# Code of Practice for the

# DESIGN, INSTALLATION AND OPERATION OF UNDERGROUND PETROLEUM STORAGE SYSTEMS

OCCUPATIONAL SAFETY & HEALTH SERVICE

DEPARTMENT OF LABOUR
TE TARI MAHI

**Addendum:**
**Health and Safety in Employment Act 1992**

Since this booklet was first published, the Health and Safety in Employment Act 1992 has come into force. While the technical and general information in this booklet remains current, it contains reference to legislation which has been superseded by the new Act. You are advised to read this booklet in conjunction with the new Act and any relevant regulations made under it. Your local Occupational Safety and Health Service office can provide further information.

**Acknowledgement**

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# CONTENTS


| *Section* | *Heading* | *Page* |
|---|---|---|
| 1 | Objective | 4 |
| 2 | Summary | 4 |
| 3 | Introduction | 5 |
| 4 | Purpose | 6 |
| 5 | Scope | 6 |
| 6 | Definitions | 6 |
| 7 | Installation Contractors | 8 |
| 8 | Drawings and Specifications | 8 |
| 9 | Safety of Works | 11 |
| 10 | Site Analysis | 13 |
| 11 | Removal of Tanks | 15 |
| 12 | Tanks | 18 |
| 13 | Piping Systems | 28 |
| 14 | Pipework Installation | 33 |
| 15 | Cathodic Protection | 35 |
| 16 | Leak Monitoring | 38 |
| 17 | Operation | 40 |
| 18 | Product Loss Investigation | 41 |
| 19 | Leak Testing | 42 |
| 20 | Site Records | 43 |
| 21 | Change of Ownership | 44 |
| Appendix A | Leak Testing Procedure for Existing UPSS | 47 |
| Appendix B | Tank Disposal Notice and Acceptance | 48 |
| Appendix C | Safe Handling of Petroleum Products | 50 |
| Appendix D | Tank Construction Specifications Approved by the Chief Inspector of Dangerous Goods | 53 |
| Appendix E | Recommended Pressure Tests for New Tanks | 54 |
| Appendix P | Glass Reinforced Polyester Underground Petroleum Storage Tanks | 57 |

# 1. OBJECTIVE

This code of practice has been prepared as a statement, both of policy and of specific measures to be taken, to ensure safe and efficient storage of petroleum products in underground tank systems, with special regard for the highest levels of protection for people, property, and the environment.

The code has been jointly prepared by:

Explosives and Dangerous Goods Division, Department of Labour

Ministry for the Environment

BP Oil New Zealand Limited

Caltex Oil (N.Z.) Limited

Mobil Oil New Zealand Limited

Shell Oil New Zealand Limited.

The code is intended to be read in conjunction with, and to complement, the Dangerous Goods Act and Regulations. It does not replace or supersede the requirements of the Act or the Regulations but provides guidance on how they can be met, and at the same time the environment can be protected from the potential hazards of petroleum product leakage. It is not intended to be used as a technical specification. It must be supported by detailed technical documentation to obtain approval for any project work from a licensing authority.

# 2. SUMMARY

The handling of petroleum products has always involved risk. The hazardous nature of the products handled and the serious potential consequences of system failure have required the oil industry to become highly accomplished in the management of this risk to a level at which the probability of system failure is acceptably remote.

One of the first principles in handling hydrocarbon fuels is to keep the product within the system. The primary concern is to engineer and operate the system to ensure that at all times the product is contained. The consequences of system failure may then be regarded as the result of exceptional circumstances rather than a hazard associated with normal operation.

This code of practice has been prepared in response to concern over the integrity of Underground Petroleum Storage Systems (UPSS) and reflects collective experience and expertise in risk management.

The UPSS is to be engineered, installed and operated so that the possibility of product release into the ground is minimised by:

- A high standard of engineering and installation reflecting currently available and proven technology.
- The application of regular detailed inventory control so that any product loss will be detected at the earliest stage.
- Prompt physical leak detection.
- Immediate and appropriate response to product release.

Specifically, the above is to be accomplished by:

- Careful selection of materials used.
- Corrosion protection of steel tanks and pipework.
- Overfill protection.
- Spill containment for the fill points of tanks.
- Strict supervision and control of installation standards and procedures.
- Use of approved contractors.
- Inventory control records maintained on-site and available for inspection.
- Verification of system integrity:
  - at manufacture, by tank testing;
  - during installation, by tank and line testing; and
  - during operation, by tank and line testing and by regular confirmation of satisfactory operation of any special systems installed.

# 3. INTRODUCTION

Increased concern over the potential incidence and effect on the environment of leakage from UPSS, principally at service stations and consumer premises, has led to a review of the engineering, equipment, installation and operating procedures associated with these facilities.

This code of practice is the result of that review. The code defines requirements for the storage of hydrocarbon products underground, and states specifically and in detail how these facilities and the individual items therein shall be designed, fabricated, installed and commissioned.

The code will be reviewed from time to time as the requirements of society change and available technology improves. Such reviews should be undertaken at least every five years by the representatives of all those who have contributed to its preparation.

# 4. PURPOSE

To ensure that the possibility of a product release from a UPSS of sufficient magnitude to be hazardous to life, health, property or the environment is minimised.

To stipulate procedures equipment and construction details that must be followed in the design, installation and operation of underground petroleum storage systems by all owners, operators and installers of UPSS.

To ensure that high standards of engineering and installation practice are applied in all UPSS.

To provide UPSS that will store and dispense their contents in a safe, efficient, effective and workable manner.

# 5. SCOPE

This code of practice applies to all underground petroleum storage systems where hydrocarbon products (such as automotive, aviation and industrial fuels, and non-toxic solvents) are stored underground in tanks.

All new storage systems shall be engineered and installed in accordance with this code.

All new and existing storage systems shall be operated in accordance with this code, and any alterations and additions shall meet all applicable requirements of it.

# 6. DEFINITIONS

For the purpose of this code, the definitions listed below shall apply.

## 6.1 Applicable Regulations

Regulations and/or by-laws that apply in the region, or municipality in which the storage system is to be installed, which apply to the work being carried out and to the equipment being installed in the course of the works.

## 6.2 Approved

Approved by the appropriate authority.

## 6.3 Authority

The authority having statutory control over, or obligation to control, a particular aspect of the works.

### 6.4 Contractor

The person or company engaged by the principal to carry out installation or maintenance work.

### 6.5 Inspector

The Inspector of Dangerous Goods responsible for the area in which the UPSS is situated.

### 6.6 Licensing Authority

The authority responsible for the issue of dangerous goods licences in the area in which the UPSS is situated.

### 6.7 Monitoring Wells

Wells installed at a distance from the UPSS to allow the spread of hydrocarbons through the ground to be monitored should a leak occur. (See section 16.)

### 6.8 Observation Wells

Wells installed within the UPSS excavation to allow any hydrocarbons in the ground to be detected. (See section 12.9.3.)

### 6.9 Operator

The person responsible for the operation of the UPSS.

### 6.10 Owner

The owner of the storage system as distinct from the owner of the land upon which the storage system is installed.

### 6.11 Principal

The person or company who contracts to have the work carried out on their behalf.

### 6.12 Project Engineer

The person who is to administer the contract between the contractor and the principal on behalf of the principal. In most cases, the project engineer will be an employee of the principal; however, the principal may engage a third party to administer the works.

### 6.13 Purchaser

The purchaser of an item of equipment as distinct from the eventual owner of that item.

### 6.14 Shall, Must, Should, May

The words “shall’’ and “must” are to be understood as mandatory and

the word “should” as advisory. The word “may” means that discretion may be used.

### 6.15 Site

That portion of the property on which the storage system is located that may reasonably be considered to be associated with the storage system and the operation thereof.

### 6.16 Storage System

The whole system used for underground storage of hydrocarbon products comprising underground tanks, all associated pipework, fittings, vents, fill points and dispensing equipment.

### 6.17 Underground Tank

A tank capable of storing hydrocarbon products which is installed below the surface of the ground and entirely covered with backfill, and as defined in the Dangerous Goods Regulations.

### 6.18 UPSS

The Underground Petroleum Storage System.

# 7. INSTALLATION CONTRACTORS

The engagement of skilled professional UPSS installers is a vital factor in avoidance of system failures. The installation of storage systems for flammable and combustible liquids is a unique field. Whilst every effort is to be made to adequately design and document UPSS, the ability to recognise and react to unexpected, abnormal conditions encountered during an installation job requires experience as well as skill.

Experience has shown that a high proportion of system failures are attributable to poor workmanship. To ensure that high standards are achieved, the Principal shall only engage contractors whom he is satisfied are capable and knowledgeable in the type of work required, to undertake the installation of UPSS.

Furthermore, all installation work shall be supervised by a suitably trained and experienced project engineer or his nominee who must inspect work in progress, witness all tests and document his approval.

# 8. DRAWINGS AND SPECIFICATIONS

Drawings and specifications are required to provide guidance for installers and a record of all components of the UPSS. The drawings

must adequately describe the property and identify the size and location of the tanks, and products to be stored, as well as the location of the pumps and piping, protection system and cabling. The plans and specifications must also detail the materials of construction and piping dimensions, as well as dimensions and locations of vents. The choice of suitable approved equipment and materials is necessary to help ensure long-term system operation and integrity.

The plans shall also show cathodic protection component locations, when used.

If hold-down pads or other anchoring devices are included in the tank system design, dimensions and construction details must be included in the drawings.

Installation drawings and any amendments thereto shall be approved by the appropriate authorities prior to commencement of any installation work on site.

## 8.1 Site Specific Drawings

Site specific drawings shall detail the locations of:

- Site boundaries;
- Existing buildings, foundations, structures, and all services, including any LPG and/or CNG installations;
- New tanks;
- Existing tanks which are to remain in use;
- All decommissioned tanks;
- Vents;
- Fill points;
- Pumps and pipework; and
- Monitoring wells and observation wells.

The site-specific drawings shall clearly indicate the size of all tanks, existing and new, showing both tank capacity and physical dimensions, and shall include any hydrogeological information available.

The product to be stored in each tank shall be recorded.

Pipework size shall be shown unless pipe sizes are detailed on the standard drawings. If, for any reason, pipe sizes are different from sizes shown on the standard drawings, then they shall be shown on the site-specific drawings.

## 8.2 Standard Drawings

Standard drawings shall show standard details of installation work and shall be in accordance with standards detailed in this code of practice.

Standard drawings shall include:

- details of pipework and fittings to be used;
- tank installation and anchoring details;
- fill point and spill containment details;
- details of tanks and tank fittings;
- details of any observation and monitoring wells; and
- cathodic protection system details.

## 8.3 "As-Built" Drawings

On completion of the work, the contractor shall prepare "as-built" drawings of the UPSS, supplemented by any photographs taken during construction showing all relevant details and dimensions. He shall provide one set of drawings and photographs each to the principal and the owner.

The "as-built" plans may consist of installation drawings marked up by the contractor.

The information recorded shall include:

- the locations and sizes of all tanks, including any decommissioned tanks;
- the location and sizes of all piping, valves, pumps and dispensers;
- clear indication of which pumps are connected to each tank, and of product stored in each tank; the locations of pipework connections to each tank;
- the locations of all electrical conduits and all underground services within or adjacent to the area occupied by the UPSS;
- the locations and details of any observation and/or monitoring wells installed;
- details of any cathodic protection system provided, including locations of anodes;
- the date the installation was commissioned; and
- the dates of all modifications.

These drawings shall be updated whenever any modification is made to the UPSS.

## 8.4 Site Lay-out Drawing

In addition to the above drawings, the owner shall provide a drawing showing the site lay-out with all buildings, tanks, fill points, vents, dispensing equipment, pumps, pipe runs, observation and/or monitoring wells, and all electrical conduits and other underground services clearly indicated. Each tank shall be identified with its size, the product it contains, and the fill point(s) and dispensing equipment to which it is connected.

The owner shall supply one copy of this drawing to the Licensing Authority, and a second copy to the site operator, who shall update it whenever any change is made, and shall keep it permanently displayed in a readily accessible and visible position on the premises.

# 9. SAFETY OF WORKS

## 9.1 General

All work on the site shall be carried out with due regard to the safety of persons employed on the work, other persons employed on the site, and the general public.

The work shall be carried out in accordance with all statutory regulations pertaining to safe work practices.

In many cases, the principal will have his own safety requirements, particularly in the case where the principal is a major oil company. This section sets a minimum standard for safety precautions to be observed and shall be read in conjunction with the requirements of the principal.

## 9.2 Permits, Regulations and Standards

Before work commences, the project engineer shall ensure that all necessary permits have been obtained from the relevant authorities. The project engineer may instruct the contractor to apply for and obtain the permits; nevertheless it is the project engineer's responsibility to ensure that permits are obtained except where there is a statutory obligation upon the contractor to obtain certain permits.

The work shall be carried out in accordance with all applicable statutory regulations, whether those regulations require a permit to be issued or not.

## 9.3 Safety of Contractor's Personnel

The works shall be carried out in accordance with all applicable occupational safety and health regulations, including those regarding work in excavations.

The contractor and the project engineer shall both make themselves familiar with the regulations, particularly as they impact upon the execution of the contract for site works.

## 9.4 Excavation Safety

In general, every effort should be made to obviate the need for persons to enter the tank excavation. Where this is unavoidable, regulations shall be complied with, and particular care taken to eliminate any risks such as asphyxiation, presence of hydrocarbon vapours, or cave-in. No

one should ever enter an unshared or unbattered excavation unless the excavation has been certified to be stable by a competent person.

## 9.5 Safety of Third Parties

The contractor shall take all necessary precautions to ensure that the works are carried out in such a manner as to present no hazard to the site, customers, staff or the public in general.

The project engineer shall satisfy himself, on behalf of the principal, that all reasonable measures have been taken. This duty upon the project engineer shall in no way relieve the contractor from his responsibilities in this area.

All excavations and work areas shall be barricaded, and unauthorised persons kept clear of such areas. Where work areas are open to the public or staff working on the site at night, the contractor shall provide and maintain adequate lighting to keep the area safe.

Particular care must be taken on sites that continue in operation whilst work is being carried out. Equipment and materials to be used on-site shall be organised in such a manner as to cause no hazard to persons on the site.

Notwithstanding the above, both the contractor and principal shall maintain appropriate insurance cover for any damage or injury to persons or property during the course of the works.

## 9.6 Statutory Permits

The formal approval of the authority responsible for administration of regulations pertaining to UPSS must be obtained before starting any onsite work and its stipulations adhered to for every installation. Applications should be made as early as is practicable, and a reasonable time before it is intended to commence any work on site. For new sites, or sites where special approvals are required, a substantial period will be necessary.

## 9.7 Safe Handling of Petroleum Products

Brief notes of general safety precautions are covered in Appendix C.

## 9.8 Electncal Equipment

Any electrical equipment can be a possible source of ignition. Where petroleum products are stored the location of equipment must be considered and hazardous areas identified. The requirements regarding electrical installations may be determined by applying the principle of zoning into regions of differing degrees of hazard in accordance with a code or Standard Specificiation as may be approved by the Chief Inspector of Dangerous Goods (NZS 6101, parts 1 and 3 is an acceptable standard). Electrical equipment that is installed into any such

zone must conform to the requirements of the Chief Electrical Inspector, Ministry of Commerce.

# 10. SITE ANALYSIS

Characteristics of the site that pertain to the UPSS are:

- The degree of environmental risk associated with the site.
- The corrosion environment to be addressed.
- The water table that will be encountered in the excavation.
- Properties of the soil with respect to the likely stability of the excavation.
- Practical considerations and site limitations.

## 10.1 Environmental Risk

The degree of environmental risk associated with an installation shall be evaluated with regard to the following parameters:

- The environmental sensitivity classification of the area in which the site is located.
- The permeability of the soil around and under the UPSS.
- The ability of the underground environment to transport hydrocarbons.

Three Environmental Sensitivity Zones are recognised:

**Zone A** **Highly Sensitive Areas** are areas where there is a high risk that any leakage from a UPSS will contaminate an aquifer which is used or has been identified for future use as a source of supply for a reticulated potable water system.

**Zone B** **Moderately Sensitive Areas** are areas that are within 100 metres (or such greater distance that the Authority shows is needed) of any pumping station drawing potable water from an underground source or of areas such as inland waterways and wetlands where any leakage from a UPSS will have a medium or long term adverse effect on that environment, as determined in consultation with the appropriate Authority.

**Zone C** **Other Areas of Lesser Sensitivity** where any leakage from a UPSS is unlikely to pose a significant threat to human life or the environment.

Secondary Containment (see section 12.10 ) shall be installed in all Zone A areas.

For Zone B sites, an environmental sensitivity survey must be carried out unless the principal, at his discretion, chooses to install a secondary containment system.

### 10.1.1 Environmental Sensitivity Survey

10.1.1.1 Where an Environmental Sensitivity Survey is to be made, the principal shall commission a competent person to carry it out.

10.1.1.2 The area of 100 metres radius (or such greater distance that the authority shows is needed) around the proposed installation shall be surveyed for locations which may create danger to people if flammable hydrocarbon leakage should find its way to them.

Such locations would include, but not be limited to, basements, tunnels, manways, service pits, etc., where hydrocarbons could infiltrate and accumulate if they were floating on the groundwater.

10.1.1.3 The survey shall also take note of areas that would be damaged environmentally by the presence of petroleum products.

Such areas would include, but not be limited to, stormwater drains, natural waterways, and artesian water sources that are currently being used or that have been designated for future use.

10.1.1.4 If this survey indicates that there are locations within the area surveyed that require consideration, then the likelihood of hydrocarbons being transported towards these locations should be assessed by means of a hydrogeological survey.

### 10.1.2 Hydrogeological Survey

The hydrogeological survey shall be carried out by a competent person.

The hydrogeological survey shall determine the rate and direction at which a release of hydrocarbons will spread from the point of release.

The hydrogeological survey will take into account soil permeability and porosity, the existence, depth, fluctuation in level, and gradient of the water table, and the existence of service trenches with permeable backfill that may act as conduits for hydrocarbon movement.

Should the hydrogeological survey indicate that a continuing release of hydrocarbons would be likely to reach a hazardous or environmentally sensitive location in less than 30 days, monitoring wells shall be placed outside the tank excavation in the probable direction of travel of released hydrocarbons to ascertain the need for interception and recovery measures in the event of suspected leakage. These monitoring wells will be in addition to the observation wells within the tank excavation (see sections 12.9.3 and 16 ).

### 10.1.3 Survey Record

A copy of all survey information comprising the evaluation of the degree of environmental risk shall be retained by the owner of the installation.

### 10.2 Soil Test

The principal shall arrange for a soil test to be carried out on change of ownership of the UPSS and also on the removal of any existing tank. Prior to or during the installation of a new UPSS, soil testing may be required in the approximate location of the tank excavations to ascertain:

- Corrosive properties of soil, including resistivity (except where fibre reinforced plastic tanks and pipework are to be used) — see section 15.
- Structural properties of the soil for allowable proximity of the excavation to nearby building foundations, and the likely need for shoring of the excavation where prior knowledge of the site is limited.
- Existence and depth of water table, where it is not more than 2 metres below the bottom of the tank excavation.

This information, together with experienced judgement, will indicate whether tank anchorage is necessary.

- Existing soil contamination. For a variety of reasons, there may be existing residual hydrocarbons in the site soil. Where significant contamination has occurred, representative soil samples must be taken and checked as set out in section 21.2.2.

The amount and extent of contamination must be recorded and reported to the appropriate area authority, who may advise regarding the necessity for further testing and clean-up. The background level of contamination at a site must also be taken into account in any subsequent investigation of suspected leakage.

Where a hydrogeological investigation is carried out, the soil test may be carried out in conjunction with that investigation.

The results of the soil tests shall be passed on to the contractor for his information in assessing the need for shoring up or dewatering any excavations.

## 11. REMOVAL OF TANKS

Underground petroleum storage systems or individual components of such systems that are no longer required or that are no longer suitable for petroleum storage shall be properly decommissioned in order to ensure future safety and avoid environmental hazard.

When a site is decommissioned, all tanks shall be removed (unless it is impracticable to do so and the appropriate Authorities agree to their remaining in place) and the site checked for residual contamination

(see section 21.2.2 ). Where residual contamination is found, the degree and extent of contamination shall be recorded and reported to the appropriate authorities who may advise regarding the need for further testing and/or remedial measures.

Where one or more tanks forming part of a storage system are to be taken out of service, the tank or tanks shall be removed from the system unless it is unsafe or impracticable to do so and the appropriate authorities agree that the tank(s) remain in place until the entire system is decommissioned.

Tank removal or decommissioning must be carried out in accordance with this code, applicable statutory requirements and accepted safety standards. Special care must be taken to ensure that any escape of hydrocarbon vapours or liquid is minimised and isolated from any potential source of ignition, or escape into surface or ground water. Hose and pipe connections must be vapour tight, and any liquid or vapour emissions checked and stopped as soon as they occur.

## 11.1 Removal

11.1.1 Some or all of the following precautions may be required when removing underground equipment, the actual need to be determined for each individual site:

- erect barriers around the work site;
- display “No Smoking/Flammable Atmosphere” signs;
- ensure no sources of ignition within 15 metres, or as otherwise approved;
- slope or shore sides of excavation if deemed necessary;
- minimise amount of equipment moving on site;
- do not disturb any equipment that is to remain in place;
- avoid undermining driveways, foundations, etc.;
- avoid damage to coatings and/or cathodic protection systems, etc;
- be aware that contaminated backfill can be a fire and an environmental hazard.

See also Appendix C: Safe Handling of Petroleum Products.

11.1.2 Remove as much liquid as practicable from the tank using flameproof or air-powered pumping equipment. (Note: Sludge is not removable, particularly where there are no manholes.) Pump motors and suction hoses shall be bonded to the tank or otherwise grounded to prevent the accumulation of static electricity. If there is still product in the tank when the pumping equipment can recover no more, the contractor shall use a thief pump to remove as much of the remaining product as is practicable.

11.1.3 Excavate to the top of the tank.

11.1.4 Disconnect and drain all pipe connections, and remove all piping. Piping that cannot, for practical reasons, be removed shall be drained and filled with grout.

11.1.5 All removable internal fittings shall be removed from the tank and all openings securely plugged.

11.1.6 Excavate all around the tank. Remove it from the ground by lifting on the lifting lugs if sound, or by means of suitable strops passed under the tank. Take particular care not to rupture the tank.

11.1.7 The tank shall be clearly and durably signed, on the ends and on opposite sides, in letters at least 50 mm high:

**TANK HAS CONTAINED LEADED PETROL***

**NOT GAS FREE**

**NO HOT WORK TO BE ATTEMPTED ON THIS TANK UNTIL IT HAS BEEN CERTIFIED GAS FREE. NOT SUITABLE FOR STORAGE OF FOOD OR LIQUID FOR HUMAN OR ANIMAL CONSUMPTION**

**Where other flammable liquids have been stored, use the applicable designation, e.g. DIESEL.*

In addition, the tank shall be labelled in at least two clearly visible places adjacent to the above warning with the standard Class 3 Dangerous Goods diamond label (400 mm x 400 mm).

11.1.8 The tank shall be transported by road from the site to a secure location as soon as possible after it has been removed from the ground and labelled.

## 11.2 Storage of Used Tanks

Used tanks shall be stored in a secure location to which access of persons is restricted and in accordance with the Dangerous Goods Act and Regulations.

## 11.3 Re-Use of Tanks

Only tanks which have been fully cleaned down, show no visible signs of corrosion or deterioration, have been checked for metal thickness and fully tested as for a new tank, have been refurbished and recoated to “as new” condition and certified as suitable for the purpose by a competent person, may be re-used in UPSS, provided that the licensing authority for the area has agreed.

If a used tank is sold for re-use for any purpose, the vendor shall supply the purchaser with a written report stating the condition and

former use of the tank. A copy of the report, signed by the purchaser, shall be retained by the vendor.

In addition to a bill of sale used to transfer ownership, the person given possession of the tank must be notified in writing that it has held dangerous goods and is liable to contain flammable liquid or vapour. (Refer Appendix B for a typical Disposal Notice.)

### 11.4 Disposal for Scrap

11.4.1 A tank that is to be sold for scrap shall first be taken to an approved secure area and be made gas free.

11.4.2 The tank shall be rendered unusable.

11.4.3 A bill of sale, as detailed above, shall be used to transfer ownership of the tank to the scrap dealer.

### 11.5 Decommissioning Tanks

Where a tank in a group of tanks is decommissioned, it may only be left in place as long as the installation remains in operation.

11.5.1 Steps 11.1.1 to 11.1.4 inclusive shall be completed as for tank removal, with the exception of the tank vent line which shall remain intact and in operation.

11.5.2 The tank may be left empty to facilitate later removal when the site is decommissioned or rebuilt, but must still be covered by a Dangerous Goods licence.

11.5.3 The excavation shall be backfilled to the surface levels.

11.5.4 The location of the decommissioned tank and pipework, and the reason for its being taken out of service, shall be recorded on the "as-built" drawings of the storage system.

# 12. TANKS

### 12.1 Tank Construction

Tanks may be of steel or fibreglass construction.

Steel tanks for use in UPSS shall be constructed in accordance with the requirements of an approved standard, and shall have a corrosion-resistant coating as detailed in section 12.5 of this code.

Steel tanks shall be cathodically protected unless soil analysis shows the corrosion environment to be sufficiently inert that cathodic protection is not required.

Fibreglass tanks may only be used provided they are constructed by an approved manufacturer and tested and installed all to an approved standard.

Except as permitted in section 11.3 of this code, all tanks installed in underground storage systems shall be new.

Where double compartment tanks are used, the two compartments must be used for the same product, or for different grades of the same product such as regular and super grades of motor gasoline.

Tanks shall have all fittings, as specified by the purchaser and as shown on the purchaser's detail drawings, installed prior to testing by the manufacturer. Fittings shall include separate fill, suction and vent connections, and dip tube fitted with a calibrated dipstick to show tank contents at any level.

Approved standards are those currently approved by the Chief Inspector of Dangerous Goods, and are those listed in Appendix D for steel tanks, and Appendix F for fibreglass tanks.

## 12.2 Tank Size

When suction pumping systems are used with petrol or other similarly volatile products, the tank diameter should be restricted to 2.5 m maximum.

When submersible pumps are used, suction lift and therefore tank diameter is not limited. There is then no theoretical limit to the size of such tanks. Practical limitations will apply.

## 12.3 Tank Identification

Each tank shall be identified according to the requirements of the purchaser. Notwithstanding the purchaser's requirements, the following minimum information shall be permanently and legibly marked on the tank shell adjacent to the dip tube connection:

- Manufacturer's identification.
- Construction Specification, e.g. NZS 7521.
- A reference number unique to the tank.
- The date of fabrication.
- The tank capacity.

## 12.4 Tank Testing

The tank shall be tested at the manufacturer's premises prior to application of the coating.

The test shall either be a hydrostatic test wherein leakage can be directly observed or detected by accurate volumetric measurement; or an air pressure test using soapy water on all joints and fittings to detect leakage. Air test pressure must be 35 kPa. Any higher pressure may rupture the tank and is highly dangerous. The recommended test method is set out in Appendix E.

Both compartments of a double compartment tank must be tested at the same time, without applying differential pressure to the internal wall.

If any leak is found, it shall be repaired, and the test repeated. Test records certifying that each tank has been tested successfully shall be supplied to the purchaser, and a duplicate copy retained by the manufacturer.

## 12.5 Coating Steel Tanks

**12.5.1 Surface Preparation:** All external sharp corners and weld pinnacles on the tank shall be removed and the shell shall be abrasive blast-cleaned to S.A.2.5.

**12.5.2 Coating Material:** The coating material shall be an approved two pack coal tar epoxy enamel or equivalent applied strictly in accordance with the manufacturer's instructions, and as approved by the purchaser (see also section 15.2 ).

A touch-up kit in sealed cans containing sufficient of each component to make 500 ml of mixed material shall be dispatched with each tank.

**12.5.3 Application:** The coating material shall be applied strictly in accordance with the manufacturer's instructions.

Successive coats shall vary in colour.

Sufficient material shall be applied to give a uniform coating with a minimum dry film thickness as recommended by the coating manufacturer.

**12.5.4 Coating Test at Manufacture:** The coating shall be carefully inspected for any obvious holidays, defects or damage. Coating thickness shall be checked using a paint thickness tester. Readings shall be taken at Im intervals maximum along opposite sides of the tank.

The coating shall be subjected to a comprehensive holiday test using a high voltage spark holiday detector calibrated to NACE RP 74-09.

## 12.6 Records

Records of the leak test and the coating tests shall be retained by the purchaser, and copies attached to the "as-built" drawings.

## 12.7 Tank Handling and Site Testing

Tanks shall at all times be handled in such a manner as to avoid any damage to the tank, its fittings or its protective coating.

During application of coating, care shall be taken that sections of the coating are allowed to harden prior to any load being applied to that section of surface such as the tank being rolled or ladders or other equipment being placed against the side of the tank.

During lifting on to and from the transport, the tank shall only be lifted using the lifting lugs installed by the manufacturer. Lifting chains or straps shall be arranged so as to be at an angle of no more than 30° to the vertical to avoid placing undue axial stress upon the tank shell.

Unless suitable holding-down fittings are provided, the tank shall be secured to transport using webbing straps only. The tank shall be chocked to prevent movement against the truck tray during transportation that may damage me coating. Cradles shall be so designed as to give even support to the tank and not damage the coating or dent or otherwise damage the tank shell.

Guide ropes shall be attached to each end of the tank and manned during all lifting and placement operations.

Whenever possible, the works should be scheduled so that tanks may be lifted from the transport and placed adjacent to the excavation ready for site testing. Following testing, the tank must be lifted directly into its final position in the excavation. Tanks must not be dragged into position.

The tank, and in particular its coating shall be inspected by the Project Engineer or his nominee prior to placement into the excavation. Where cathodic protection is to be installed, this inspection shall be carried out by the Cathodic Protection Contractor (refer section 15). Any defect in the coating shall be repaired using a material that is compatible with the coating and that can be readily applied in the field.

Immediately prior to installation on site, the tank leak test described in Appendix E shall be repeated and shall be witnessed by the project engineer or his nominee. The contractor shall also notify the inspector at least 24 hours in advance of the time at which the test will be carried out so that the inspector can attend if he so wishes. The contractor shall supply a copy of the test certificate to the Licensing Authority.

During connection of piping and cathodic protection wiring to the tank shell, it will be necessary for installation and inspection personnel to walk on top of the tank. A layer of durable material shall be placed over the exposed portion of the tank shell to ensure that the coating is not damaged by this traffic.

## 12.8 Tank Location

Tank location will be determined considering the following parameters:

- Dangerous Goods Regulations
- Delivery vehicle access
- Location of pumps
- Site boundaries

- Building foundations
- Environmental constraints.

Generally, it will be proximity to pumps that will be the overriding criterion. As petrol tends to vaporise, the suction pipe length needs to be minimised. Delivery vehicle access can be improved by running fill lines to a location where the vehicle can safely unload.

Tank excavation shall be far enough away from structural foundations and existing tanks so that no load can be transmitted to the excavation wall. In general, a slope of 45$^{o}$ drawn from the nearest part of the foundation should not intersect with any part of the tank excavation. In practice, the soil test (see section 10.2 ) will indicate the allowable proximity to foundations.

The location of tanks to be installed shall be shown on the site drawings, and tanks shall be installed strictly in accordance with those drawings.

## 12.9 Tank Installation

Tanks shall be buried in such a manner as to ensure that they are:

- Adequately supported by the surrounding backfill;
- Insulated from direct corrosion attack by being surrounded by inert material; and
- Protected from imposed loads from above by pavement and/or adequate cover of compacted backfill.

Steel tanks shall be surrounded with sand, but for FRP tanks, pea-gravel or similar approved materials shall be used. Whichever material is used, it must be properly tamped into place to provide good support to the tank shell and ends.

At sites where the nature of the ground is such that the sand or pea gravel may be washed away into the surrounding material and allow the tank to settle, the sand or pea gravel shall be surrounded with a suitable filter membrane to prevent migration. Minimum cover over tanks will usually be determined by the need to have all pipework draining back to the tank, but shall not be less than:

(i) Where the tank is under an open yard where it will not be subject to frequent or heavy traffic loadings and is not less than 3 m from any building:
   - not less than 400 mm of earth; or
   - not less than 300 mm of cover of which not less than 100 mm is reinforced concrete.

(ii) Where the tank is under a building or in an open yard within 3 m of a building and will not be subject to trams loading:
   - not less than 600 mm of earth; or

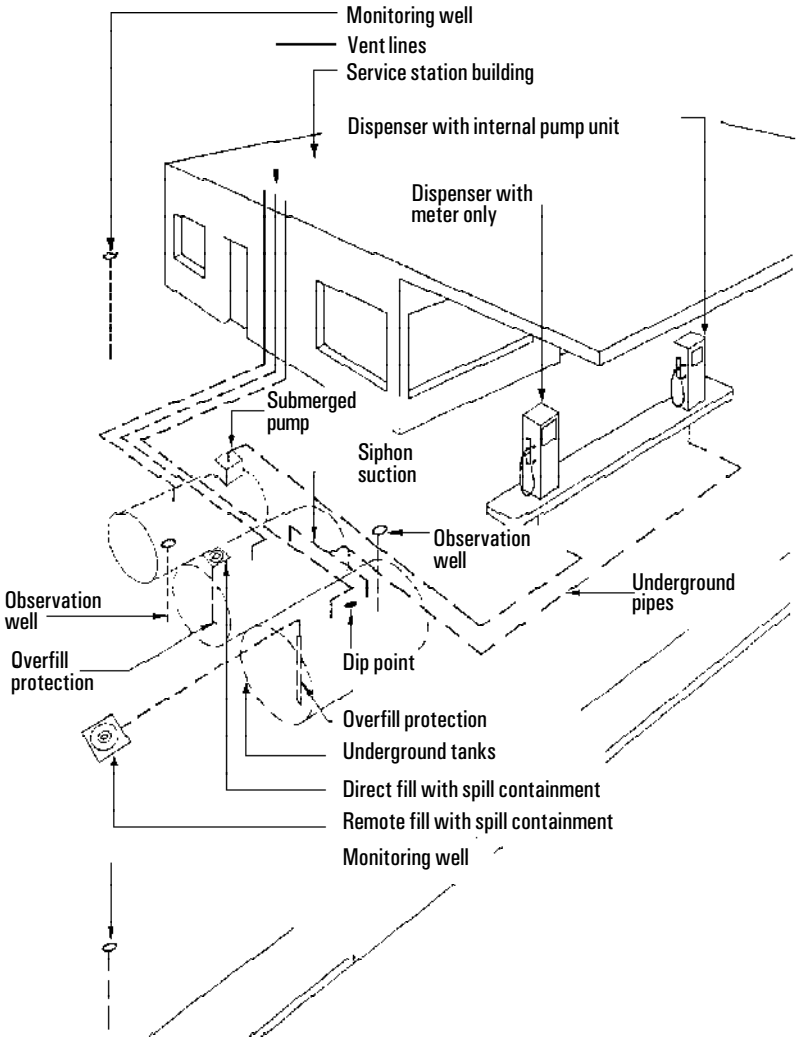
- not less than 400 m of cover of which not less than 100 mm is reinforced concrete.

(iii) Where the tank is subject to frequent or heavy traffic loadings:

- Not less than 900 mm of earth; or
- Not less than 650 mm of cover of which not less than 150 mm is reinforced concrete. Where the concrete is supported by the walls of a concrete chamber, the total cover may be reduced to 500 mm.

(iv) Alternative combinations of reinforced concrete and earth cover that provide appropriate equivalent bearing capacity may be used provided the minimum cover over the top of the tank is not less than 300 mm in any case.

**Fig. 12.9 Tank Installation (Typical)**



### 12.9.1 Materials

**12.9.1.1 Sand:** The sand backfill surrounding steel tanks and pipework shall be clean, non-plastic, chemically inert, free from salt, shells, organic matter, balls of clay, lumps of earth and corrosive materials. The backfill shall be approved by the corrosion practitioner referred to in clause 15.7. The latter may require sample resistivities from stock pile or truckload in which case such samples shall be taken by the soil box method in accordance with the corrosion practitioner's instructions. The sand shall be free-flowing and of an approved grade complying with the following:

| *Sieve Aperture mm* | *Percent Passing* |
|---|---|
| 9.5 | 100 |
| 4.75 | 70 - 100 |
| 2.36 | 50 - 100 |
| 0.425 | 15 - 70 |
| 0.075 | 0 |

**12.9.1.2 Pea Gravel:** Pea gravel used to surround FRP tanks and pipework must comply with the specification recommended by the tank manufacturer and approved by the Chief Inspector of Dangerous Goods. Wherever fines are present it shall be laid within an ap proved filter membrane designed to prevent the ingress of fine soil or sand particles, in strict accordance with the tank manufacturer's recommendations.

**12.9.1.3 Test Certificate:** The contractor shall furnish the project engineer with a test report for the sand or pea gravel certifying that it complies with the relevant specification.

**12.9.1.4 Concrete:** Concrete shall have a minimum compressive strength of 17.5 MPa.

**12.9.2 Excavation:** The excavation for the tank(s) shall be sufficiently large to allow the placement of the full depth of sand/pea gravel bed below the tank and with adequate clearance at ends and sides to allow backfilling around the tank to be properly placed. The floor, sides and ends of the excavation shall be smoothly shaped and free from loose stones or projections that may reduce the minimum thickness of bedding material to less than 150 mm at any point.

The excavation shall also accommodate the anodes of the cathodic protection system where installed.

The excavation and placement of the tank should be completed without anyone having to enter the excavation. If circumstances require people to enter the excavation, then statutory regulations shall be complied with. See sections 9.2 and 9.3 also.

**Fig. 12.9(a) Single Tank and Monitoring Well**

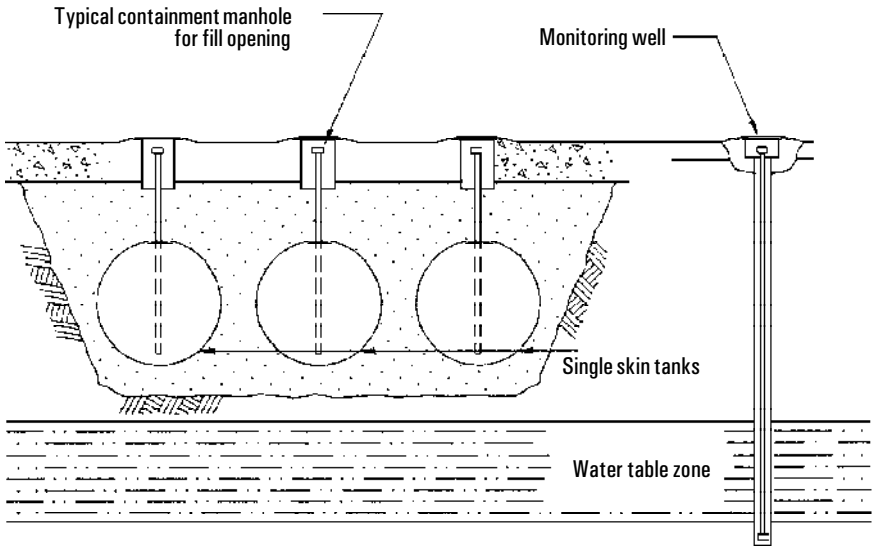



**Fig. 12.9 (b) Single Tank with Plastic Liner and Observation Well**

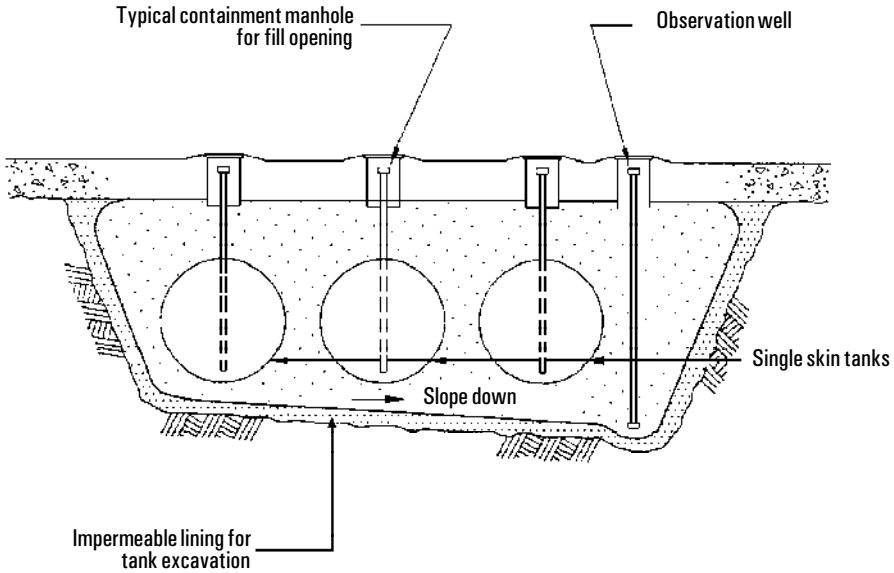
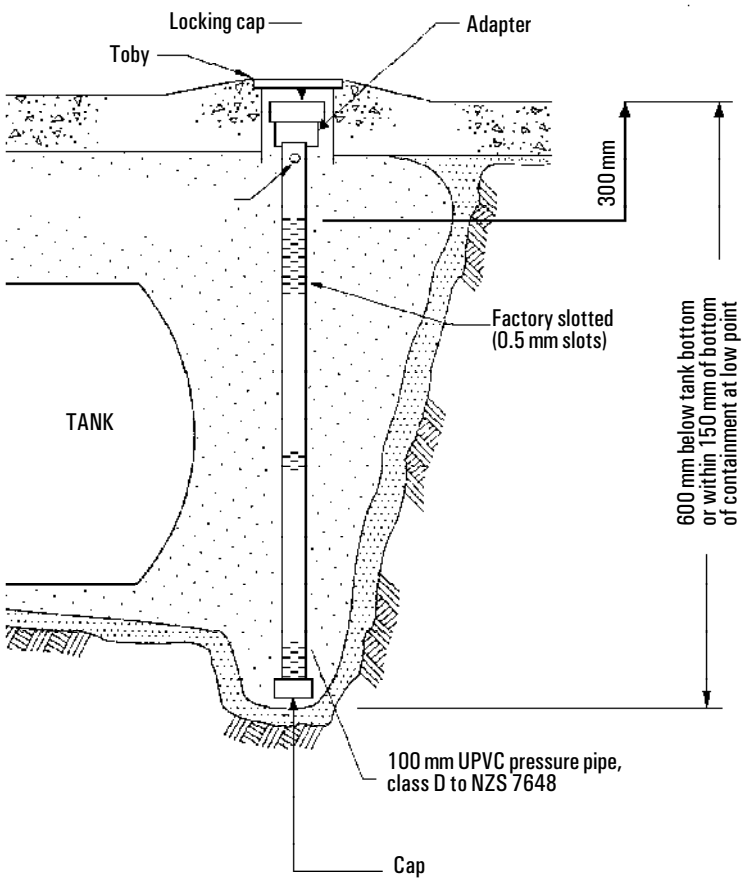


**Fig. 12.9(c) Observation Well (Typical)**




**12.9.3 Observation Wells:** Observation wells shall be installed within the excavation alongside all new tanks or groups of tanks. See also section 16 — Leak Monitoring, and Figures 12.9(b) and 12.9(c). The toby box lid over the well shall be identified by a solid black marking in the form of an equilateral triangle having a 50 mm side, on a pale background.

**12.9.4 Sand Bed:** A sand or pea gravel bed of 150 mm minimum thickness is to be placed on the floor of the excavation.

**12.9.5 Placement:** The tank shall be placed into the excavation and approved sand or pea gravel backfill shall be placed at the ends to stabilise the tank temporarily while levelling is carried out. The tank should be laid with a fall of at least 1:100 to the drain point end.

During tank placement and subsequent backfilling operations, care shall be taken to ensure that no foreign material, including soil, enters the excavation and becomes trapped in the sand/pea gravel surrounding the tank. The project engineer shall closely supervise placement

and backfilling operations and ensure that any such material is immediately removed from the excavation, even if it means having to remove the tank to do so.

Immediately after placement, observation wells, when required, shall be placed into position.

**12.9.6 Ballasting:** When the project engineer considers it necessary, tanks may be ballasted with water. With the approval of the licensing authority, only aviation fuel tanks may be ballasted with product.

**12.9.7 Backfilling:** After placement and levelling of the tank, sand/ pea gravel shall be placed around the sides of the tank. Sand/ pea gravel shall be as specified and shall be placed dry to ensure free flow and compaction. The contractor shall ensure that the tank will be ad equately supported and shall use vibration, tamping or whatever means are necessary to ensure that the sand flows in under the sides of the tank.

## 12.10 Secondary Containment

The purpose of secondary containment is to retain liquids that may be released from the primary storage vessel, so that sensitive resources as outlined in section 10.1 are protected from contamination.

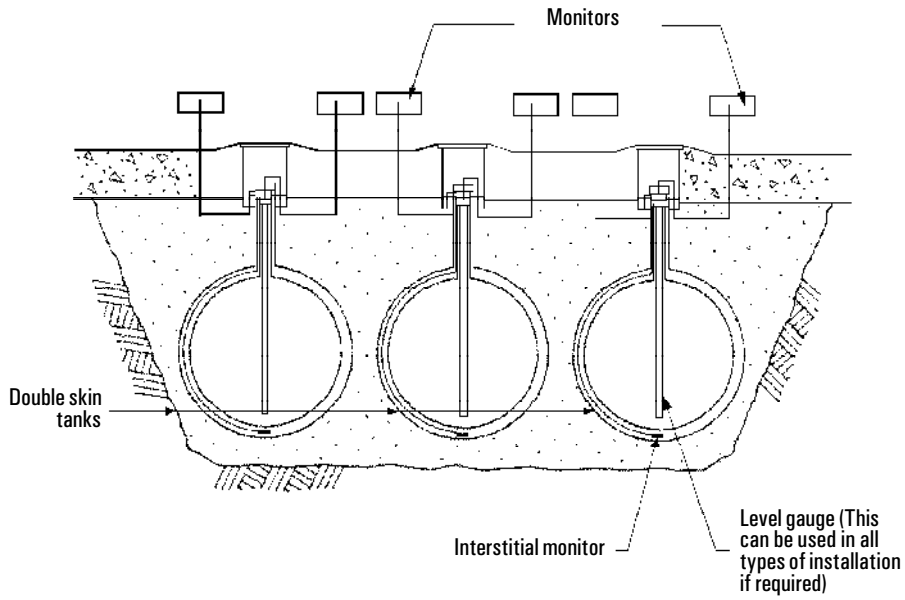
All secondary containment systems must be able to be monitored for the presence of hydrocarbons and the secondary containment barrier must provide effective protection against further migration of the primary vessel's contents for a minimum period of two months.

Where secondary containment is installed, it may be achieved by using an impermeable liner or double-walled tanks and pipework.

Where double-walled tanks are used, the interstitial space of each tank must be fitted with an approved monitoring device, in place of observation wells within the excavation.

**12.10.1 Impermeable Linings:** The whole of the tank pit and all pipe trenches shall be completely lined with an approved impermeable material before backfilling. The impermeable liner shall extend to the under-side of any cover slab or pavement used, or to ground level. It shall be continuous and may be formed of a single layer of high density polyethylene sheet at least Imm thick and welded at all joints or other approved material capable of retaining leakage of hydrocarbon products. Every care must be taken to ensure that the liner is not damaged in any way during installation or backfilling.

**Fig 12.10 Double Skin Tank with Interstitial Monitor and Level Gauge**




**12.10.2 Double-walled Tanks and Pipework:** Double-walled tanks and pipework must be tested, installed, backfilled and protected as set out in this code for other tanks and pipework (see also Appendix E ). In addition, the manufacturer's recommended handling, installation and testing procedures must b followed, and provision made for prompt detection of any leakage that may occur.

**12.10.3 Automatic Leak Detection:** Where an approved automatic leak detection system is installed, secondary containment need not be extended to include underground pipework.

# 13. PIPING SYSTEMS

All pipework should be laid with a fall of not less than 1:100 towards the tank so that it can drain completely.

## 13.1 Piping System Design — Suction Systems

Suction lines should be not less than 50 rnm nominal bore.

To minimise the likelihood of suction problems, it is recommended that suction line length be kept as short as possible commensurate with good installation practices and the other requirements of this code.

Suction lines shall be fined with a tank valve at the tank and a non-return (poppet) valve below the pump, and shall be arranged to drain

back to the tank at a gradient of at least 1:100. The non-return valve shall be so placed that it is protected from damage should the pump be damaged or knocked over.

Each suction line shall have its own individual suction stub within the tank. The suction stub shall be of at least the same diameter as the suction line it serves.

Syphon connections may be installed between tanks containing the same grade of product by connecting between suction stubs. It is recommended that a suction line draws off this connection so that the syphon may be primed initially.

Tanks may only be syphon connected where the tank top levels do not differ by more than 50 mm.

## 13.2 Piping System Design — Pressure Systems

UPSS owner/operator may choose to use a system of delivery lines pressurised by pumps in the underground tanks. Any pressurised product line must be equipped with a leak detection device that is activated immediately leakage is detected in piping downstream of the pump.

When product delivery lines are pressurised, there shall be a rigidly anchored emergency shut-off valve installed in the supply line at the base of each individual dispenser. The valve shall contain a device designed to close automatically in the event of either severe impact or exposure to fire. The automatic closing feature shall be checked at the time of installation and annually thereafter by manually tripping the hold-open linkage.

## 13.3 Venting System

A separate tank venting system shall be provided for each tank. The vent tiffing shall meet or exceed the requirements of the Dangerous Goods Regulations and be approved by the project engineer.

Note: In relation to size section 13.5 applies.

## 13.4 Vent Location

Vent pipes shall terminate in the open air in such a position that flammable vapours will not accumulate or travel to an unsafe position, but in no case less than 4m above ground, nor less than am above the fill connection, and in accordance with the Dangerous Goods Regulations.

Vents from tanks used to store Class 3(a) or 3(b) products shall be not less than:

- 1.5 m above the eaves line of any building that is less than 3 m from the vent;
- laterally from any opening to a building;

- 4 m laterally from any chimney or flue outlet;
- 4 m laterally from any exposed electrical equipment;
- 15 m laterally from a location where vehicles may park.

Vent risers shall be located so that they are protected from mechanical damage.

Vent lines shall not run through or under any part of a building (including soffits) or its foundations.

Except in the case of low volatility products and aviation fuels, the vent shall discharge upwards and shall be protected from ingress of foreign material. The vent shall be fitted with a flame arrestor, a brass gauze shield of 500 microns mesh being sufficient for this purpose.

## 13.5 Vent Pipe Diameter

No vent pipe may be smaller than half the diameter of the fill line connected to the same tank, nor less than 50 mm nominal bore for a run of up to 60 m. Where it is possible to fill the same tank via two fill points simultaneously, the vent line diameter must be at least 70% of the larger fill connection diameter.

## 13.6 Fill Lines System Design

There shall be a separate fill line for each tank.

Each fill point shall be identified as required by the Dangerous Goods Regulations and shall also show:

- the tank to which it is connected;
- the product stored in the tank.

Fill points shall be located such that:

- they are readily accessible;
- the fill point fitting shall be installed so that it will be protected from accidental damage and shall be able to be locked. Fittings shall be liquid and vapour tight.

Fill lines should be 100 mm diameter.

Each fill point shall be installed in such a way that all spillage at the fill point shall be contained and kept for recovery or redirected to the storage tank. A suitable device is shown in Figure 13.6(a).

The fill fitting shall be a system approved by the project engineer as complying with this section, and may include an overfill protection device (see Figure 13.6(b)).

**Fig 13.6(a) Spill Container (Typical)**

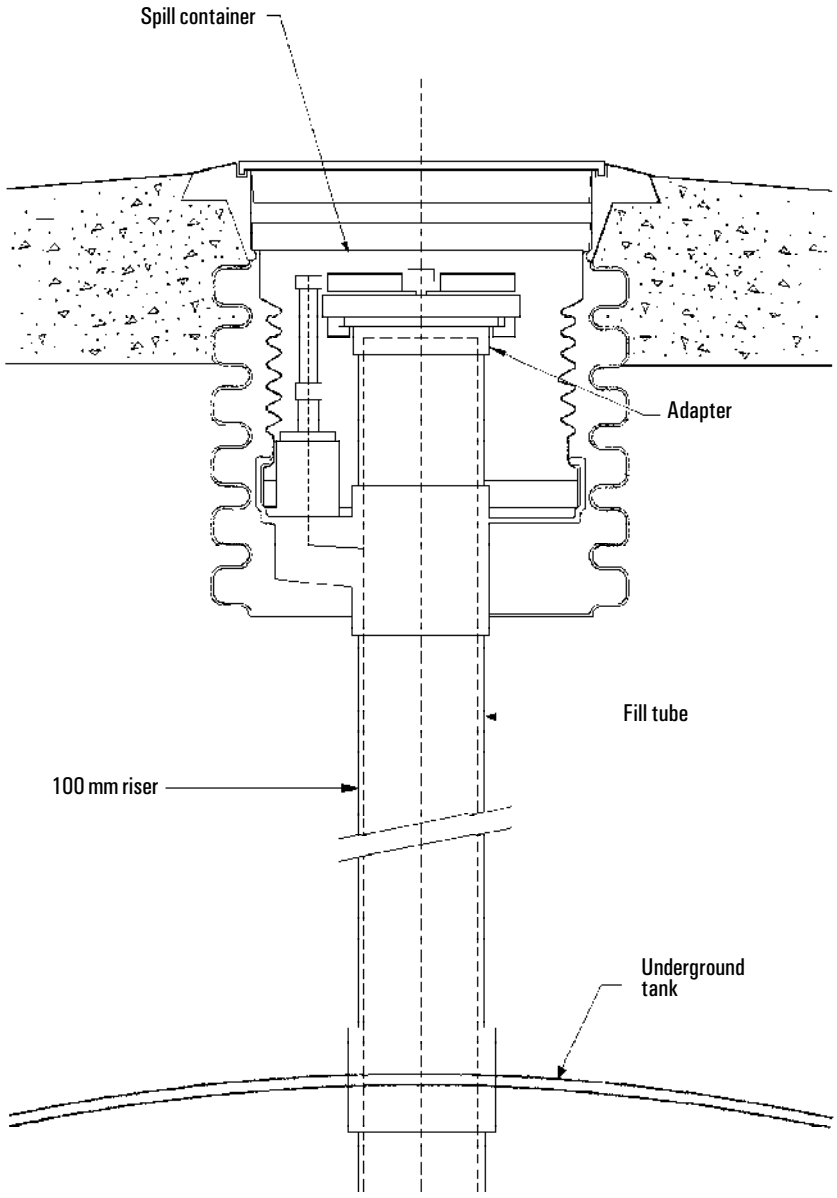
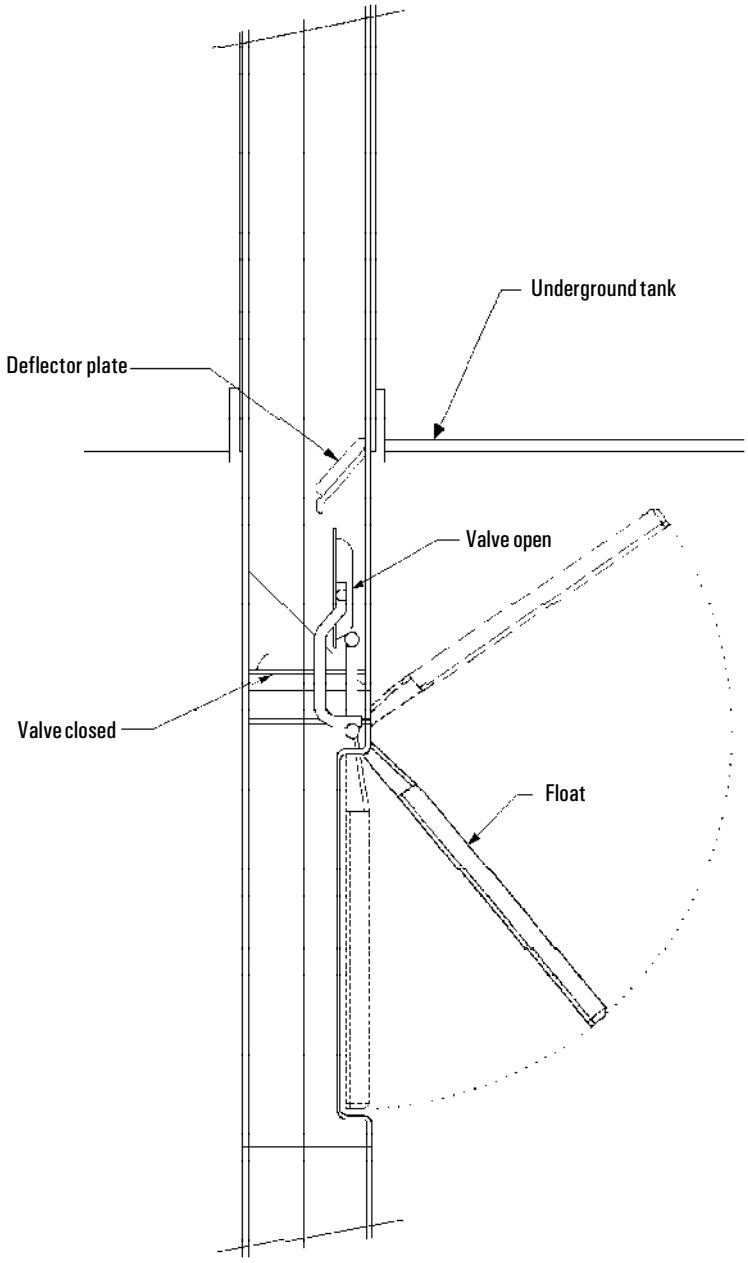


**Fig. 13.6(b) Over Fill Device — Optional (Typical)**



# 14. PIPEWORK INSTALLATION

Product and vent piping shall be installed so that it is completely surrounded by and supported by clean inert backfill. Backfill material shall be clean salt-free sand or pea gravel as specified in section 12.9.1.

## 14.1 Piping Material

Piping shall be constructed of a material that is compatible with the contents of the UPSS and sufficiently corrosion-resistant to ensure a life comparable with that of the tank to which it is connected.

Piping shall be constructed of either steel or fibreglass or other material approved by the Chief Inspector of Dangerous Goods.

Steel pipe shall be black or galvanised medium grade manufactured to BS 1387.

Steel pipe shall be protected from corrosion by a suitable anti-corrosion system.

FRP pipe constructed to a specification approved by the Chief Inspector of Dangerous Goods may be used.

Pipe fittings shall be malleable iron, steel or bronze. Caps on fill and dip points, etc. may be aluminium.

## 14.2 Pipe Laying Trenches

Trenches shall be made sufficiently large that all buried pipes can be separated from the bottom and sides of the trench by a minimum of 150 mm of sand (or pea gravel for fibreglass pipework), and have a minimum cover of 300 mm. Trenches shall be sufficiently wide to allow pipes to lie side-by-side with a minimum clear spacing of 50 mm. Pipes following the same route shall not be laid over or under each other.

Backfill shall be placed in layers not exceeding 150 mm loose depth and shall be thoroughly compacted to provide support at least equal to adjacent material.

The 150 mm sand bed (or pea gravel) should be laid and compacted under pipe runs before piping is installed. Where necessary, temporary timber supports should be used to prevent movement during backfilling. Bricks shall not be used for this purpose.

## 14.3 Pipe Jointing

All pipes shall be examined before installation to ensure that the bore is clean. Any pipe showing internal dirt or other foreign matter shall be thoroughly cleaned by drawing a cleaning brush through with wire; on no account may rag or similar material be used.

Care shall be taken during installation to prevent the inclusion of foreign matter in the bore. All open ends of pipe shall be blanked off with a screwed cap or plug whilst work is not actually being carried out on that section of the installation.

**14.3.1** **Steel Pipe Jointing:** Steel pipes shall be joined using a minimum of joints and long lengths of pipe used wherever possible. All joints shall be carefully made with good quality BSP taper threads, tightly assembled in a clean and true manner.

Dies shall be adjusted so that all screwed joints shall be made with not less than eight threads engaged, and shall tighten hard on the taper of the thread leaving three threads free of engagement

All traces of lubricant or cuffing oil shall be removed from threads of pipe and fittings by washing with solvent and allowing to dry. All internal burrs shall be removed from threads before making joints.

All joints shall be made using oil thread jointing compound spread evenly on the male threads only, care being taken that none is allowed to enter the pipe during fabrication.

Where screwed valves are used in a pipe, the connecting thread on the male pipe should be cut to a length where a tight joint is obtained before the end of the pipe bottoms on the valve body.

Joints made with brass-seated unions shall be examined closely to ensure that good even contact is made over each face and that faces are in good condition. All flanges shall have machined finish contact faces.

Swing joints or flexible connections shall be installed at the tank valve, the riser to the pump, the vent riser and on indirect fill lines, and at other major changes in direction where subsequent surface settlement may distort the pipework.

All joints shall be left exposed until AFTER pressure testing has been completed and approved.

**14.3.2** **I:RP Pipe Jointing:** Standards of manufacture and installation of fibreglass reinforced plastic pipe shall be as stipulated by the purchaser and approved by the Chief Inspector of Dangerous Goods, and in accordance with the pipe manufacturer's instructions.

Swing joints or flexible connections shall be installed at the tank valve, the riser to the pump, the vent riser and on indirect fill lines, and at other major changes of direction where subsequent surface settlement may distort the pipework.

## 14.4 Testing Pipework

All pipework shall be tested prior to backfilling to allow visual inspection of all joints and connections, and again following backfilling to ensure that pipework has not been damaged during backfilling.

All testing shall be witnessed and approved by the project engineer or his nominee. The contractor shall also notify the inspector at least 24 hours in advance of the time at which the test will be carried out so that the inspector can attend if he so wishes.

**14.4.1** **Distribution Lines:** New product distribution lines must be pressure tested before being placed in service. The line shall hold pressure for 10 minutes to be accepted as sound. Suction lines shall be tested to 250 kPa, pressurised lines shall be tested to 400 kPa.

Lines that have previously been in service may be tested with product.

Care shall be taken to ensure that the tank is isolated and vented during the pipework test to avoid excessive pressure being applied to the tank.

**14.4.2** **Fill, Dip and Vent Lines:** After the tank has been hydrostatically tested, fill, dip and vent pipework shall be tested. The fill line shall be capped and the level in the dip pipe raised until the total head of water above the bottom of the tank is 3.5 m. An extension shall be added to the dip pipe if necessary. If diesel is used for this test, the total head shall be 4.2 m.

The level in the dip pipe shall be recorded and the fill line, vapour and vent lines and connections to the top of the tank examined for signs of leakage. After a minimum of 15 minutes, the fluid level shall again be checked for any loss. A variation of more than 100 ml would give cause to suspect leakage and require a repeat of the test and investigation as to the cause of the loss.

**14.4.3** **Automatic Shut-off Valves:** Automatic shut-off valves shall be tested by manually tripping the hold-open linkage.

**14.4.4** **Test Records:** The project engineer or his nominee shall make a record of all tests witnessed together with the results of each test.

Test records shall be retained with all other records pertaining

.

# 15. CATHODIC PROTECTION

## 15.1 General

Before any new steel tank or pipework is installed, a site investigation shall be carried out to establish soil resistivity levels and the presence or absence of stray currents in the ground.

UPSS that are constructed of steel shall be protected against failure due to corrosion by a suitable coating supplemented by cathodic protection, unless site investigation shows that the system will not be subject to corrosive attack.

The UPSS shall be protected from corrosion in its entirety. Tanks, pipework, fill lines, and vent lines are all potential areas for product leakage and/or water ingress and must therefore be protected against corrosion.

## 15.2 Coatings

The coating shall be:

- of high dielectric resistance;
- resistant to moisture transfer and penetration;
- stringly adherent to metal surfaces;
- applicable with a minimum of defects;
- resistant to mechanical damage;
- easily repairable on-site prior to installation; and
- proven by experience in service.

These properties can be obtained with coal tar epoxy, polyamide cured epoxy, or glass flake epoxy paints.

## 15.3 Corrosion Protection

Sacrificial anodes will in most cases be the most cost-effective method of providing corrosion protection. Site tests prior to installation will determine the type and number of anodes to be installed.

In situations where current demand will be high due to a large number of tanks, or where stray currents are known to existunderground, an impressed current system may be used.

A system shall be installed that is suitable for the individual installation, taking into account:

- the number of tanks to be protected;
- the length of pipework requiring protection;
- soil resistivity;
- other corrosive characteristics of the soil; and
- presence of stray currents.

## 15.4 Testing and Monitoring

The owner shall be responsible for having all tests carried out and shall retain the test reports for the life of the system.

Upon completion of the installation, tests shall be carried out to confirm that the system is functioning correctly and that corrosion protection is being given. This situation should again be confirmed 6-12 weeks after installation and again one year later.

If all tests yield satisfactory results, then checks shall be made at intervals of 12 months.

Should any check reveal the need for remedial work (such as additional anodes), the system shall be upgraded without delay and the cycle of checking and monitoring shall recommence.

For impressed current systems, monthly checks of the rectifiers must be made to verify that the units are operational. Annual surveys of the system must also be carried out to ensure continued satisfactory operation.

The cathodic protection system must include permanent test points to facilitate the above checks.

## 15.5 Isolation

The components being protected by the cathodic protection system must be electrically isolated from components to which they are physically connected and for which cathodic protection is not intended. Isolating bushes must be installed at the connection between the product lines and the pumps, and special care taken to maintain isolation where such equipment as submersible pumps or electronic contents gauges are used.

The UPSS shall be isolated from electrical earth. A minimum of 300 mm separation must be maintained between all protected UPSS components and other metal conduits on the site. Wherever this 300 mm separation cannot be achieved, suitable insulating material must be placed between protected and unprotected items so that the current path between is at least 300 mm. Where shielding insulation is used, anode positions should be reviewed and adjusted if necessary.

On existing sites where additional storage facilities are to be installed, the newly installed cathodically protected systems shall be electrically isolated from existing non-protected systems.

## 15.6 Records

The owner shall ensure that records are kept and shall include the readings obtained in commissioning tests and the readings that should be expected in later checks so that any need for remedial work may be immediately recognised.

Records must also indude the results of periodic checks and details of any remedial works carried out.

## 15.7 Practitioners

Site tests, installation works, commissioning and monitoring tests shall be carried out by or under the direct supervision of a competent person qualified to advise on corrosion control for buried metallic structures.

# 16. LEAK MONITORING

Observation wells and monitoring wells, where installed, shall be placed at the time of installation of the storage system. They should generally be placed down ground water gradient from the tanks.

These wells will enable prompt confirmation of suspected leakage as they may be readily examined for the presence of fuel or vapours using bailers or a portable gas analyser. This examination may be carried out at any time by a representative of the owner, or by an authorised officer of the authority. The site operator must check each well regularly, at least once every month, for any liquid hydrocarbons, and record his observations.

Typical details for the construction of observation and monitoring wells are shown in Figures 12.9(a), (b) and (c) and 16.0. For both types of well, the well liner must terminate in a locking cap so designed that it is impossible to connect any hose coupling to the well.

The number of wells required depends upon site conditions.

## 16.1 Observation Wells

Observation wells are normally used to observe secondary containment areas in lined excavations or where the water table is normally within the excavation or where there is an impermeable lining in the floor of the excavation, to monitor the back-fill area around underground tanks.

One well is required for a single tank, two for each group of adjacent tanks up to five, and one additional well for each further group of up to four additional tanks.

The first observation well shall always be at the lowest point of the tank excavation.

## 16.2 Monitoring Wells

Monitoring wells are used to monitor the ground water table in the general area of the UPSS for any sign of hydrocarbons at the water surface on sites where there is no secondary containment.

**Fig.16.0 Monitoring Well (Typical)**

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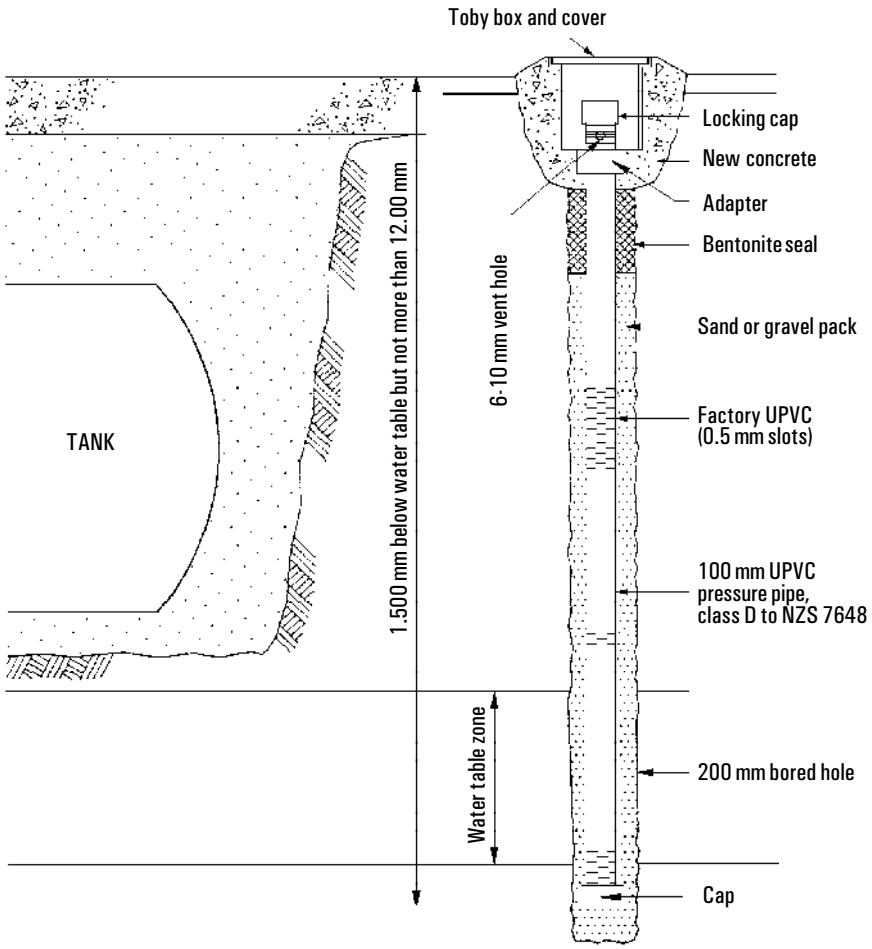



They provide a leak detection capability equivalent to an observation well, but should only be used where soil permeability is high and the normal water level is below the tank excavation but within 12 m of ground level.

Monitoring wells should be installed at a distance from the tank(s) agreed with the regional authority having regard to the site conditions and probable spread of any leakage that might occur.

Care must be taken to ensure that monitoring wells do not penetrate any soil layer lying below tank excavation level that provides a natural barrier to travel of hydrocarbons to lower levels, especially where there is an important aquifer at the lower level.

# 17. OPERATION

## 17.1 Inventory Control

The operator shall set up and maintain an inventory control system.

The system shall include regular routine reconciliations of quantities of sales, use, receipts and stock-on-hand, with monthly reviews of cumulative variances. Reconciliations should be made daily on a busy site, and no less frequently than fill-to-fill on any other site.

Any petroleum storage installation that has a properly administered inventory control system will display a regular pattern of stock variation peculiar to that installation. Similar sites in the same region should display similar characteristics.

Any departure from the established pattern for a particular UPSS must be immediately investigated and explained.

## 17.2 Equipment Checks

In addition to inventory control, the components of the UPSS should be regularly checked by the operator.

Pumps and dispensers should be inspected weekly for signs of product loss. A small leakage may be thus corrected before it becomes of sufficient magnitude to create an inventory shortage.

Hesitation in the delivery from a pump may indicate a leak in the suction piping.

Tanks should be checked at least weekly for the presence of water. This may not necessarily be due to leakage but it is nevertheless a most undesirable situation. Water should be removed as soon as practicable and the cause of water ingress investigated.

The cathodic protection system will have a prescribed maintenance and checking routine. If an impressed current system is installed, the site operator will be required to check on a monthly basis that the system is energised and operating from a continuous power supply and that a fault condition is not indicated.

## 17.3 Response to Product Release

The UPSS is engineered and operated so that the likelihood of product release is minimised. Notwithstanding this, further precautions by way of preparedness must be in place so that should a product release occur, its effect will be minimised by prompt and appropriate action.

The owner shall have an appropriate response plan prepared in case product is released.

The immediate essential steps, some of which can be taken concurrently, are:

- Stop the release at source.
- Report the release to the relevant authorities and to the owner.
- Respond to any emergencies.
- Contain any release of product where possible.
- Assess the degree of contamination.
- Develop a corrective action plan in conjunction with the authority and clean up the released product.

# 18. PRODUCT LOSS INVESTIGATION

## 18.1 General

Whenever a loss is suspected, observation wells should first be checked to see whether there is any build-up of hydrocarbons in the ground or ground water.

Product loss will usually become apparent due to inventory shortage. Rather than immediately concluding that the UPSS is leaking, a series of steps should be undertaken promptly in the order listed to find the reason for the shortage. The order listed reflects their probability as the cause of product shortage, beginning with the most likely.

## 18.2 Inventory Check

The most common cause of an apparent shortage of inventory is error in the calculation of stock on hand. Inventory records should be carefully reviewed to ensure that the discrepancy has not been caused by record keeping error. If no error in the records is found, an independent calculation of apparent loss should be made by a qualified person, starting from the point where records indicate satisfactory results.

The objectives of the audit should be:

- To confirm an actual product loss or identify and reconcile the apparent loss.
- To prescribe improvements to inventory control procedures appropriate to the site in question.
- To prescribe appropriate improvements to product security measures at the site.

The above audit, if it does confirm that there is a product shortage should, if adequate inventory control procedures are in place, indicate an individual tank or group of syphon-connected tanks as being the suspected source of loss.

## 18.3 Meter Calibration Checks

The most common cause of actual product shortage is that of overdispensing. Experience shows that as meters wear they almost invariably drift towards dispensing more product than is recorded. Unfortunately, meters wear at an unpredictable rate. The first step after confirming that an apparent inventory shortage is not the result of accounting error is to have a qualified person check the calibration of all the meters on the site. Should this check show that meters are inaccurate, the pump maintenance contractor should be contacted to carry out adjushnent.

### 18.4 Pump Leakage Checks

The pump cover panels should be removed and the area below each pump inspected for signs of obvious leakage. If leakage is detected, the pump shall be taken out of service and locked, and the pump maintenance contractor should be summoned immediately to carry out repairs.

### 18.5 Delivery Checks

Another possible cause of product shortage is that the amount of product actually delivered to the site is less than the amount invoiced. A check should be made that the amount invoiced has in fact been delivered. If this does not correspond, the recipient should take the necessary measures to reconcile the difference.

### 18.6 Leak Test

Where there is product shortage and all the above possibilities have been investigated, the tank(s) involved, together with associated pipework, must be tested for any leakage as described in section 19.

## 19. LEAK TESTING

### 19.1 General

Leak testing of the tank and pipework shall be carried out upon completion of the installation.

After the UPSS has been commissioned, a leak test should only be carried out when there is reason to believe that there has been a release of product from the system and all other possible explanations have been tested. Experience with product loss investigation has shown system leakage to be the least likely cause.

Free product suddenly appearing in trenches, drains, etc., near a UPSS does not necessarily indicate tank leakage. Such incidents may be the result of accidental spillage during delivery. An immediate check of deliveries should be made, the time of the last delivery determined, enquiries made and quantities reconciled. These checks should be

carried out within four hours of the product being detected, by which time all free product should have been recovered and a determination made of whether further product is continuing to appear. When the foregoing fails to suggest an explanation for the product release, a leak test should be arranged.

### 19.2 Method

A proven hydrostatic or other approved test method shall be used by a competent exponent of that method to test the tank system. Air pressure testing shall not be used in any circumstances.

The whole tank and pipework system shall be tested and repaired if found to be leaking.

A tank that is found to be leaking shall be immediately emptied and removed from service.

A suitable leak testing procedure is attached as Appendix A.

## 20. SITE RECORDS

The owner shall maintain records as specified in this section.

### 20.1 As-Built Drawings

As-built drawings as specified in section 8.3 shall be kept by the owner, and key plans provided as described in section 8.4.

The as-built drawings shall include details of the initial installation and any subsequent additions and alterations.

In addition, the owner shall maintain on file any photographs taken during construction, additions and alterations.

### 20.2 Environmental Risk Evaluation

The Owner shall retain on file the results of the environmental sensitivity analysis together with the hydrogeological survey where one was carried out.

### 20.3 Records of Tests

**20.3.1** **Tank Manufacture Test:** The record of the tank tests carried out at the manufacturer's premises shall be retained by the owner of the installation.

**20.3.2** **Backfill:** The certificate that the material used for backfilling around the tank and pipework meets this code shall be retained by the owner of the installation.

**20.3.3** **Leak Tests:** The records of all tank and pipework tests carried out at the time of installation, together with the record of any tank and/or pipework leak tests carried out during the operational life of the site,

shall be retained by the owner. These records shall also include details of any repair work that had to be carried out to the tanks and associated pipework.

**20.3.4 Cathodic Protection Tests:** The results of the commissioning tests and ongoing routine tests of the cathodic protection system shall be retained on-site and also by the owner. (See section 15.6.)

# 21. CHANGE OF OWNERSHIP OR USE

## 21.1 G General

When an underground petroleum storage system (UPSS) undergoes a change of ownership, both the vendor of the UPSS and the purchaser of the UPSS must ensure that their interests are protected regarding the possibility of environmental clean-up costs. Doing so will ensure that the interests of the environment will also be protected.

The vendor will wish to be protected from incurring the costs of cleanup of contamination which may occur under the ownership of the purchaser. Similarly, the purchaser will not wish to be liable for the dean-up of contamination which occurred whilst the property was in the possession of the previous owner.

Vendor and purchaser must agree a test programme, and the tanks and pipework shall be checked for integrity and the UPSS proved leak-tight in all its components within 30 days prior to the transfer of ownership. If any leaks are detected, they must be repaired and proved leak-tight, or the UPSS must be removed. In addition, the site is to be examined for hydrocarbon contamination. If residual contamination is not found, the site will be considered acceptable. If residual contamination is found, then irrespective of the future use of the site, the Authority shall be informed and immediate clean-up action taken to reinstate the site to a standard agreed with the appropriate authorities having regard to the environmental sensitivity of the site.

Costs of any investigation and clean-up shall be subject to negotiation between the vendor and the purchaser of the UPSS.

## 21.2 Site Assessment

**21.2.1 Tank and Pipework Integrity Test:** Tanks and pipework shall be tested by the methods detailed in this code, or other approved test methods. Where testing is carried out due to a change in ownership of the UPSS, the purchaser of the UPSS shall be given the opportunity to witness the testing.

**21.2.2 Presence of Contamination:** The presence of hydrocarbon contamination can be assessed by direct examination of the soil.

Where tanks and pipework are removed, all backfill shall also be removed and the empty excavations shall be examined for the presence of any hydrocarbons.

Samples of soil from the pit sides and floor shall be taken and sent to an approved testing laboratory and analysed for hydrocarbon contamination. The results of the analysis shall be kept on file by the vendor, and a copy passed on to the purchaser.

Where a site is being sold as an operating facility, a bore hole shall be made adjacent to each tank or group of tanks on the site but outside any secondary containment system used. The bore shall extend to 2 m below the level of the bottom of the lowest tank, and soil samples taken.

Where a secondary containment system has been used, any backfill within the secondary containment shall also be sampled unless the observation wells are completely clear of any petroleum liquids or vapours.

Samples of soil shall be examined by an approved testing laboratory for the presence of hydrocarbon, and the results recorded and communicated to the purchaser and kept on file by the vendor.

**21.2.3 Extent of Contamination:** If the initial examination of soil samples shows the presence of hydrocarbons, the extent of the contamination shall be determined by detailed testing by a competent engineer.

A minimum of three monitoring wells shall be made in appropriate locations on the site, and sampled to determine the depth and spread of the hydrocarbon plume, the depth and gradient of the water table and the porosity of the site soil.

Further examination shall be carried out as required until the limits of the hydrocarbon contamination can be established. The extent of contamination shall be fully documented and communicated to the appropriate authorities.

A clean-up plan to suit the condition of the site shall be drawn up by the engineer. Details of the plan shall be communicated to and agreed with the appropriate authorities and clean-up commence immediately.

At the completion of clean-up, the appropriate authorities shall be requested to certify that hydrocarbon contamination of the site soil has been removed to their satisfaction.

## 21.3 Site Records

The vendor of the LASS shall pass on to the new owner, at the time of sale, all site records described in section 20 of this code.

## 21.4 Change of Use

Should the site use change so that it is no longer used for the storage of petroleum, or should the owner of the site require the UPSS to be removed for any other reason, all tanks and associated equipment shall be removed, including any tanks that have been previously decommissioned.

At the same time, checks shall be made for any hydrocarbon contamination as described in section 21.2.2, and any contamination found dealt with as described in section 21.2.3.

## 21.5 Change of Operator

When a new operator takes over control of any UPSS site, the owner shall review all site records relating to the UPSS including drawings, site manual and log books with the new operator.

# APPENDIX A: LEAK TESTING PROCEDURE FOR EXISTING UPSS

1. The tank shall be filled to maximum safe fill level 12 hours before the test is scheduled.
2. The fill and vent fittings shall be securely capped and a stand pipe fitted to the top of the dip pipe.
3. The level in the dip pipe shall be raised, using fuel from an adjacent tank if available, until the level in the standpipe is approximately 1 m above ground level. Care shall be taken to ensure that the pressure at the bottom of the tank does not exceed 35 kPa.
4. The level in the standpipe shall be observed for 30 minutes.
5. If there is an apparent loss, the amount shall be determined by the amount of product that must be added to the standpipe to restore the product to its original level.
6. Steps 4 and 5 shall be repeated until consistent results are achieved.
7. A consistent loss of 250 ml or more shall be taken to indicate that the system is leaking, and the following steps shall be taken.
8. The top of the tank shall be exposed and all pipes to dispensing equipment shall be isolated from the tank and tested hydrostatically to 250 kPa for suction lines, 400 kPa for pressurised lines.
9. If there is no access to the vent connection at step 2 above, the vent line shall be cut and capped and tested separately.
10. If all dispensing equipment lines prove sound, adjust the product level to l00 mm above the tank shell and observe for 30 minutes.

    During this period, all fittings along the top of the tank shall be closely checked for signs of weeping.
11. If there is consistent loss of product and no weeping is observed from the fittings, then it may be concluded that the tank is leaking, and must generally be replaced.
12. If there is no loss of product at step 11, then a standpipe test shall be applied to confirm that the fill pipe is the source of loss.

## APPENDIX B: TANK DISPOSAL NOTICE AND ACCEPTANCE

**TO:** _____ **DATE:** _____

_____

**LOCATION:** _____

**TANK DESCRIPTION:** _____

_____

In accordance with the Dangerous Goods Act 1974 we hereby advise you that this tank has held dangerous goods of Class 3 and is liable to contain flammable liquid or vapour. The tank has not been cleaned of such liquid or vapour by steaming or any other approved process.

This equipment may have or may still contain leaded sludge. The equipment shall not be used for the storage of drinking water or foodstuffs.

Furthermore, as the new owner of this tank, you must take notice that the following Dangerous Goods Regulations apply:

**Regulation 55: Alterations and repairs to tanks**

(1) No person shall make any alteration to any tank for the storage of any dangerous goods of Class 3 (other than repairs to the tank or its fittings) except with the approval of the local licensing authority, and every person carrying out any repairs to any such tank shall ensure that adequate precautions are taken for the prevention of accidents from fire or explosion.

(2) No person shall remove any such underground tank from the ground until all openings In the tank are securely closed and made gas-tight.

**Regulation 56: Disused underground tanks**

(1) Where any underground tank that has been used for the storage of dangerous goods of Class 3 ceases to be used, and where any such underground tank is situated on premises that have ceased to be licensed for the storage of dangerous goods, the tank shall be removed by the Owner thereof unless permission to the contrary is given in writing by the licensing auhority within whose area the tank is situated.

(2) Any permission given by a licensing authority under subclause (1) of this regulation shall be subject to such conditions as the licensing authority thinks fit.

(3) Where any underground tank is required to be removed under the provisions of sub clause (1) of this regulation, but by reason of its situation under a building or for any other reason it is impracticable to carry out the removal, the tank shall be filled with some solid incombustible material such as sand, and all openings in the tank shall be securely closed vapour-tight.

(4) Where any filling pipe or dipping pipe which has been attached to any underground tank for dangerous goods of Class 3 ceases to be used the Owner shall either remove the pipe or shall dose it in such a fashion that no attempt can be made to use it.

**Regulation 194: Storage of used containers exceeding five litres**

No person shall keep or store any container of capacity exceeding five litres which has contained dangerous goods of Class 3(a) that has not been freed from flammable liquid and vapour, except in a licensed depot or an open yard or other storage place for dangerous goods permitted by these regulations, unless the container is secure from access by unauthorised persons and reasonably free from danger from fire, and is securely closed by a bung screwed well home, or in some other approved manner.

**Regulation 195: Disposal of containers**

No person shall dispose of any container which has contained dangerous goods of Class 3 or permit any such container to be disposed of unless he has taken reasonable precautions to ensure that any remaining dangerous goods or flammable vapour or gas therefrom will not be a hazard to persons or property.

**Regulation 196: Sale or disposal of containers exceeding twenty litres**

No person shall sell or otherwise dispose of or permit disposal of any container of capacity exceeding twenty litres which has contained dangerous goods of Class 3 (a), unless all dangerous goods and flanunable vapour have been removed by an approved method, or the person given possession of the container has been notified in writing that it has held dangerous goods and is liable to contain flammable liquid or vapour.

**Regulation 197: Repairs to used containers**

No person shall repair or cause or permit to be repaired any container which has held dangerous goods of Class 3, nor shall any person bring or permit any source of ignition to be brought into such container or so near thereto as to create a hazard, unless that container has first been cleared of all traces of dangerous goods and flammable vapour by an approved method:

Provided that this regulation shall not prohibit the carrying out of such servicing and repairs as will not create or involve a source of ignition, and the work is carried out in accordance with conditions approved by an inspector.

The above notice has been read, understood and accepted by me prior to taking delivery of the tank and I acknowledge receipt of a copy of this notice.

**Signed:** _____ **Date:** _____

*(Recipient)*

# APPENDIX C: SAFE HANDLING OF PETROLEUM PRODUCTS

## General

All petroleum products are hazardous. They can cause EXPLOSION or FIRE.

Most petroleum products are TOXIC when not used with due care.

## Fire and Explosion

All petroleum products must be treated as being potentially explosive, even in small quantities.

Petrol, aviation gasoline and most solvents evaporate readily, producing an explosive mixture with air. Kerosine, aviation turbine fuel and the less volatile solvents can also produce explosive vapours, particularly in poorly ventilated areas. All products can accumulate static electricity which may trigger an explosion — kerosine-type products are particularly susceptible.

Automotive diesel, fuel oils and lubricating oils can produce explosive conditions if sprayed or heated, even over small areas.

## Precautions Against Fire and Explosion

Keep all SOURCES OF IGNITION away from petroleum products and their vapours. Sources of ignition include:

- ✕ Matches, lighters and cigarettes, etc.
- ✕ Any flame or spark.
- ✕ Any non-flameproof electrical equipment, including switches, hand torches, electric radiators, vacuum cleaners, power tools and radios.
- ✕ Welding sets, leads, connections and hand-pieces.
- ✕ Gas welding torches.
- ✕ Motor vehicles and all internal combustion engines.
- ✕ Tools which can cause a spark if dropped, etc.
- ✕ Grinders.

Petroleum vapours are heavier than air and will readily collect in pits, drainage sumps, cellars, and any low areas. Small quantities of vapour can be quickly and safely dispersed by good and rapid ventilation.

- The presence or absence of petroleum vapours can be checked by a competent operator using an explosimeter.
- **Do not enter any tank or pit** that has contained or does contain petroleum products unless it has first been tested and a safety certificate issued by a competent person.

- Do not do any hot work (e.g. welding, gas cuffing, grinding, drilling or power wire-brushing) on any tank or container that still contains any product or that has not been tested and certified gas free by a competent person.
- Do not transfer or pour petroleum products from one container to another, without ensuring that both containers are fully earthed, and that an effective earthing connection is made between hose nozzle and receiving container before any transfer is started, and is maintained as long as the transfer continues.

## Toxic Hazards

Petroleum vapours can quickly asphyxiate. At lower concentrations, they irritate the eyes and lungs, and may cause nausea, headache and depression.

Petroleum products will irritate the eyes and skin and may cause dermatitis on prolonged or repeated contact.

In addition, high octane petrol and aviation gasolines contain toxic lead compounds. Internal surfaces of tanks which have contained these products will be contaminated and must be treated as highly toxic, even after all product has been removed.

## Precautions Against Toxic Hazards

- Avoid splashing, or any contact with the eyes or skin.
- Wear PVC gloves and boots, and cotton overalls. Wear goggles or face shield if splashing is possible.
- If clothing gets contaminated with product, remove under a running shower.
- If eyes or skin contact occurs, treat as under First Aid Treatment on following page.

## Notes for Physician

Administration of medicinal liquid paraffin may reduce absorption through the digestive tract. Gastric ravage should only be done after endotracheal intubation in view of the risk of aspiration which can cause serious chemical pneumonitis for which antibiotic and corticos-teroid therapy may be indicated. Motor gasolines may contain lead compounds; however, the quantities involved are unimportant in the context of the treatment of acute gasoline poisoning.

# EMERGENCY ACTION

## In Case of Petroleum Spillage

- If a spill occurs, extinguish all naked flames.
- Shut down any other potential sources of ignition.
- Ensure area is well ventilated.

  **Small Spill:** Absorb spills in enclosed areas. Absorb outside spills using sand, earth, or a proprietary absorbent.

  **Large Spill:** Contain and pump into storage.

## Petroleum Fire

- Use dry powder, foam, B.C.F., or carbon dioxide extinguishers.
- Do not use water jets - these will spread the fire.

## First Aid Treatment

**Petroleum Products Swallowed:**

- **Do not induct vomiting!** The main hazard following accidental ingestion is aspiration of the liquid into the lungs, and children are more susceptible than adults.
- Give 250 mls (1/2 pint) of milk to drink; if not available, give water.
- SEND TO THE HOSPITAL IMMEDIATELY.

**Eye Contact:**

- Wash with copious amounts of water for at least 10 minutes.

**Skin Contact:**

- Drench the skin immediately with cold water.
- Remove contaminated clothing under a running shower and wash all contaminated skin with soap and water.

**Inhalation:**

- Move victim to fresh air.
- Keep the patient warm and at rest.
- If unconscious, place in the recovery position.
- If patient not breathing, give artificial respiration.
- Give cardiac massage if necessary.
- SEND TO THE HOSPITAL.

## Medical Treatment

See Notes for Physician on page 51.

# APPENDIX D: TANK CONSTRUCTION SPECIFICATIONS APPROVED BY THE CHIEF INSPECTOR OF DANGEROUS GOODS

## Steel Tanks

**AS 1692**

Tanks for flammable and combustible liquids.

Category 4 — Horizontal cylindrical tanks up to 150 $m^3$ capacity, for underground or above ground use, intended principally for industrial or service station use.

**NZS 7521**

Specification for underground steel storage tanks and their fittings, for the petroleum industry. Non-pressurised, horizontal, cylindrical, flat-ended.

**BS 2594**

Carbon steel welded horizontal cylindrical storage tanks

Maximum working pressure 40 kPa.

Maximum internal vacuum 10 kPa.

Temperature range —10°C to 150°C.

Above ground with saddle supports and underground tanks, dished ends.

## Fibreglass Tanks

**ASTM D4021-81**

Glass fibre reinforced polyester underground petroleum storage tanks.

**NS 1545 — (Norwegian Standard under NVS)**

Horizontal cylindrical glass fibre reinforced polyester (GRP) petroleum storage tanks 1.2 to 50 $m^{3.}$

# APPENDIX E: RECOMMENDED PRESSURE TESTS FOR NEW TANKS PRIOR TO INSTALLATION

## Testing of Single Wall Steel or Glass Fibre Reinforced Polyester Underground Storage Tanks

The tank is to be thoroughly checked visually for mechanical damage which may have occurred. Any mechanical damage shall be repaired by the tank manufacturer or his authorised agent, to the same approved construction specification, before the tank is pressure tested.

The tank shall be subjected to a pneumatic test pressure of 35 kPa above ground without special support, using calibrated pressure gauges graduated in 2 kPa increments or less. A pressure relief valve set to 37 kPa is to be incorporated in the test manifold to prevent inadvertent over-pressurisation of the tanks during pneumatic testing. When air for testing is taken from a source of supply having a pressure greater than 35 kPa, pressure shall be reduced by means of a pressure reducing device.

The pressure relief valve shall be capable of discharging the maximum delivery of the pressure reducing device without pressure rising to more than 110% of the test pressure.

The relief pressure setting should be set to 37 kPa and calibrated on a regular basis.

While holding at the required pressure level, the entire tank is to be soaped with a liquid composed of water and leak test fluid or detergent.

After soaping, the entire tank is to be visually checked for leaks, giving special attention to tank openings.

Note: The pressure may drop in this test as the tank makes a temperature adjustment. Do not start the leakage test until the pressure settles and the tank holds the pressure. Make adjustments to the tank pressure to maintain the required pressure during this settling period.

## Testing of Double-Walled Tanks

To prevent damage from over-pressurisation of the interstitial space (space between inner tank outer wall and outer shell inner wall), the following procedure should be followed:

1. Vent the interstitial space to the open air.
2. Pressurise the inner tank to 35 kPa.
3. Seal the inner tank and disconnect the external air supply.
4. Monitor the pressure for a period of at least 1 hour. While air

tests are generally inconclusive without soaping and careful inspection for bubbles, this step is recommended to detect a very large leak in the inner tank and to prepare for the next step.

5. Pressurise the interstitial space with air from the inner tank. Use a second gauge for measuring this interstitial space pressure.
6. Soap the exterior of the tank and inspect for bubbles whilst continuing to monitor the gauges to detect any pressure drop.
7. When the test is complete, first release pressure in the interstitial space and then release pressure on the primary tank.

**WARNING: Pressurisation of the interstitial space directly from an outside air source is dangerous and is strictly prohibited. Never enter the tank whilst the interstitial space is under pressure.**

## Comments

(a) The capacity of the interstitial space is very small in relation to the primary tank capacity. Compressors commonly used for testing can over-pressurise the space in seconds, causing serious damage to the tank.

(b) A slight decrease in pressure in the inner tank may occur when the interstitial space is pressurised. A pressure drop of 2 kPa (0.3 psig) or less is typical.

(c) The space between the inner and outer tank walls is variously referred to as the “annular space”, “annulus”, “interstitial space” and “interstices.

The primary containment vessel is referred as as the “inner tank” and the exterior shell of the tank as the “outer tank”.

## Diagrams

Figures 1 and 2 attached show the recommended arrangements of test connections, pressure gauges and pressure relief valve.

**Fig. 1 Air Testing Double Walled Tanks**

Pressurizing the interstice with air pressure from the inner tank, after disconnecting the outside air source, prevents over-pressurization. The manifold illustrated is a useful method for accomplishing this.

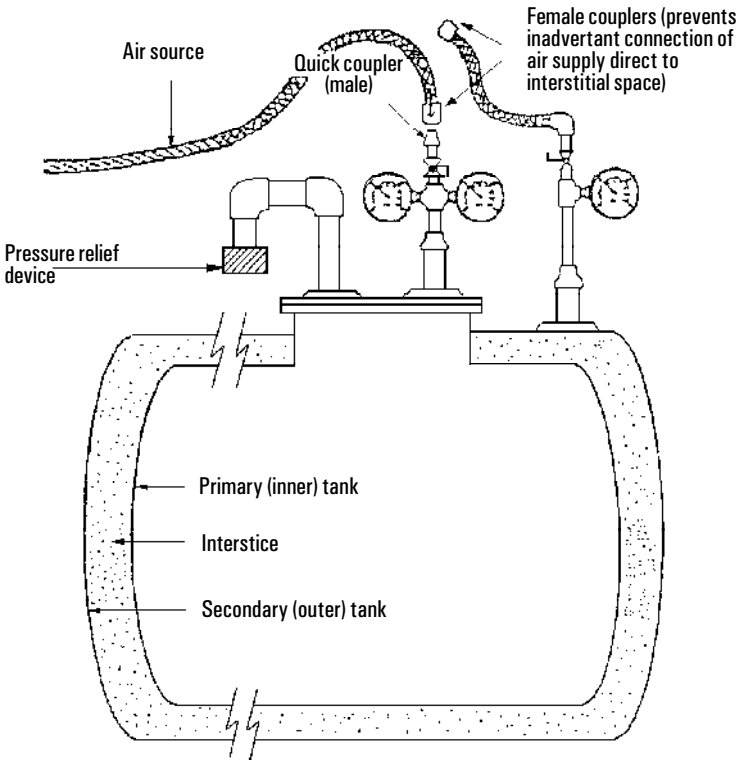
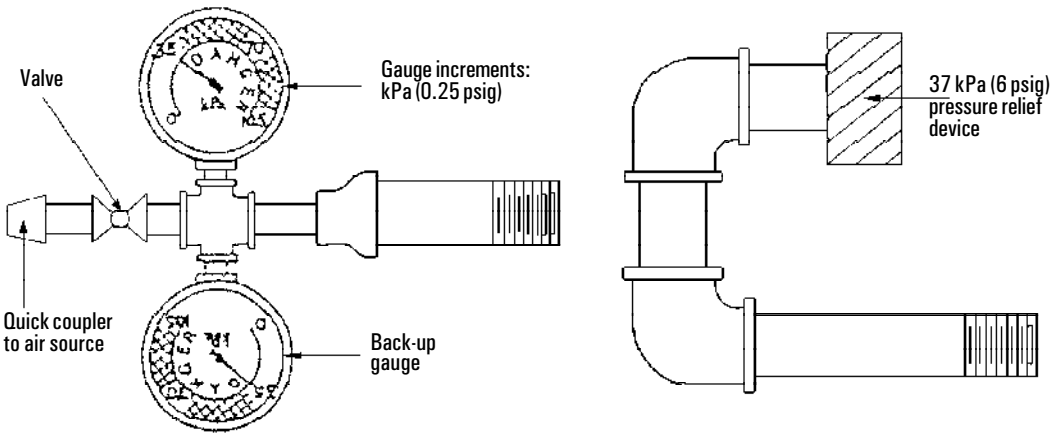



**Fig. 2 Pressure Gauges and Relief Device**

Note: Pressure relief devices shall be capable of discharging the maximum delivery of the pressure reducing device without a rise in pressure to beyond 110% of the test pressure.



# APPEND/X F: GLASS REINFORCED POLYESTER UNDERGROUND PETROLEUM STORAGE TANKS

Manufacturers wishing to produce glass fibre reinforced polyester underground petroleum storage tanks must first obtain approval of their manufacturing works from the Chief Inspector of Dangerous Goods.

In order to submit for approval, it will be necessary for the manufacturer to submit full QA/QC manuals nominating the approved design specification.

The QA/QC manuals are to address the following:

1. Prototype testing in accordance with the design specification.
2. Complete inventory of equipment used in manufacture.
3. List of laboratory equipment with calibration certificates and proposed quality control tests citing the relevant standards to which the tests will be carried out.

Note: The following design specifications are applicable to the testing of glass fibre reinforced polyester resins:

| | |
|---|---|
| ASTM D2393-96 | Standard test method for viscosity of epoxy resins and related components. |
| ASTMD638-87a | Standard test method for tensile properties of plastics. |
| ANSI/ASTM D2587-68 | (Reapproved 1979) — Standard test method acetone extraction and ignition of glass fibre strands yarns and roving for reinforced plastics. |
| ASTM D584-68 | (Reapproved 1979) — Standard test method for ignition loss of cured reinforced resins. |
| ASTM D790-86 | Standard test method for flexural properties of unreinforced and reinforced plastics and electrical insulating materials. |
| ASTM C581-87 | Standard practice for determining chemical resistance of thermosetting resins used in glass fibre reinforced structures intended for liquid service. |
| ASTM D2563-70 | (Reapproved 1987) - Standard practice for classifying visual defects in glass reinforced plastic laminate parts. |

4. A history of the Company should be provided showing management structure and the numbers of staff employed stating years of relevant experience and qualifications held. A current annual report should be provided to back up the application for approval. This report should show the annual turnover of: the company in addition to listing the major projects carried out.

   It is strongly advised that the company obtain accreditation to the ISO 9000 series Quality Systems.