the pipe and the trench wall. Individual piping runs shall have a minimum separation distance of 100 mm (4 in) or at least two pipe diameters, whichever is greater.

3.2.3 Underground product lines and vent lines shall have a uniform down slope of not less than 3 mm (1/8 in) (1%) per foot toward the tank.

3.2.4 Before any underground lines are laid, each trench for such piping shall receive a minimum 150 mm (6 in) deep bed of well compacted non-corrosive approved backfill material.

3.2.5 Product transfer lines shall have a minimum burial depth of 450 mm (18 in) at the dispenser island(s) when covered with 150 mm (6 in) of reinforced concrete.

3.2.6 All pipe trenches shall be filled with clean non-corrosive approved backfill material.

3.2.7 (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 the piping enters the building.

(3) Where piping 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.

3.3 Installation Practices for Steel Piping

3.3.1 If crossing of lines is unavoidable, provide clearance of at least two pipe diameters or 100 mm (4 in), whichever is larger, to prevent contact.

3.3.2 Avoid damage to piping materials or coatings during handling, installation, testing and backfilling.

3.3.3 Keep pipe, as well as fitting interiors and threads, free from dirt, corrosion, moisture and debris.

3.3.4 Exercise care to accurately measure and cut pipe, so as to avoid the failure that can occur when pipe fittings are installed under stress.

3.3.5 Use a pipe sealant compatible with the piping materials and the product being handled and certified under CAN/ULC - S642 - M87, "Standard for Compounds and Tapes for Threaded Joints".

3.3.6 Install flexible connectors in accordance with manufacturer's recommendations and certified as meeting CAN/ULC - S633 - M-90, "Standard for Flexible Underground Hose Connectors for Flammable and Combustible Liquids".

3.3.7 Protect all piping from physical damage with non-conductive material at any point at which it passes through pavement and structures.

3.3.8 Inspect pipe-cutting dies frequently and replace when worn. Threaded metallic piping depends on a liquid-tight, metal-to-metal seal to prevent leaks. Dull dies may extrude or tear threads, making a tight seal impossible.

3.3.9 Ream and de-burr pipe ends after cutting.

3.3.10 Swing-joints and flexible connectors provide flexibility in the piping and must be used at the beginning and end of each product line,

vent to relieve stress, where lines change direction. Do not use street elbows or continuously threaded (close) nipples.

3.3.11 Avoid using dielectric unions underground, If dielectric unions are used, care must be taken to ensure all lines are cathodically protected.

3.3.12 Protect all underground metallic piping with a properly designed and installed cathodic protection system. Dispensers, submerged pumps, check valves, tanks or other metallic components, not intended to be protected by the cathodic protection system provided for the piping, should be electrically isolated from the protected system using dielectric unions.

3.3.13 Repair damage to coatings caused by handling, threading or tightening. Use mastic material or ULC certified product for this purpose and apply in accordance with the manufacturer's application instructions.

3.3.14 Isolating armoured couplings, isolating unions or prefabricated isolating joints used to electrically isolate the submersible pump from the tank shall be in the free air space in an access sleeve above the tank. Care shall be taken to ensure that the brackets/flanges of submersible pumps, when fitted, are electrically isolated from the tank. At the dispensing equipment, isolating connections shall be placed aboveground. Isolating unions shall be installed with the clamping nut on the grounded side to reduce the risk of grounding.

3.3.15 Electrical conduits shall not be in contact with the product or vent piping in order to prevent electrical grounding of the pipe runs. Separation distances must be in accordance with the *National Fire Code.*

3.3.16 All joints and threads shall be coated with a ULC certified mastic compound as specified in CAN4-S603.1-M85.

3.3.17 Electrical isolation checks of the lines from the tank or other sections of the system shall also be made just after the completion of the piping system before the backfilling is completed and again after the entire system is totally backfilled to grade.

3.3.18 The testing of the cathodic protection system shall be conducted in

accordance with CAN4-S603.1M for the required voltage (-850 millivolts) output and shall be carried out by a person qualified to do the work.

3.3.19 Steel piping shall be tested for tightness prior to completing the coating of the fittings and joints and backfilling (see section 3.5 for details).

3.4 Basic Minimum Requirements for Steel Piping

3.4.1 Schedule 40 steel pipe, either galvanized or wrapped black iron, cathodically protected is required for use when steel underground installations are considered. Schedule 40 galvanized steel pipe is also required for aboveground vent piping.

3.4.2 Where black iron pipe is used the exterior of the line shall be coated or wrapped with a mastic or other similar approved coating material.

3.4.3 For galvanized piping where screwed fittings are used, the fittings, exposed thread and all wrench marks must be thoroughly coated with a mastic material or similar approved material capable of protecting bare steel from corrosion and resistant to petroleum products.

3.4.4 Product transfer lines from tanks to dispensers (including siphons used to equalize product levels in two or more tanks) shall be sized according to the recommendations of the pump manufacturer.

3.4.5 All buried metallic product transfer lines including vent piping, fill piping and flex connections must be cathodically protected to prevent corrosion. Cathodic protection systems for piping shall be independent of cathodic systems for underground tanks.

3.4.6 Connections between tank to pipe, and pipe to dispenser must be made by a swing joint system or flex connector that will provide for three-dimensional movement of the components. Swing joints or flexible connectors must be used at any change in direction.

3.4.7 It is recommended that each tank shall be vented through adequately sized, schedule 40 galvanized steel pipe.

3.4.8 The vent line shall be located at the opposite end of the tank from

the fill pipe.

3.4.9 The vent line must be cathodically protected and electrically isolated from other metallic components. The testing of the cathodic protection system must be done by trained individuals.

3.4.10 All free standing vent lines over 2 m (6 ft) in height shall be adequately supported to at least half height.

3.5 Placement of Backfill for Steel Piping Systems

3.5.1 Acceptable backfill/bedding material shall be free of debris, rock, ice, snow or organic material.

3.5.2 The bottom of the piping trench excavation shall be covered with compacted approved material to a minimum depth of 150 mm (6 inches).

3.5.3 Sand backfill shall be mechanically compacted to manufacturer's specified minimum compaction density.

3.5.4 Filter fabric shall be installed in every excavation where pea gravel or crushed stone is used since there is a potential for the migration of native soil into voids of the approved backfill.

3.6 Line Leak Testing for Steel Piping Systems

Steel underground piping shall be inspected and tested prior to actual usage.

3.6.1 Isolate piping from the tank, pumps and dispensers to prevent damage to these parts of the system.

3.6.2 A new piping system shall be subject to an air pressure test of 1 1/2 times the working pressure but not less than 350 kPa (50 psi).

3.6.3 This air pressure test shall be maintained without a loss for a minimum of 2 hours.

3.6.4 Soap all joints to assist in locating leaks. For lines that have contained petroleum product or that are suspected of leaking, the

only acceptable method of testing is a precision test.

3.6.5 Joints and fittings shall not be coated with the required mastic coating until the piping has been found to be product tight.

3.7 Basic Minimum Requirements for Double Wall Steel Piping

3.7.1 The secondary containment must extend from the manway at the tank to the containment sump at the dispenser.

3.7.2 Installation of double-walled steel piping shall be made in accordance with manufacturer's installation instructions. Requirements for trenching and cathodic protection are similar to those for conventional piping.

3.7.3 Air tight double walled piping systems do not need to have the inner metal product pipe cathodically protected.

3.7.4 Single walled pipes may be enclosed by a re-enforced flexible membrane which is ULC certified. The system must be designed to contain any spill or leak from the interior pipe.

3.7.5 Double walled piping systems must be equipped with ULC certified interstitial leak detection. Product dispensing capability shall be interlocked to the leak detection system such that the presence of product in the interstice will disable the ability to deliver product.

3.8 Testing for Double Wall Steel Piping

3.8.1 Testing is the most integral part of the installation process to ensure the integrity of the steel double wall piping system.

3.8.2 Piping tightness, as well as the satisfactory operation of monitoring systems, must be proven before the system is placed in operation. The following component tests shall be completed to ensure the integrity of a double wall system.

3.8.3 Testing of the cathodic protection system shall be conducted to ensure electrical continuity between the anodes and the pipes and to ensure electrical isolation between the piping and any other part of the storage system.

3.8.4 Before pressure testing the piping must be isolated from the tanks and dispenser units.

3.8.5 For new double wall piping systems, the primary product transfer lines shall be subject to an air test of 1 1/2 times the working pressure but not less than 350 kPa (50 psi).

3.8.6 The secondary containment piping shall be subject to an air test of 35 kPa (5psi).

3.8.7 The pressure testing shall be maintained without a loss for a minimum of 2 hours.

3.8.8 All joints must be soaped to assist in locating potential leaks.

3.8.9 For lines that have contained petroleum products or that are suspected of leaking, the only acceptable method of testing is a precision test.

3.9 Fibreglass Reinforced Plastic Product Transfer Lines

3.9.1 General

(1) All fibreglass reinforced plastic pipe shall be ULC-certified as meeting ULC/ORB - C107.7 - 1992, "Glass Fibre Reinforced Plastic Pipe and Fittings for Flammable Liquids".

(2) Installation of fibreglass pipe is different from the installation of steel pipe. The major difference is the fact that the pipe sections are joined together using an adhesive product rather than screwed fittings. For this reason the manufacturers of this type of pipe have taken great care in developing training manuals and programs for installers of their piping systems.

(3) Only certified installers who have been trained and approved by the pipe manufacturer may install fibreglass reinforced plastic piping.

3.10 Handling, Storage, Inspection and Materials for Fibreglass Piping

3.10.1 Inspection

(1) Upon receipt at the jobsite, and before starting installation, fully inspect the pipe for damage. Locate, cut out, repair or replace damaged pipe.

(2) Impact damage is usually recognizable as rounded pale areas just under the surface, or as deep gouges, scratches or cracks. Remove end protectors to inspect the taper for damage and then replace protectors.

3.10.2 Handling

(1) Fibreglass pipe is susceptible to damage if not handled correctly.

(2) Do not transport the pipe without proper protection against impact damage.

(3) Do not use chains to tie down the pipe on a truck. Use nylon straps or rope.

(4) Do not drop the pipe from a truck bed when placing pipe. Lay the pipe down by hand.

(5) All storage and truck pipe racks shall be padded (e.g. carpeting, inner tube, etc.) to prevent damage to the pipe wall. Tie the pipe down during transport to prevent it from bouncing on the racks and suffering impact damage.

(6) Pipe loads that are properly separated and supported can be unloaded by padded forklifts.

3.10.3 Materials Requirements

(1) Pipe furnished from the manufacturer is tallied on the basis of overall length.

(2) Some additional lengths should be ordered to offset cutting losses and contingencies.

(3) Calculate the number of adhesive bonds required. Refer to the line layout or blueprint supplied. Include bonds for all fittings, elbows, tees, reducers, adapters, and collars.

(4) A waste factor should be added to determine the total number of kits to be ordered. The shorter pot life at higher temperatures may not allow as many bonds to be made. At higher temperatures, allow for a greater waste factor.

3.10.4 Accessories

Tapering equipment, heating blankets, and Chem Cure Packs are available from the different pipe manufacturers.

3.10.5 Field Cuts and Taper

(1) Pipe can be cut easily in the field using a fine-bladed hacksaw or a circular saw with an abrasive wheel. Saw guides are recommended to ensure a square cut. If saw guides are not available, a "wrap around" should be used for marking the cut line. In order to provide a proper taper, the cut pipe end must be square to within 4.2 mm (3/16 in).

(2) The tapering tools are designed to cut a 1 3/4 degree taper on 50 mm (2 in) through 150 mm (6 in) pipe.

(3) For all cutting and tapering, the pipe must be held securely. Always wrap the pipe with protective material (rubber) before clamping to prevent damage to the pipe. Do not damage or over deflect the pipe when clamping.

3.10.6 Pre-installation Inspection

(1) Pipe is shipped from the factory with end protectors. Avoid contamination while handling. This includes fingerprints, petroleum fume/mist and condensation which is adverse to good bonding.

(2) If oil or grease does get on any tapered section, clean it sparingly with joint cleaner. Always lightly sandpaper surfaces after using joint cleaner and wipe off dust with a dry cloth. If dirt gets on any tapered section, sand it off with emery cloth. Never touch the bonding surface with bare

hands after cleaning or sanding as this will leave an oily deposit on the bonding surface.

(3) Adhesive will not bond to a wet surface. If the tapered section is wet or moist, dry it with a blow dryer or heat gun. Do not overheat or burn the pipe. The joint cleaner does not remove moisture. It fact, it can draw moisture from the air when used to clean the pipe.

(4) If the temperature is at or below 19 deg C (65 deg F) all glued joints must be forced dried.

3.10.7 **Making the joint - Stabbing Procedure**

(1) Align the mating surfaces so that they may be brought together in a straight line.

(2) Insert spigot all the way into ball.

(3) Twist one quarter turn while pushing together to evenly distribute adhesive and friction lock.

(4) Avoid cocking joint.

(5) Over-insertion can collapse the spigot end and cause a leaky connection.

(6) Under-insertion can cause a leaky connection.

(7) Do not drive the connection together with a hammer unless recommended by manufacturer.

(8) Do not disturb the connection while the adhesive is uncured. Do not move the pipe and fittings until adhesive is set.

3.10.8 **Curing the adhesive**

(1) The connections should not be disturbed until the adhesive is cured. If the air temperature is at or below 19 deg C (65 deg F) a forced curing procedure must be followed.

(2) Warm adhesive before mixing.

(3) Warm connecting surfaces before applying adhesive.

(4) Use a Chem-Cure-Pak or heating blanket.

3.10.9 Forced Curing

(1) At temperatures below 19 deg C (65 deg F) the adhesive will not gain sufficient strength to make an acceptable bond. When temperatures are expected to approach or be below 19 deg C (65 deg F) during cure time, forced curing is needed as directed by the applicable pipe manufacture.

(2) For temperatures lower than 18 deg C (0 deg F) or for extra heavy fittings, specific recommendations should be requested from the manufacturer.

3.11 Fibreglass Pipe Installation

3.11.1 Backfilling, Bedding and Covering

(1) The trench bottom must be graded to provide firm, even support for the bottom of the pipe.

(2) The trench bottom must be free of hard or sharp objects that could damage the pipe.

(3) Never leave empty adhesive cans, bottles, or trash in the ditch.

3.11.2 Trenching Layout

(1) Refer to section 3.2 "Pipe and Trench Layout".

(2) The layout of all fibreglass piping shall be dry fitted before applying adhesive to any joints.

(3) Although fibreglass pipe has high strength properties, it must be protected against impact damage which is most likely to result either from improper handling or during backfilling.

(4) Sand, pea gravel or fine crushed stone (see Section

B.2.6.1(2)) are required as padding to protect the pipe from damage during backfill and against abrasion during operation. When the pipe is laid near or through concrete, it must be wrapped with rubber or form padding to avoid direct contact, and the subgrade must be well compacted to prevent differential settling.

3.11.3 Burial and Backfill Depth

(1) When the pavement is reinforced concrete, at least 100 mm (4 in) thick, a minimum of 300 mm (12 in) of sand, pea gravel or fine crushed stone (see Section B.2.6.1 (2)) is required between the top of the pipe and the bottom of the concrete.

(2) When the pavement is an asphalt mix at least 150 mm (6 in) thick, a minimum of 300 mm (12 in) of sand, pea gravel or fine crushed stone (see Section B.2.6.1 (2)) is required between the top of the pipe and the bottom of the pavement. The above minimums are acceptable only if the backfill is sand, pea gravel or fine crushed stone.

(3) For multiple lines in the same ditch, separate the pipes by at least 100 mm (4 in) or two pipe diameters, whichever is greater.

3.11.4 Pipe Protection-General

(1) Although fibreglass pipe has high strength properties, it must be protected against impact damage which is most likely to result either from improper handling or during backfilling.

3.11.5 Protection Techniques

(1) Sand, pea gravel or fine crushed stone (see Section B.2.6.1 (2)} are required as padding to protect the pipe during backfill and against abrasion during operation.

(2) 300 mm (12 in) of sand or pea gravel shall surround the pipe. When the pipe is laid near or through concrete, it must be wrapped with rubber or foam padding to avoid direct contact, and the sub-grade must be well compacted to prevent

differential settling.

(3) When heavy items such as valves are used in a line, the weight of these fittings must be supported separately. This may require additional support or compaction under these items to prevent differential settling.

3.11.6 Pipe Testing

The following is offered only as a guide to testing fibreglass pipe. The Department of the Environment assumes no responsibility or liability for the consequences of any testing practices.

(1) Pressuring equipment should be suited to the size of the line and the pressure required. Pumps should have the capability of approaching test pressure on a gradual basis.

(2) **Gauges**

(a) Gauges should have a full scale reading of no more than twice the test pressure. i.e. do not use a 690 kPa (100 psi) gauge for a 69 kPa (10 psi) test. Gauges should be reliable, calibrated against a dead weight tester, and zeroed for atmospheric pressure.

(3) **Test Pressure**

(a) The recommended hydrostatic test pressure is one and a half times expected operating pressure or 345 kPa (50 psi) whichever is greater, and should be maintained for at least 10 minutes. Do not exceed one and a half times the rating of the system. Check the pressure rating of all components of the system--not just the pipe--because tanks or hoses are rated lower than the pipe. Always isolate the piping from the tanks when pressure testing the piping.

(b) Temperature changes can affect the pressure in the test line. In closed systems, where pipe is exposed to the sun, sizeable pressure increases may be experienced. An overnight decrease in pressure from afternoon to early morning is normal due to temperature changes and does not necessarily

indicate a leak.

(4) **Safety Considerations**

(a) Pressurizing equipment should be operated by qualified and experienced personnel only. Do not make any adjustments on pressurized fittings. For example, if a threaded adapter is leaking, release the pressure before attempting to tighten.

(b) The test operation should be well planned and carried out with all due precautions. Hydrostatic testing is recommended. Because liquids cannot be compressed, the effects of a sudden decompression due to a component failure are far less severe with liquids than those which can occur if air is used. If it is necessary to test with air, the system should be adequately restrained to prevent damage or injury should rapid decompression occur.

(c) Warning: Pneumatic testing is extremely dangerous and is not recommended.

3.11.7 Repairs

If damage occurs to the pipe, follow manufacture's instructions for repair procedures.

3.12 Fibreglass Secondary Containment System

3.12.1 General

(1) The Secondary Containment system is designed to encapsulate (double wall) products for handling flammable liquids. The Secondary Containment system consists of a larger size pipe and custom fabricated fittings that can totally contain primary piping (product, vapour recovery, etc.) from shear valve, under dispenser, to the product storage tank.

(2) All piping used for these systems shall be certified as meeting ULC/ORD C107.4 - 1992, "Ducted Flexible

Reinforced Plastic Pipe and Fittings for Flammable Liquids" and ULC/ORD C107.19 - 1992, "Secondary Containment of Underground Piping for Flammable and Combustible Liquids".

(3) Only certified contractors who have been trained and approved by the pipe manufacturer may install secondary containment systems.

3.12.2 On Site Inspection

(1) Primary piping inspection is especially critical on double wall projects. Damage caused by shipping or handling is not visible once piping is encased. Damaged pipe can be identified by localized discoloration of piping, minute cracks and deep scratches or gouges.

(2) Inspect Secondary Containment system piping and fittings for damage. Insure that sufficient nuts, bolts, washers and adhesive are available to join system together before starting installation of secondary containment system.

3.12.3 Trenching, Backfill and Bedding

(1) The trench bottom must be graded to provide firm, even support on the bottom of the pipe. The trench bottom must be free of hard sharp objects that could damage the pipe or fittings.

(2) At new facilities, island forms, pump or dispenser boxes and impact valves shall be staked in place before proceeding with piping.

(3) In areas not subject to traffic, a minimum of 450 mm (18 in) of sand, pea gravel or fine crushed stone is required between the top of the pipe and the ground surface to minimize likelihood of damaging the pipe.

(4) For multiple lines in the same ditch, separate the pipes by 100 mm (4 in) or at least two pipe diameters, whichever is greater.

(5) Although fibreglass pipe has high strength properties, it must

be protected against impact damage which is most likely to result either from improper handling or during backfilling.

(6) Sand, pea gravel or fine crushed stone (see Section B.2.6.1(2)) are required as padding to protect the pipe from damage during backfill and against abrasion during operation. When the pipe is laid near or through concrete, it must be wrapped with rubber or form padding to avoid direct contact, and the subgrade must be well compacted to prevent differential settling.

3.12.4 Dry Fitting Primary Piping

(1) Island forms, boxes, and shear valves shall be in place before proceeding with piping.

(2) It is necessary to completely dry fit the product lines, before attempting to install the secondary containment system.

(3) Allow sufficient clearance when dry fitting to accommodate dimensions of secondary containment fittings.

(4) **DO NOT BOND PRIMARY SYSTEM TOGETHER BEFORE THE SECONDARY CONTAINMENT SYSTEM HAS BEEN DRY FITTED.**

3.12.5 Dry Fitting Secondary Containment System

(1) Only after the primary piping has been completely dry fitted can assembly of the Secondary Containment system proceed.

3.12.6 Bonding and Testing Primary System

(1) Primary lines must be bonded and tested before installing the secondary containment fittings to allow visual and soap testing of primary lines fittings.

3.12.7 Adhesives

See sections 3.10.8 and 3.10.9.

(1) The full cure time as indicated by the manufacturer must

elapse prior to testing.

(2) At temperatures below 19 deg C (65 deg F), an external heat source must be used to force cure the adhesives.

3.12.8 Testing

(1) Secondary containment systems are intended to prevent accidental pollution of soil and water table. Shut off valves, leak detectors and similar devices must prevent the secondary containment system from seeing the operating pressure of primary lines.

(2) Low pressure air testing of approximately 35 kPa (5 psi) is allowable and is the preferred method of testing. In the Secondary Containment system, greater air pressures would be dangerous due to stored energy, which in the event of a sudden release will cause pipe and fittings to "whip" out of trench. A 35 kPa (5 psi) test will attest to integrity of system. If higher pressures are required, please consult the manufacturer.

(3) Pressure testing equipment can be connected to the Containment piping at a "U" trap if a threaded adapter is installed on the end or a saddle with a threaded outlet can be bonded to the containment pipe as directed by manufacturer.

3.13 Alternative Secondary Containment Piping Systems

In addition to double wall steel and double wall fibreglass piping, secondary containment piping can:

(a) be constructed and installed in accordance with ULC/ORD-C107.4, "Ducted Flexible Underground Piping Systems for Flammable and Combustible Liquids"; or

(b) consist of single wall piping contained within impervious underlayment as specified in Section B.1.3.2.

3.14 Appliance Piping

3.14.1 Except as provided in this Part, piping and pumping systems for underground storage tanks containing petroleum products shall be designed, built and installed in conformance with the NFC.

3.14.2 Subject to Sections B.3.14.3 to B.3.14.5, appliance supply piping and return piping and tubing used in conjunction with or part of a fuel oil storage tank system that is connected to an oil burning appliance shall be designed and installed in conformance with Part 8 of CSA Standard B139, Installation Code for Oil Burning Equipment.

3.14.3 All steel pipe, including galvanized pipe, shall be cathodically protected.

3.14.4 Supply and return line copper tubing does not need to be cathodically protected but it shall be:

(a) part of a secondary containment system; or

(b) installed within polyvinyl chloride (PVC) pipe or other material compatible with the petroleum product.

3.14.5 Buried supply and return line tubing shall slope towards the tank, at a rate greater than one per cent, and a manhole or an access point to the piping connections at the tank shall be provided so that the line leaks may be detected.

3.14.6 Compression fittings are not acceptable on appliance piping.

3.15 Leak Detection

Leak Detection in Pressurized Underground Piping

3.15.1 (1) Line leak detection devices shall be designed, built and certified in conformance with ULC/ORD - C107.12, "Line Leak Detection Devices for Flammable Liquid Piping" and shall be capable, as a minimum, of detecting a leak of 0.8 L/h with a probability of detection of 0.95 and a probability of false alarm of 0.05.

(2) Subject to Section B.3.15.1 (3), the line leak detection device shall be electrically interlocked in such a manner that:

(a) when the line leak detection device is activated, an audible and visual alarm shall be activated; and

(b) when the line leak detection device is turned off or bypassed for more than one minute, product flow shall be shut off; and

(c) when the detection device is activated, product flow shall be shut off.

(3) When electrical interlocking of the type required in Section B.3.15.1(2) is not possible, the Department shall be notified whenever the line leak detection device indicates a leak.

(4) Leak detection alarms shall be located in areas which are relatively staffed.

3.15.2 **Non-Pressurized Piping**

(1) Leak detection devices or methods shall be designed, built, certified and operated in conformance with:

(a) ULC/ORD - C58.12, "Leak Detection Devices (Volumetric Type) for Underground Flammable Liquid Storage Tanks";

(b) ULC/ORD - C58/14, "Nonvolumetric Leak Detection Devices for Underground Flammable Liquid Storage Tanks" and, as a minimum, shall be capable of detecting a leak of 0.8 L/h with a probability of detection of 0.95 and a probability of false alarm of 0.05.

(2) Groundwater monitoring wells designed and installed in conformacne with section C.8 shall be considered to provide leak detection equivalent to 0.8 L/h.

(3) Vapour monitoring systems designed and installed in conformance with section C.7 shall be considered to provide leak detection equivalent to 0.8 L/h.

4. SITE PROTECTION AND MONITORING

4.1 Overfill/Spill Protection

The following devices are considered to be acceptable for overfill or spill protection.

4.1.1 Spill Containment Devices

Installed at the top of the fill pipe, spill containment devices contain product spills which occur while disconnecting delivery hoses. These devices shall conform to the requirements of ULC/ORD-C58.19, "Standard for Spill Containment Devices for Underground Flammable Liquid Storage Tanks".

4.1.2 Overfill Protection Devices

Fitted on the drop tube inside a tank, overfill protection devices gradually reduce the flow of product into the tank as the product level approaches maximum capacity. These devices shall conform to the requirements of ULC/ORD-C53.15, "Standard for Overfill Prevention Devices for Flammable Liquid Storage Tanks".

4.1.3 High Level Sensors

Often incorporated in automatic tank gauging systems, this device triggers an alarm when the product level reaches a predetermined upper critical level.

4.1.4 Vent Float Valves

Fitted on the vent pipe extension inside the tank this device may only be used on heating oil tanks.

4.2 Leak Detection

The following technologies are considered to be acceptable methods of leak detection.

4.2.1 Electronic Liquid/Vapour Sensors

These devices, often used in conjunction with observation wells or as interstitial monitoring for double walled tanks, are electrically connected to a central control panel and alarm system. These devices shall be ULC-certified.

4.2.2 **Automatic Tank Gauging Systems**

These systems require the installation of probes and sensors for continuous product level monitoring inside the tank and are electrically connected to a remote readout location. These devices will be ULC-certified.

4.2.3 **Interstitial Leak Detection**

These mechanisms monitor the interstitial space between the inner and outer membranes of a secondary containment system through the use of liquid/vapour sensors, or a vacuum system in the case of double wall steel tanks.

4.2.4 **Observation Wells**

Observation wells must be detailed on all drawings submitted for registration approval. If more than one monitoring well is necessary then the wells must be numbered for easy tracking of results.

(1) Observation wells shall be installed in the tank excavation within 30 cm (12 inches) of the tank and typically extend 60 cm (24 inches) below the level of the tank or hold downpad.

(2) The well shall have a casing at least 100 mm (4 inches) in diameter and be constructed of factory perforated or slotted PVC, galvanized or coated metallic pipe with 0.50 mm (0.020 inch) openings and permeable backfill to permit water or released product to flow freely into the well.

(3) The top of the observation well shall have a removable, locking cap and shall be constructed and covered to restrict infiltration of surface water.

(4) Well covers shall be clearly marked with a black equilateral triangle on a white background and shall be secured to prevent accidental or intentional introduction of petroleum product into the well. Care must be taken to clearly differentiate observation wells from fill pipes.

(5) If two wells are necessary, they should be installed diagonally opposite at each end of the tank(s).

(6) Observation wells may be equipped with liquid/vapour sensor electrically connected to a central control panel system, with an alarm.

(7) Manual monitoring requires securing a water sample from the well for analysis, or using a portable hydrocarbon detection meter to test for petroleum vapours.

PART C - SPECIAL REQUIREMENTS FOR PETROLEUM STORAGE SITES - ABOVEGROUND AND UNDERGROUND TANK SYSTEMS

1. USED OIL

1.1 Used oil shall be as defined in the *Used Oil Regulations*.

1.2 Every used oil storage tank system shall:

(a)(i) be a ULC certified double walled tank with piping equipped with secondary containment and have ULC certified leak detection in the interstitial spaces or;

(ii) be a ULC certified single walled tank with secondary containment for bot the tank and attached piping; and

(b) have a permanent suction pipe filled with a liquid tight coupling for connection to the product removal suction hose; and

(c) have product removal or transfer connections located within a spill containment device.

1.3 Fill ports shall be:

(a) fitted with a funnel having a capacity of at least 25 L (5.5 gal Imp);

(b) a rain cover; and

(c) a screen to prevent foreign materials such as nuts, bolts and rags from entering the storage tank.

1.4 Used oil storage tanks shall be sufficiently vented to avoid vacuum collapse when removing product at a high rate.

2. MOTIVE FUELS

2.1 At every site where motive fuel is sold for vehicular use:

(a) ULC certified dispensers and dispenser sumps shall be used;

(b) tank systems must be equipped with a vapour probe leak detection system which is ULC certified. These probes must be compatible with the product to be detected and have audible and visual alarms located within view of the operators console. The equipment shall be of the type which will shutdown the power to the supply pumps when a leak is detected or when the power to the leak detection unit is disconnected;

(c) if underground storage tanks are used, shall have a minimum of two observation wells in each tank excavation; and

(d) if aboveground storage tanks are used, the tanks shall be protected from vehicular traffic.

2.2 All storage tank systems for motive fuels shall be equipped for future installation of vapour recovery systems.

2.3. Dispensers

2.3.1 Dispenser Units

Any dispenser unit for an aboveground or underground storage tank system:

(a) shall be shown on the drawing submitted for registration approval;

(b) shall be constructed on a base with a catchment area for containing leaked product, and shall have a concrete apron;

(c) shall have an electrically operated hose reel where the dispenser hose exceeds 6 m (20 ft) in length;

(d) shall have an automatic shut off valve located between the tank and the dispenser; and

(e) shall be equipped with devices to shut off power in case of emergency. A remote shut off device shall be located in a central office readily accessible to an attendant or, in the case of a keylock installation, an authorized user.

2.3.2 **Dispenser Island**

(a) All openings in new or re-used dispenser islands shall be equipped with a ULC certified containment sump;

(b) a concrete apron shall be included at all new or upgraded dispenser locations;

(c) an environmental concrete apron slab and an oil/water separator shall be installed at all new or upgraded installations where motive fuel is sold for vehicular use at all keylock and cardlock installations;

(d) all keylock and cardlock installations shall be provided with an alarm in the oil/water separator to alert the operator to a product spill;

(e) all aprons shall be constructed to a minimum of 0.5 m (18 in) beyond the reach of the dispenser hoses. The environmental apron shall have drains connected to the separator;

(f) the island must be at least 100 mm (4 in) high or have other substantial means of protecting the dispensers from collision damage;

(g) the operator shall have on hand and available for immediate use a sufficient amount of petroleum-absorbent material and/or equipment required to contain and clean up spilled product.

3. SELF SERVE/CARDLOCK/KEYLOCK OUTLETS

1. All nozzles at self serve, cardlock or keylock outlets must be ULC certified and shall be either:

   i) kept open only by the continuous application of manual pressure, or
   ii) equipped with a hold open device and a break away coupling conforming to ULC S644M, "Emergency Breakaway Fittings for Flammable and Combustible Liquids".

2. Clearly legible operating instructions, visible at all times, shall be posted at every dispenser at all self serve, cardlock or keylock outlets.

3. The console operator at a self serve outlet shall have an acceptable manual depicting the outlet's policy on self serve operation including:

   i) safety requirements,
   ii) preventative maintenance,
   iii) fire prevention and spill prevention, and
   iv) emergency procedures.

4. The console operator at a self serve outlet shall be trained in accordance with the manual.

5. All self serve outlets shall have a 2 way communication system between the console and the dispenser island.

6. Self serve outlets shall have an emergency shut off switch located at the console to shut off power to the dispensers.

7. The control console at self serve outlets shall be within 25 m of all dispensers and the console operator shall have an unobstructed view of the dispenser.

8. Card operated and preset dispensers are permitted at self serve outlets provided there is a minimum of one console operator for each 12 nozzles.

9. Emergency instructions for cardlock or keylock outlets shall be conspicuously posted to advise the user:

   i) how to use the emergency shut off switch, and
   ii) the telephone numbers of emergency response personnel.

10. Every cardlock or keylock outlet shall have a telephone readily accessible to the user.

11. All cardlock or keylock outlets shall have an emergency shut off switch readily accessible to the user to shut off power to the dispensers.

12. All new or upgraded cardlock or keylock outlets shall have at each dispenser island a environmental concrete apron that drains to an oil/water separator (see Section 3).

4. OIL/WATER SEPARATORS

4.0 All oil/water separators shall be ULC-certified in conformance with other:

(a) ULC/ORD - C58.24 - 1993, "Underground Oil/Water Separators", or
(b) ULC/ORD - C142.24 - 1991, "Aboveground Oil/Water Separators".

4.1 Design

4.1.1 The separator shall be designed to capture a spill of petroleum product of a volume equal to the amount of petroleum product transferred in 2 minutes at the highest pumping rate used within the area that drains to the oil/water separator..

4.1.2 As well, when subject to runoff, the separator shall be designed to operate in conformance with Section C.4.1.3 when subject to runoff flows resulting from a storm event equal to a 1 in 10 year rainfall.

4.1.3 The separator shall be designed, maintained and operated such that the effluent discharge from the separator has a concentration of petroleum product not exceeding 15 mg/l (15 ppm) of oil and grease as measured by the partition-gravimetric method or other method as approved by an Administrator.

4.1.4 All separators shall be equipped with a watertight manway and, where located under a building slab, be vapour proof except for a vent which shall extend outdoors.

4.1.5 The separator shall be equipped such that an easy access is available for monitoring and effluent sampling.

4.1.6 The separator shall be equipped with a gate valve at the outlet of the separator to permit rapid and complete shutdown of the system in an emergency.

4.1.7 The separator shall be vented to prevent the buildup of hydrocarbon vapours in the system.

4.1.8 The separator shall be equipped so as to allow the removal of separated free petroleum products from the unit.

4.1.9 The separator shall be equipped with a sludge baffle to retain settleable

solids and sediments and prevent them from entering the settling chamber.

4.2 **Operation**

4.2.1 The separator is to be inspected regularly and shall have accumulated sediments and petroleum products removed from their respective chambers.

4.2.2 The effluent water from the separator shall be discharged to one of the following:

(a) a municipal sewer system, with the permission of the municipality;

(b) a separate holding tank for collection and disposal at an approved sewage treatment plant; or

(c) to free drainage where site conditions permit and the discharge will have no adverse effects on other properties. On-site discharge is only acceptable with the written approval of an inspector and may require additional treatment or other conditions imposed by the inspector.

4.2.3 The collection and disposal of petroleum products and sludge from separators must be done in accordance with Departmental policy.

5. MARINA SITES

5.1 **Location**

5.1.1 Storage tank systems shall be located at vertical distance of at least 4.5 m (15 ft) above the high water mark.

5.1.2 (1) Subject to the *National Fire Code*, storage tanks may be located in non-combustible buildings on piers and wharves of the solid fill, non-combustible construction type.

(2) When the pier or wharf is not constructed of concrete or other non-combustible material, any storage tank in excess of 230 L (52 gal Imp) shall be located 5 m (16 ft) on a horizontal distance from that structure.

5.2 Safety

5.2.1 Tanks shall be protected from traffic by appropriate vehicle barriers, and shall be located inside a security fence at least 1.8 m (6 ft) high.

5.2.2 Where a storage tank at a marina is at an elevation above the dispensing unit or the product line to the dispensing unit the storage tank outlet shall be equipped with an electrically operated, normally closed safety control valve positioned adjacent to and down gradient of the tank isolation valve so as to prevent syphoning in the event of a rupture of the supply line to the dispensing unit. The safety control valve shall not open unless the dispenser pump is activated. An option would be an anti-syphon valve.

5.2.3 All marinas shall be equipped with a containment device into which portable containers are placed when being fuelled.

5.3 Piping and Dispensing

5.3.1 Piping

(1) Lines between a storage tank located on shore and a dispensing unit located on a floating structure shall be equipped with a suitable length of flexible hose to accommodate changes in water levels.

(2) Joints between flexible lines at the dispensing units shall be equipped with a device that when severed will automatically stop the flow of petroleum product.

(3) Where piping is located on or above the surface of a pier or wharf, the line shall be protected from impact and damage. As well, piping shall be located so that it is not possible to use the piping as a cleat or tie-up point for watercraft.

(4) Where piping changes from below ground to above ground the transition shall be through a suitable flexible joint system to allow for any differential movement between the two segments of the line.

5.3.2 Dispensers

(1) The dispenser unit located on any pier or wharf shall be protected from accidental damage by water craft or motor vehicle.

(2) The dispenser unit shall be securely mounted to the pier or wharf. For seasonal installations either:

(a) the dispensing unit shall be removed from the pier or wharf and the lines drained and capped during the off season, or

(b) the entire system shall be drained of all product.

(3) The flexible hose between the dispenser and the dispensing nozzle shall not be over 4.5 m (15 ft) in length. Where a retracting mechanism used, the hose shall not exceed 6 m (20 ft) in extended length without the prior written approval of an Administrator or inspector.

(4) The flexible hose between the dispenser and the dispensing nozzle shall be connected to the dispensing unit by an emergency separation device that will automatically stop the flow of product in the event of an accidental separation.

(5) Under no circumstances shall a permanently installed dispenser unit be located at a point below the high water mark.

(6) The dispenser nozzle shall be the automatic closing type without a hold open device.

6. TANK REMOVAL/ABANDONMENT

6.1 **Removal**

6.1.1 (1) When removing any underground storage tank system due to detected leakage, excessive age or redundancy, all associated piping and supports, including cement slabs and anchors, must be removed as well unless approved in writing by an Administrator or an inspector.

(2) When removing any aboveground storage tank system, all associated piping must also be removed. If the site, including the support base and dyking, is not to be reused for petroleum storage, all groundworks associated with the storage tank system must also be removed.

6.1.2 (1) When removing the storage tank system, the following procedure must be followed:

(a) all liquid petroleum products shall be removed from the storage tank system;

(b) sludge remaining in the system shall be removed and treated or disposed of in a manner acceptable to the Department;

(c) the storage tank system shall be purged of petroleum vapour to a sustained level of less than 10% of the lower flammable limit for the product stored in the system; and

(d) sufficient openings shall be cut in the storage tanks to render them unfit for further use for petroleum product storage.

(2) The installer shall complete and submit to the Department a Petroleum Storage Tank System Removal Report.

6.2 **Disposal**

6.2.1 All removed tanks shall be disposed of at a facility approved by the Department.

6.2.2 Facilities accepting tanks for disposal must have the prior written approval of an administrator and must also have a current registration as a salvage yard.

6.3 **Remediation**

6.3.1 When storage tank systems are removed, the site must be assessed for contamination by petroleum products and appropriate samples taken and analyses performed to meet the requirements of the Department's policies and guidelines.

6.3.2 If contamination is identified, the affected site shall be remediated to the satisfaction of the Department. The remediation will take into consideration the particular site's current and proposed future usage or zoning.

6.4 **Abandonment In-place**

6.4.1 When an owner or operator of an underground storage tank system is required to or desires to discontinue the use of that system and it is impractical for physical reasons to remove the system, the owner or operator shall apply in writing to the Department for approval for abandonment in place.

(a) The written application must describe in detail the reasons why removal is not practical.

(b) Financial hardship or inconvenience will not be considered as reasons precluding removal of a storage tank system.

6.4.2 Within 60 days of receipt of a complete application for abandonment in-place, the Department will issue a written reply either granting or denying approval.

6.4.3 If permission for abandonment in-place is received, the abandonment shall comply with the following procedure:

(a) any liquid or sludge in the storage tank system shall be removed and used or disposed of in a manner acceptable to the Department;

(b) the system shall be purged of petroleum vapours to a sustained level of less than 10% of the lower flammable limit for the product stored in the system;

(c) the storage tank shall be completely filled with non-degradable inert material (this procedure may require the cutting of additional holes in the top of the tank);

(d) associated aboveground piping shall be removed and properly disposed of; and

(e) a record of the size, description and location of the storage tank system shall be:

(i) permanently appended to the deed of the property; and
(ii) a copy of the deed sent to the Department.

6.4.4 Aboveground tanks shall not normally be abandoned in-place. However, an inspector or an Administrator may issue written approval after reviewing

a written report by the tank owner giving:

(a) reasons why removal is not practical;
(b) methods used to remove petroleum and residue from tanks;
(c) method to label tanks as unsuitable for foodstuffs or potable water; and
(d) proposed final use of tank.

7. VAPOUR MONITORING

7.1.1 **Design**

Where vapour monitoring is to be used, a hydrogeologist or other person experienced in the design of vapour monitoring systems shall:

(a) assess the site and establish the number and positioning of the monitoring wells so that product releases from any portion of the storage tank system that routinely contains a petroleum product will be detected; and

(b) ensure compliance with the requirements of this Section.

7.1.2 The product stored or tracer compound placed in the storage tank system shall be sufficiently volatile to result in a vapour level that is detectable by the monitoring devices.

7.1.3 The measurement of vapours by the monitoring device shall not be rendered inoperative by the groundwater, rainfall, soil moisture, or other known interferences so that a leak could go undetected for more than 30 days.

7.1.4 The level of background contamination shall not interfere with the method used to detect leaks from the storage tank system.

7.1.5 Vapour monitors are not suitable for fuel oils or diesel and shall not be used for leak detection for these substances.

7.1.6 The vapour monitors shall be ULC approved or approved by an Administrator.

7.1.7 The vapour monitors shall be designed and operated to detect any significant increase in concentration above the background level of:

(a) the petroleum product stored;
(b) a component or components of the petroleum product, or
(c) a tracer compound placed in the storage tank system.

7.2.1 **Installation**

If more than one monitoring well is necessary to monitor an installation effectively, the monitoring wells shall be numbered so that all monitoring and testing results shall be easily correlated to a specific monitoring location.

7.2.2 (1) Vapour monitoring wells shall be equipped with liquid-proof caps.

(2) Monitoring wells shall be distinguished from fill pipes and marked in conformance with "Using the CPPI Colour-Symbol System to Mark Equipment and Vehicles for Product Identification".

(3) Monitoring wells shall be secured to prevent unauthorized access and tampering.

7.2.3 Vapour monitoring wells that are located in traffic areas shall be cut off at ground level and/or properly protected from vehicles.

7.2.4 Vapour monitoring wells installed within the interstitial space of a secondary containment system shall not penetrate the liner.

7.2.5 Any damaged monitoring well shall be repaired or replaced within 30 days after discovery of the damage.

8. VERTICAL GROUNDWATER MONITORING WELLS

Design

8.1.1 When vertical groundwater monitoring wells are to be used, a hydrogeologist or other person experienced in the design of monitoring wells shall:

(a) assess the site and establish the number and positioning of the monitoring wells so that product releases from any portion of the storage tank system that routinely contains a petroleum product will be detected; and

(b) ensure compliance with the requirements of this section.

8.1.2 The product stored in the storage tank shall have a specific gravity of less than one.

8.1.3 Groundwater monitoring wells may be used as leak detection only if the groundwater surface is less than 7 m (23 ft) from the ground surface.

8.1.4 The hydraulic conductivity of the soil between the storage tank system and the monitoring well shall not be less than 0.01 cm/s.

Installation

8.2.1 Monitoring wells shall be a minimum of 50 mm (2 in) in diameter.

8.2.2 (1) Subject to Section C.7.2.4, if the monitoring well is eventually to be used as a recovery well, the screened zone shall extend at least 1.5 m (5 ft) into the water table and at least 1.5 m (5 ft) above the groundwater surface, as determined at the time of installation.

(2) Subject to Section C.7.2.4, the screened portion of the monitoring well shall be a minimum of 3.0 m (10 ft) in length and shall be factory slotted with a slot size of 0.25 mm.

8.2.3 (1) The area around the screened portion of the monitoring well shall be surrounded by a filter pack.

(2) Subject to Section C.7.2.4, the filter pack shall extend to 0.5 m (18 in) above the top of the screened portion of the well.

(3) The outside of the monitoring wells shall be sealed from the ground surface to the top of the filter pack using bentonite, grout, or other material with equivalent performance.

8.2.4 Where the groundwater surface is less than 2.5 m (8 ft) from the ground surface, a hydrogeologist or other person experienced in the design of monitoring wells shall determine the length and position of:

(a) the screened portion of the well
(b) the filter pack; and
(c) the bentonite or other seal.

8.2.5 Monitoring wells shall be installed with a cap at the bottom of the screened section of the well.

8.2.6 Monitoring wells shall be constructed of flush joint, threaded, or bell and spigot Schedule 40 PVC or other brands of PVC with equivalent or greater wall thickness.

Identification

8.3.1 If more than one monitoring well is necessary to monitor an installation effectively, the monitoring wells shall be numbered so that all monitoring and testing results can be easily correlated to a specific monitoring location.

8.3.2 (1) Monitoring wells shall be equipped with liquid-proof caps.

(2) Monitoring wells shall be distinguished from fill pipes and marked in conformance with "Using the CPPI Colour-Symbol System to Mark Equipment and Vehicles for Product Identification" (CPPI, 1990).

(3) Monitoring wells shall be secured to prevent unauthorized access and tampering.

Operation

8.4.1 Continuous monitoring devices or manual methods shall be able to detect at least 3 mm (1/8 in) of free product on top of the groundwater surface in the monitoring well.

8.4.2 Monitoring wells that are located in traffic areas shall be cut off at ground level and/or properly protected from vehicles.

8.4.3 Monitoring wells installed within the interstitial space shall not penetrate the liner.

8.4.4 Any damaged monitoring well shall be repaired or replaced within 30 days after discovery of the damage.

Appendix A - Bibliography

Unless specifically referred to in a section of the Nova Scotia Standard, the documents listed in Table 1 are intended for information only.

Table 1. Documents

Issuing Agency/ Document Number	Title
American Petroleum Institute	
API Recommended Practice 651	Cathodic Protection of Aboveground Petroleum Storage Tanks
API Recommended Practice 652	Lining of Aboveground Petroleum Storage Tank Bottoms
API Standard 650	Welded Steel Tanks for Oil Storage
API Standard 653	Tank Injection, Repair, Alteration and Reconstruction
API Standard 2610	Design, Construction, Operation, Maintenance and Inspection of Terminal and Tank Facilities
API 5L	Line Pipe
ASTM A53 American Society for Testing Materials	Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless
Canadian Council of Ministers of the Environment	
CCME-EPC/TRE-30E	Environmental Code of Practice for Vapour Recovery in Gasoline Distribution Networks - 1991
CCME-EPC-87E	Environmental Guideline for Controlling Emissions of Volatile Organic Compounds from Aboveground Storage Tanks - 1994
CCME-EPC-CS34	Interim Canadian Quality Criteria for Contaminated Sites
CCME-EPC-LST-61E	Environmental Code of Practice for Underground Storage Tank Systems Containing Petroleum Products and Allied Petroleum Products - 1993

Issuing Agency/ Document Number	Title
CCME-EPC-LST-71E	Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products - 1994
Canadian Petroleum Products Institute	
CPPI/PACE Report 87-1	Guideline Specification for the Impressed Current Method of Cathodic Protection of Underground Petroleum Storage Tanks
CPPI (1990)	Using the CPPI Colour-Symbol System to Mark Equipment and Vehicles for Product Identification
CPPI (1992)	The Petroleum Products Professional Driver's Manual
Canadian Standards Association	
CAN/CSA-B139-M91	Installation Code for Oil Burning Equipment
CAN/CSA-B140.0	General Requirements for Oil Burning Equipment
CSA Z 245.1	Steel Line Pipe
Environmental Protection Agency	
EPA 530/UST-90-007	Standard Test Procedures for Evaluating Leak Detection Methods: Statistical Inventory Reconciliation Methods
National Research Council	
NRCC 30621	National Fire Code of Canada (NFC) - 1995
New York Department of Environmental Conservation	
	Recommended Practices for Aboveground Storage of Petroleum Products - 1987
Underwriters' Laboratories of Canada	
ULC-S601-93	Standard for Shop Fabricated Aboveground Horizontal Tanks for Flammable and Combustible Liquids
CAN/ULC-S601(A)	Shop Refurnishing of Steel Aboveground Horizontal Tanks for Flammable and Combustible Liquids
CAN/ULC-S602-92	Standard for Aboveground Steel Tanks for Fuel Oil and Lubricating Oil

Issuing Agency/ Document Number	Title
CAN/ULC-S603-92	Standard for Steel Underground Tanks for Flammable and Combustible Liquids
CAN/ULC-603.1-92	Refurbishing of Steel Underground Tanks for Flammable and Combustible Liquids
CAN/ULC-S612-M88	Standard for Hose for Flammable and Combustible Liquids
CAN/ULC-S615-M92	Standard for Reinforced Plastic Underground Tanks for Petroleum Liquids
CAN/ULC-S615(A)-87	Refurbishing of Reenforced Plastics Underground Tanks for Petroleum Fuels
CAN/ULC-S616-M93	Standard for Liquid Protective Coating Materials for Steel Storage Tanks and Associated Equipment for Flammable and Combustible Liquids
CAN/ULC-S618-M	Standard for Magnesium and Zinc Anode Assemblies and Zinc Reference Electrodes
ULC-S630-93	Standard for Shop Fabricated Steel Aboveground Vertical Tanks for Flammable and Combustible Liquids
CAN/ULC-S630(A)	Shop Refurbishing of Steel Aboveground Vertical Tanks for Flammable and Combustible Liquids
CAN/ULC-S633-M90	Standard for Flexible Underground Hose Connectors for Flammable and Combustible Liquids
CAN/ULC-S634-Me	Standard for Hose Swivel Connectors for Flammable and Combustible Liquids
ULC-S652-93	Standard for Tank Assemblies for Collection of Used Oil
ULC-S653-94	Standard for Aboveground Steel Contained Tank Assemblies for Flammable and Combustible Liquids
ULC/ORD-C58.9-1993	Secondary Containment Liners for Underground and Aboveground Flammable and Combustible Liquid Tanks
CAN/ULC-S631-M84	Standard for Isolating Bushings for Steel Underground Tanks Protected with Coatings and Galvanic Systems
CAN/ULC-S642-M87	Standard for Compounds and Tapes for Threaded Joints

Issuing Agency/ Document Number	Title
CAN/ULC-S643-M90	Standard for Shop Fabricated Steel Aboveground Utility Tanks for Flammable and Combustible Liquids
CAN/ULC-S644-M90	Standard for Emergency Breakaway Fittings for Flammable and Combustible Liquids
CAN/ULC-S651-M90	Standard for Emergency Valves for Flammable and Combustible Liquids
CAN/ULC-S620-M90	Standard for Hose Nozzle Valves for Flammable and Combustible Liquids
ULC/ORD-C58.19-1992	Spill Containment Devices for Underground Flammable Liquid Storage Tanks
ULC/ORD-C58.24-1993	Underground Oil/Water Separators
ULC/ORD-C58.10-1992	Underground Jacketed Steel Tanks for Flammable Liquids
ULC/ORD-C58.12-1992	Leak Detection Devices (Volumetric Type) for Underground Flammable Liquid Storage Tanks
ULC/ORD-C58.14-1992	Nonvolumetric Leak Detection Devices for Underground Flammable Liquid Storage Tanks
ULC/ORD-C58.15-1992	Overfill Protection Devices for Flammable Liquid Storage Tanks
ULC/ORD-C107.4-1992	Ducted Flexible Reinforced Plastic Pipe and Fittings for Flammable Liquids
ULC/ORD-C107.7-1992	Glass Fibre Reinforced Plastic Pipe and Fittings for Flammable Liquids
ULC/ORD-C107.12-1992	Line Leak Detection Devices - Flammable Liquid Piping
ULC/ORD-C107.19-1992	Secondary Containment of Underground Piping for Flammable and Combustible Liquids
ULC/ORD-C107.21-1992	Under-Dispenser Sumps
ULC/ORD-C142-3-1991	Contained Steel Aboveground Tank Assemblies for Flammable and Combustible Liquids
ULC/ORD-C142-16.1994	Protected Aboveground Tank Assemblies for Flammable and Combustible Liquids

Issuing Agency/ Document Number	Title
ULC/ORD-C142-19-1992	Spill Containment Devices for Aboveground Flammable Liquid Storage Tanks
ULC/ORD-C142.23-1991	Aboveground Waste Oil Tanks
ULC/ORD-C142.24-1991	Aboveground Oil/Water Separators
ULC/ORD-C842-1992	Valves for Flammable and Combustible Liquids

Abbreviations

The abbreviations used in the Nova Scotia Standard for the names of associations or other codes shall have the meanings assigned to them in this Article. The addresses of the associations or code-sponsoring organizations are given in brackets.

API American Petroleum Institute (1220 L Street N.W., Washington, D.C. 20005. Phone: 202-682-8375 FAX: 202-682-8537)

CAN National Standards of Canada.

CCME Canadian Council of Ministers of the Environment (326 Broadway, Suite 400, Winnipeg, Manitoba R3C 0S5. Phone: 204-948-2090 FAX: 204-948-2125).

CGSB Canadian General Standards Board (1402-222 Queen Street, Ottawa, Ontario K1A 1G6. Phone: 613-941-8640 FAX: 613-956-4716)

CPPI Canadian Petroleum Products Institute (1000 - 275 Slater Street, Ottawa, Ontario K1P 5H9. Phone: 613-232-3709 FAX: 613-236-4280) (formerly known as PACE--Petroleum Association of Conversation of the Canadian Environment)

CSA Canadian Standards Association (178 Rexdale Blvd., Rexdale, Ontario M9W 1R3. Phone: 416-747-4363 FAX: 416-747-4149)

EPA U.S. Environmental Protection Agency, Office of Underground Storage Tanks (401 M Street S.W., Mailing - 05400WF, Washington, D.C. 20460. Phone: 703-308-8850 FAX: 703-308-8505)

NACE National Association of Corrosion Engineers International (1440 South Creek Drive, P.O. Box 218340, Houston, Texas 77218. Phone: 713-492-0535 FAX: 713-492-8254)

NFC *National Fire Code of Canada*, published under the auspices of the National Research Council of Canada (National Research Council of Canada, Ottawa, Ontario K1A 0R6. Phone: 613-993-2463 FAX: 613-954-5984)

ULC Underwriters' Laboratories of Canada (7 Crouse Road, Scarborough, Ontario M1R 3A9. Phone: 416-757-3611 FAX: 416-757-9540)