

# HAZARDOUS GOODS STORAGE FACILITIES

**A code of practice for the design and construction of static storage facilities, including static tanks, pipelines and pumping systems for facilities storing and transferring hazardous goods in bulk**



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# SECTION 1: GENERAL

## 1.1 Introduction

- 1.1.1 This code is intended to supplement the Dangerous Goods (Class 3 - Flammable Liquids) Regulations 1985 and Dangerous Goods (Class 2-Gases) Regulations 1980 and their subsequent amendments, extending their provisions clarifying areas of approval, approved specifications and approved materials.
- 1.1.2 This code also clarifies areas of regulatory responsibility between the Department of Labour, Ministry of Transport and Ministry of Energy with respect to the storage and transfer of dangerous goods.
- 1.1.3 This code applies to any static facility storing Class 2 or Class 3 dangerous goods in bulk constructed after the date of introduction of this code.
- 1.1.9 It is not the function of this Department to act as a design consultant, however, this Department is required to assure itself that the facilities are designed and constructed to sound principles including acceptable codes and standards.
- 1.1.5 In the event that this code or the applicable regulations do not fully cover the installation, tanks or pipework or any part of it, an applicable specification may be used with the approval of the Department of Labour.

## 1.2 Definitions

The following definitions of terms apply throughout this code. Where any term used is not defined below, the meaning of that term shall be that defined by the Dangerous Goods Act and Regulations.

### 1.2.1 **Approved**

Means that the item referred to is approved by an Inspector of Dangerous Goods.

### 1.2.2 **(a) Class 3(a) Flammable Liquids**

Liquids, mixtures of liquids, and liquids containing solids in solution and suspension, which in each case has a flash point lower than 23°C. A few examples of some such liquids are petrol, acetone, methanol, and ethanol.

### **(b) Class 3(b) Flammable Liquids**

As above with flash point no lower than 23°C and 61°C or lower.

### **(c) Class 3(c)**

Fuel oil.

- 1.2.3 **Class 2(d) LPG — (liquefied petroleum gas)** — a substance which is composed predominantly of mixtures of propane (C<sub>3</sub>H<sub>8</sub>) and butane (C<sub>4</sub>H<sub>10</sub>).

#### **1.2.4 Tank**

A vessel exceeding 250 litres water capacity used for storage of Class 2(d) (LPO) or Class 3 (flammable liquids) in bulk. Tanks may be of the following types:

- (a) Fixed Tank — tank which is permanently mounted on supports.
- (b) Skid Tank — A tank designed for temporary storage and suitable for transportation from one location to another.
- (c) Horizontal Tanks — tanks where the centreline of the cylindrical section is horizontal:
  - generally has dished ends and is mounted on saddle supports;
  - generally small (thousands of litres) and may be under pressure;
- (d) Vertical Tanks — tanks where the centreline of the cylindrical section is vertical.
  - has a coned bottom and fixed or floating roof;
  - generally large and at atmospheric pressure;
- (e) Underground Tanks — varied with depth of cover related to location and traffic loadings.

#### **1.2.5 Ullage**

The ullage of a container is the air space left when the container is nominally full so that any expansion of the liquid will not cause over flow or excessive hydraulic pressure.

The ullage space is to be measured at 15°C.

#### **1.2.6 Maximum Capacities**

All capacities quoted are water capacity (tank full) at standard temperature and pressure. Capacity of installations, whether a single tank or multi-tanks define isolation distances, tank operation, etc. Refer relevant regulations.

### **1.3 Limits of this Code**

If it is desired to use materials, standards or techniques other than those specified in this code, or methods of construction and processes not in conformity with this code, details shall be submitted to the Department of Labour for determination as to their suitability.

### **1.4 Legislation**

#### **1.4.1 Ministry of Energy**

Under the Petroleum Act of 1937 as amended 1982 the Ministry of Energy has jurisdiction over pipelines, conveying natural gas (above 200 kPa), oil, minerals, or dangerous goods not including:

- (a) any bulk storage installation;
- (b) any pipeline wholly within the plant boundary, generally including all pipework on the plant side of the pig receiver.

Where a leak detection system is installed as part of the pipeline, the associated pipework and equipment is covered by the Petroleum Act. (The appropriate jurisdiction is decided on a case-by-case basis by the Ministry of Energy and Department of Labour);

- (c) any pipeline between a bulk installation and a transfer system (other than another pipeline) unless the product is LPG. (Note the Ministry of Energy and Department of Labour can modify this requirement.)

Under the Gas Act 1982, as amended 1987, the Ministry has jurisdiction over low pressure distribution of CNG and LPG (for vapour LPG, low pressure is defined as not more than 7 kPa and up to 200 kPa with dual jurisdiction with the Department of Labour).

#### **1.4.2 Ministry of Transport (Marine Division)**

This Ministry of Transport is responsible for the pressure containment under the Boilers Lifts and Cranes Act. In the normal commercial and industrial environment the Marine Division is responsible for all safety containment functions which include design, materials, manufacture, workmanship, erection or installation, inspection, testing, commissioning, control, operation, maintenance and repair of:

- (a) all steam raising and steam generating equipment and their associated piping containing steam or feedwater;
- (b) all steam filled pressure vessels and their associated piping;
- (c) all pressure vessels and their associated pumps, compressors, relief and/or control valves, plus all associated piping which contain:  
air; liquified gases; hydrocarbon, gas and vapours; hydrocarbon liquids containing gases and vapours; cryogenic substances; and any mixtures of these;

where pressure relief is designed to occur above 206 kPa.

The term “associated piping”, as used above refers to piping which forms part of the boiler or pressure vessel and does not refer in any way to pipelines as defined in the Petroleum Act 1937.

#### **1.4.3 Department of Health**

Under the Toxic Substances Act 1979 and subsequent regulation, the Department of Health has jurisdiction over installation, storage and transferring Class 6 (Toxic Substances) and Class 8 (Corrosives).

#### **1.4.4 Department of Labour**

Under the Dangerous Goods Act 1974 and the subsequent regulations the Department of Labour has jurisdiction over installations and pipelines storing and transferring dangerous goods of Class 2, 3, 4 and 5 including pipelines as follows:

- (a) within designated tank farm areas;
- (b) for the reception of raw materials;
- (c) for the distribution of processed product;

- (d) for the supply of water for fire services.
- 1.4.5 In cases where jurisdiction overlaps, it is normal for the departments to agree on the extent of jurisdiction and for one Department to look after the interests of the other. In all cases, the higher requirements (e.g. in pressure testing) govern and are to be adhered to.

## 1.5 Approval of Installations

- 1.5.1 An installation and/or part of an installation may be given approval to commence operations and/or be issued a Dangerous Goods Licence when the following approvals (where applicable) have been successfully passed and sighted by an Inspector:
  - (a) Local Authority (under any Acts or bylaws they administer) including Town Planning approval and issue of Building Permits;
  - (b) Marine Division, Ministry of Transport under the Boilers, Lifts and Cranes Act;
  - (c) Fire Service report on acceptance of fire fighting facilities;
  - (d) certification of personnel trained in operation and emergency procedures;
  - (e) engineers certificate on tank and pipework design and construction;
  - (f) tank and/or pipeline tests;
  - (g) electrical certificate for wiring in hazardous areas including bonding and earthing;
  - (h) Department of Labour, where installation size exceeds Local Authority limits.

Also refer Appendix D.

- 1.5.2 Codes relating to overall installations are as follows:
  - NFPA 30: *Flammable and combustible liquids code*
  - AS 1940: 1982 SAA *Flammable and combustible liquids code*.

## 1.6 Welding of Tanks and Pipelines

- 1.6.1 All welding for structural or pressure purposes shall be carried out in accordance with recognised good practice including recognised welding codes and inspection codes.
- 1.6.2 All welding of mild steel components shall conform with NZS 4701 including welder qualification to NZS 4711.

Alternative acceptable welding specifications for pipelines are as follows:

- BS 1821: *Oxy-acetylene welding of Class 1 steel pipelines.*
- BS 4515: *Field welding of carbon steel pipelines.*
- BS 4677: 1984 *Specification for Arc welding of austenitic stainless steel pipework for carrying fluids.*

ASME IX

API 1104

Other acceptable welding specifications are:

*BS 2971: Specification for Class II arc welding of carbon steel pipework.*

*BS 2640 Specification for Class II oxy-acetylene welding of carbon steel pipework.*

- 1.6.3 All welding of aluminium components shall comply with AS 1665: (*SAA Aluminium Welding Code*) with procedures qualified under BS 4870: Pt 2 *Approval testing of welding procedures* and approval of welders under BS 4871: Pt 2 *Approval testing of welders working to approved welding procedures*.
- 1.6.4 Inspection of the welding shall be carried out in accordance with the welding specification, and to be generally as follows:
- (a) verification of material;
  - (b) verification of filler material;
  - (c) qualification of welding procedures;
  - (d) qualification of welders to the above procedures;
  - (e) inspection of production welds.

Visual testing may be carried out to BS 5289: 1983 *Code of practice for visual inspection of fusion welded joints*.

- 1.6.5 Inspection is to be carried out by properly qualified personnel. In particular, testing laboratory registration under the TELARC system is required with personnel qualified under the CBIP scheme (Certification Board for Inspection Personnel).
- 1.6.6 As part of the approval of each unit, certification that this testing has been carried out and passed is to be sent to the Department of Labour.

The documents from the above inspections are to be available for inspection at any time.

The Department reserves the right to utilise an independent inspector or inspection agency at the cost of the owner to check the welding or construction if it considers that some aspect does not conform to the requirements of the specification or as specified in this code.

## 1.7 Hazard and Operability Studies

Where complex or large installations are proposed, the Department may call for a hazard appraisal study to be carried out by such personnel and procedures as he considers appropriate.

This study shall comprise an examination of the proposal during which each process component is examined under varying conditions of use and hazard to ensure that safety features are adequate for all conditions.

The study shall be carried out systematically in the presence of the designer, a representative of the Dangerous Goods Inspectorate

(including local authority and Department of Labour) and a representative of the Fire Service.

ALSO refer to *Administrative Guidelines for the Appraisal and Control of Major Accident Hazards in New Zealand* issued by the Department of Labour.

## 1.8 Containment of Spillage — Bunding

- 1.8.1 Containment of spillage shall be by bunding as prescribed in the appropriate regulations.
- 1.8.2 Where remote containment is allowed, such that the product is retained in safety pending recovery or neutralisation and disposal, such systems shall comply with the following:
  - (a) all spillage shall be contained;
  - (b) containment shall be vented to prevent unsafe pressures being developed;
  - (c) any drainage system to the area of containment shall be sloped to allow full drainage and located to minimise any potential ignition and fire and the effects on the surrounding facilities.
- 1.8.3 Walls and floor of compound to be impervious to the dangerous goods and walls to be of adequate strength to contain full liquid load.
- 1.8.4 Bunds around LPG vessels should not be used. Separation kerbs, low to avoid forming gas traps (recommended maximum height 38 cm) may be required to control spillage.

## 1.9 Code and Standard Organisations

The following are the full titles of code and standard organisations referred to in this code:

ASME — American Society of Mechanical Engineers

ANSI — American National Standards Institute

API — American Petroleum Institute

BSI(BS) — British Standards Institute.

## 1.10 Engineers Certificate

- 1.10.1 Engineers Certificates stating that a design, or construction, or inspection or any combination meets acceptable requirements (generally as laid out under this code) may be acceptable with the approval of the Department in lieu of a full design check.
- 1.10.2 The certificate may be, in the form of the ACENZ's Design Certificate or may be based on the model in this code (see Appendix C).

For recommissioning used tanks certification will be accepted from qualified persons in lieu of a registered engineer.

## 1.11 Repairs to Tanks and Pipelines

- 1.11.1 In general, all tanks and pipelines that require repairs for reasons of corrosion or other damage shall be repaired in accordance with the code or specification under which they were designed and constructed or a code or specification acceptable to the Chief Inspector.
- 1.11.2 Damage shall be assessed according to the specification and the limits of damage to be repaired shall be as described in the code or specification unless otherwise approved.
- 1.11.3 Where design codes give options for repair techniques, the preferred technique shall be proposed to the Chief Inspector for his approval.
- 1.11.4 Pipelines and tanks that have contained dangerous goods and are to be repaired shall be gas freed in accordance with an acceptable method and a gas freed certificate issued by a competent person (see Appendix F—Recommended Gas Freeing Methods).

A “competent person” is defined as:

  - (a) registered engineer or engineering associate with experience in gas-freezing techniques;
  - (b) an operator with experience in gas-freezing techniques and who has been trained under acceptable schemes in gas-freezing techniques and vapour testing.
- 1.11.5 Pipelines and tanks that contain dangerous goods shall not be repaired by a hot work method (operations that could cause a spark or dangerous rise in temperature) unless the procedure is approved.

## 1.12 Fire Protection

- 1.12.1 Any premises licensed for the storage of Class 3 dangerous goods in bulk shall provide or install to the approval of the Department:
  - (a) appliances or equipment for preventing or extinguishing any fire involving dangerous goods or the premises where they are located;
  - (b) means of extinguishing or controlling a tank fire.

The fire protection system shall be designed in accordance with New Zealand Fire Service codes of practice and as otherwise approved. See also Appendix G.

Fire protection systems shall be designed for the installation noting its layout and products.

It is important to design the system and select the foam based on the coverage required. In particular, the height of monitors, jet velocity (and cohesion) to combat wind effects, etc and system operating pressure need to be considered.

- 1.12.2 The fire protection system shall be designed to the following specifications:

NZS 4503:1974 *Code of practice for the distribution, installation and maintenance of hand-operated fire fighting equipment for use in buildings.*

NZS 4504:19B1 *Fire hose reels.*

NZS 4541P:1972 *Rules for automatic fire sprinkler installations.*

BS 5306 *Code of practice for fire extinguishing installations and equipment on premises* (Part 1, 2, 3, 4, 5)

NFPA National Fire Codes, including:

- NFPA 11 *Foam Extinguishing Systems*
- NFPA 12B Halon 1211 (BCF) *Fire extinguishing systems.*
- NFPA 15:1985 *Water spray systems for fire protection.*
- API 2001 *Fire Protection in Refineries* (5th Edition 1974).

Also refer Dangerous Goods (Class 3 - Flammable Liquids) Regulations 1985, Regulation 72 and 171-191 (inclusive).

- 1.12.3 The Petroleum Industry Emergency Action Committee operates a scheme for the fire protection of bulk installations involving consultation and collaboration between the Oil Companies, the Fire Service and the Chief Inspector of Dangerous Goods.

Generally, the oil companies provide the equipment and material, as agreed, for use by the fire brigade at each centre where there are oil company installations. The brigade is responsible for the supply of water although each company may install hydrants or other equipment within their installation (depending on requirements and/or company policy) for the convenience of the brigade.

The standard of protection involves a minimum of mechanical air-foam and hand-operated generating nozzles (the foam is to be compatible and suitable for use with either salt or fresh water). The minimum rate of foam application is 7.4 litres of foam compound solution (before aeration) per minute for each square metre of horizontal surface of the largest diameter Class 3A tank for 30 minutes application.

For further information on equipment and maintenance refer PIEAC Manual.

- 1.12.4 It is recommended that a fixed foam system should be permanently installed on fuel storage tanks. Alternatively, mobile foam monitors may be used but are not favoured because of:

- (a) time taken to set up equipment;
- (b) difficulties in approaching the fire;
- (c) foam would be less effective because of high impact.

There are two main types of fixed foam systems for tanks:

- (a) base injection near bottom of tank — foam floats through liquid and layers on the surface;
- (b) top pourer — from above the liquid.

Base or sub-surface injection is preferred in a fixed or cone roof tank (and for cone roof tanks with internal covers) for the following reasons:

- (a) foam flow through the liquid carries cold liquid to the top layers reducing vapour production;
- (b) equipment unlikely to be damaged during an explosion or fire;
- (c) base injection can be installed cheaper and is more likely to be better maintained.

Base injection of foam shall only use foam acceptable and proven in these conditions with the specific product.

Top pourers are preferred for fuel with either a low flashpoint (less than 40°C) and a low boiling point or with high viscosity at storage temperatures (generally greater than heavy fuel oil). Also top pourers are essential on tanks containing polar solvents because the foam cannot pass through a polar liquid and still function effectively.

With a floating roof tank, where fire would initially occur in the rim seal area, foam systems are designed to pour foam into the annular space between the tank wall and a dam on the floating roof. Fluoroprotein foams are normally used here because of minimal contamination by fuel and good burn-back resistance.

Horizontal tanks generally do not require foam protection, only water for cooling.

Portable foam monitors may be used for cone roof tanks less than 15m diameter or under 9 m high. Ground level monitors are not recommended for use against floating roof rim fires because of the excessive amount of foam required, the difficulty of accurate placement and the considerable weight of foam on the roof. Monitors on trucks are preferable in this case.

Portable monitors are also effective in fighting spill fires.

## 1.13 Depot Security, Maintenance and Equipment Protection

- 1.13.1 Depot area to be enclosed by an industrial-type security fence to prevent unauthorised access. Recommended minimum height is 1.88m with at least two means of ready exit, not adjacent to each other. Gates should open outwards and not be self-locking.

Any operation that results in vapour discharge shall not be less than 8m from a public place unless a screen wall is used such that the vapour path is no less than 8 m.

This screen wall may be part of the security fence.

- 1.13.2 All tanks, pipelines, fittings, pumps, compounds, mounds and depots shall be maintained in good order at all times and to the satisfaction of an inspector. For LPG, the depot shall be maintained clear of all rubbish and combustible vegetation within 3m of any tank or filling connection, or 8m if the depot water capacity exceeds 20,000 litres.
- 1.13.3 No source of ignition (including matches or smoking) is allowed within

a depot area. Use of tools or equipment that constitute a source of ignition (where required for equipment maintenance or erection) are allowed within such an area if the work is carried out in accordance with approved procedures.

- 1.13.4 Precautions are to be taken where equipment damage from vehicular traffic is a possibility, e.g. by crash barriers or bollards. Note also that underground vessels are to be similarly protected, e.g. by barriers or a concrete slab cover.

## 1.14 Electrical Bonding

- 1.14.1 Earthing and bonding shall comply with accepted requirements, e.g. Institute of Petroleum's *Model Code of Safe Practice — Electrical*. For lighting protection refer NFPA 78 *Lighting Protection Code*.
- 1.14.2 Vessels should be electrically earthed as a protection against the accumulation of static electricity. It is recommended that resistance not exceed  $1 \times 10^6$  Ohms.
- 1.14.3 Pipelines and hoses should have electrical continuity and be effectively earthed. Note that valves, etc. with non-conducting seals may need separate earthing.

## 1.15 Training of Operators

- 1.15.1 Personnel responsible for the operation of plant equipment and product handling should be trained to understand:
  - (a) the nature of the product and its physical characteristics;
  - (b) the correct operation of the plant and equipment both in normal and emergency conditions;
  - (c) emergency procedures.
- 1.15.2 All personnel should be familiar with the fundamentals of fire fighting and fire control including correct handling of fire fighting equipment and its location.
- 1.15.3 The operating and emergency procedures shall be clearly laid down and defined, including operator responsibilities.

## 1.16 Lining of Tanks and Pipelines

- 1.16.1 Except as provided, below tanks and pipelines shall be lined and the material used for lining shall be homogenous, nonporous, impermeable when applied, not less elastic than the metal of the tank proper, and substantially immune to attack by the commodities to be transported therein. It shall be directly bonded or attached by other equally satisfactory means. Joints and seams in the lining shall be made by fusing the material together, or by other equally satisfactory means.
- 1.16.2 Conditions under which tanks and pipelines need not be lined:

- (a) the material of the tank or pipeline is substantially immune to attack by the materials to be stored therein; or
- (b) the material of the tanks or pipeline is thin enough to withstand at least 10 years normal service without being reduced at any point to a thickness less than the minimum thickness specified under the design specification;
- (c) The chemical reaction between the material of the tank or pipeline and the commodity to be transported therein is such as to allow proper passivation or neutralisation if it is not frequently cleaned and not used for other commodities.

## 1.17 Colour Coding and Labelling

All pipework and tanks are to be colour coded for different products, preferably in accordance with the following:

*NZS 5807: 1980 Code of practice for industrial identification by colour, wording, or other coding.*

*BS 1710 Specification for identification of pipelines and services.*

*BS 381C Specification for colours for identification, coding and special purposes.*

1.17.2 It is recommended that pipework in product storage depots have the following colour code:

premium motor fuel — red

regular motor fuel — blue

kerosene motor fuel — brown

diesel motor fuel — green

Tanks and pipework shall be predominantly painted as follows:

LPG — gloss white

Natural gas — light buff (BS 5252 colour 08C35).

1.17.3 It is recommended that pipelines and tanks are labelled with the name of the product such that there is easy identification in an emergency. Also for pipelines flow direction should be indicated.

# SECTION 2: STATIC STORAGE TANKS

## 2.1 General

- 2.1.1 This section applies to the storage of class 3 Dangerous Goods (flammable liquids) in bulk (above 250L) in above ground tanks with storage pressures approximately atmospheric pressure or slightly above, generally as follows:

**Atmospheric Tank:**

Tank designed to operate at working pressures up to 3 kPa.

**Low Pressure Tank:**

Tank designed to operate at working pressures from 3 kPa to 100 kPa.

**Medium Pressure Tank:**

Tank designed to operate at working pressures between 100 kPa and 200 kPa.

**Pressure Vessel:**

Tank designed to operate at working pressures over 200 kPa.

Note: That most overseas pressure vessel codes apply from a working pressure of 100 kPa and upwards. The legal requirement in New Zealand under the Boilers, Lifts and Cranes Act is from a working pressure of 200kPa.

For precommissioning certification requirements refer to Section 1.5.

- 2.1.2 Tanks shall be located and isolated in accordance with the distances prescribed in the regulations. Individual tank placement or alignment should be such that tank rupture effects the safety of any person or property will not be prejudiced.
- 2.1.3 Tanks shall be maintained and operated in accordance with recommended practice. Every above ground tank shall be bonded and earthed.

Also refer to:

*API RP 2003 Protection Against Ignition Arising Out of Static, Lightning and Stray Currents.*

*API 2027 Ignition Hazards involved in Abrasive Blasting of Tanks in Service* (1st Edition 1982).

- 2.1.4 Storage of fuel for aircraft may be subject to additional requirements (refer Ministry of Transport). There are three basic types of aircraft fuel:
- (a) aviation gasoline, AVGAS, flash point (CC) - 45°C;
  - (b) aviation kerosine, AVTUR or JET A, flash point (CC) 35°C to 63°C;
  - (c) Jet B, a blend of gasoline and kerosine, flashpoint (CC) -23°C to -1°C.

### 2.1.5 Filling ratios and ullages for fixed roof tanks and vessels

- (a) For flammable liquids and low concentration acids and alkalis:

$$\text{degree of filling} = \frac{97\%}{1 + a(\text{Tr} - \text{tf})}$$

- (b) For high concentration toxic liquids and high concentration acids and alkalis:

$$\text{degree of filling} = \frac{95\%}{1 + a(\text{Tr} - \text{tf})}$$

where a = mean coefficient of cubical expansion of the liquid between the mean temperature of the liquid during filling (tf) and the maxima mean bulk temperature (Tr) and is calculated as follows:

$$a = \frac{d_{15} - d_{50}}{35 \times d_{50}}$$

in which d<sub>15</sub> and d<sub>50</sub> are the densities of the liquid at 15°C and 50°C respectively.

- (c) If the tank contents are heated above 50°C, the above does not apply. In this case, the degree of filling shall be such that the tank is not filled to more than 95% of its capacity at any time.
- (d) Ullage is calculated as (100% — deg of filling).
- (e) Under no circumstances shall the ullage be less than 2% or the degree of filling greater than that calculated as above.

## 2.2 Tank Approval Requirements

- 2.2.1 Tank to be designed and constructed to a specification approved by the Department (see 2.5).

NOTE: Refer Section 5 for tanks with design pressure above 200 kPa.

Tanks not exceeding 60,000 litres may be designed and constructed in accordance with Regulation 60 of the Dangerous Goods (Class 3 — Flammable Liquids) Regulations 1985.

- 2.2.2 In the case of all designs, general details to be supplied as follows:

#### Overall Design

Details: holding down arrangements, tank appurtenances such as nozzles, etc. material specification, flange, fitting valve, including relief valves, foundations.

- 2.2.3 Tank lining and external protection to be satisfactory for the intended service.
- 2.2.4 Seismic and wind loading design to be to NZS 4203 and API 650 App E for the particular location. If necessary, investigations may be required to ensure realistic design and site factors are used.

Also refer *Seismic Design of Storage Tanks*, published by the NZ National Society of Earthquake Engineering.

- 2.2.5 In lieu of full design check to an approved specification, a letter of compliance including calculations and drawings shall be supplied, via District Offices to Head Office signed by a Registered Engineer, stating that design is in accordance with the approved specification (see Appendix C).
- 2.2.6 All tanks to be permanently fitted with a corrosion resistant nameplate in accordance with the design specification, showing a minimum of:
  - manufacturers name
  - basic vessel data including:
    - tank material and thickness
    - design specification
    - design pressure and temperature
    - nominal capacity product and specific gravity
  - tank number (specific to each tank)
  - LAB number (approval number where applicable).
- 2.2.7 Inspection of tank and installation, including sighting of certification, is required before approval will be given for operation.

## 2.3 Stainless Steel Tanks

Tanks made of stainless steel may be designed and constructed to a specification listed in Clause 2.5 with the following conditions:

1. The wall thickness may be thinner than the specified minimum under the following conditions:
  - (a) wall thickness to be no thinner than that calculated by the wall thickness formula from an acceptable standard;
  - (b) tank and supports to be designed to withstand wind and seismic forces (see Clause 2.2.6);
  - (c) tank to be designed to withstand erection, lifting and other forces during construction.
2. Tank to comply with all other requirements of the particular specification.

## 2.4 Glass Reinforced Plastic (GRP) Tanks

GRP or fibreglass tanks to be designed to BS 4994 (or other accepted specifications) with the following additional requirements:

- (a) provision to be installed to dissipate static charges either by:
  - (i) metallic grills; or
  - (ii) metal foot valve.
- (b) GRP tanks are not normally accepted for flammable liquid

- storage. Specific approval is required — full supporting details of design and materials are required for each application;
- (c) for structural strength use at least 40% glass;
  - (d) concrete supports of adequate design are required;
  - (e) hold-down straps of minimum width 400 mm are to be used.

## 2.5 Approved Design specifications

### 2.5.1 General

In all cases check individual specifications as listed to ensure correct application.

The specifications marked with an asterisk (\*) are suitable for the design of tanks with working pressures above 200 kPa.

### 2.5.2 List of Acceptable Specifications

\* BS 1500: Pt 3 *Fusion Welded Pressure Vessels: Aluminium* — excludes vessels subject only to atmospheric pressure.

\* BS 1515: *Fusion Welded Pressure Vessels for Use in the Chemical, Petroleum and Allied Industries*.

Part 1: *Carbon and Ferritic Alloy Steels*

- generally higher design stress than BS 1500;
- not applicable to vacuum or external pressure;
- shell thickness less than 6.4 mm;
- minimum pressure limit based on diameter;
- may be lined with corrosion resistant material.

Part 2 - *Austenitic Stainless Steel*.

- operation up to 400°C.
- covers external pressure, jacketed vessels and tube plates.
- not applicable where wall thickness less than 2.5 mm.
- minimum pressure limit based on diameter.

BS 1564 *Pressed Steel Sectional Rectangular Tanks*

- static liquid head only. Sizes in multiples of 1.2m sq bolted sections. Temperature not be exceed 100°F.

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.

BS 2654 *Vertical Steel Welded Storage Tanks*.

- specifically for the petroleum industry.
- carbon steels, generally Gr 43 and above.

- design temperature -10°C minimum.
- minimum plate thickness 5mm (for diameter smaller than 15m).
- three types:

**atmospheric pressure**

- maximum pressure 7.5 kPa, maximum

**low pressure**

- maximum pressure 20 kPa, maximum vacuum 6 kPa.

**high pressure**

- maximum pressure 56 kPa, maximum vacuum 6 kPa.  
vacuum 2.5 kPa.

BS 4741 *Vertical Cylindrical Welded Steel Storage Tanks for low-temperature Service. Temperature to -50C.*

- pressure not to exceed 14 kPa, and vacuum no lower than 6 mbar;
- notch ductility and impact requirements;
- generally low carbon steels (similar to BS 2654).

\* BS 4994 *Vessels and Tanks in Reinforced Plastics.*

- temperature between 0°C and 100°C;
- maximum pressure 500kPa.

BS 5387 *Vertical Cylindrical Welded Storage Tanks for Low-temperature Service: Double-wall tanks for temperatures down to -196°C. (cryogenic)*

- pressure not to exceed 14 kPa.
- Aluminium and steel alloys.

\* BS 5500 *Unfired Fusion Welded Pressure Vessels.*

- (supersedes BS 1500 and BS 1515);
- not for vessels for transport or atmospheric storage;
- steel and aluminium.

AS 1692 *Steel Tanks for the Storage of Flammable and Combustible Liquids.*

- six categories of tank. Up to 150 m<sup>3</sup> and above using alternative codes. Includes stainless steel, covers design, construction and testing.

\* AS 1210 *Unfired Pressured Vessels*

- generally for pressures above 100 kPa.

AS 1727 *Tank Containers (International size).*

NZS 1841 *Fusion Welded Tanks (for water supply, generally steel).*

\* NZS 2213 *Fusion Welded Pressure Vessels for General Purpose (BS 1500).* (Since withdrawn and superseded by BS 5500).

NZS 5418: 1983 - Part 1 *Transportation Containers for Hazardous Substances.*

- from IMDG Code for Type 1 and Type 2 tanks (IMO) for 10 ft and 20 ft 150 module base sizes;
- see Note 2.

NZS 7521 *Underground steel storage tanks for the petroleum industry (non-pressurised, horizontal, cylindrical flat-ended)*. Capacities between 5.000L and 50, 000L

\* ASME *Unfired Pressure Vessels*, Section VIII.

- for pressures over 100 kPa. ID, width, height or cross-section over 150mm.

API 620 *Recommended Rules for Design and Construction of Large, Welded Low-Pressure Storage Tanks*.

- steel only, temp not to exceed 100°C, pressure 0.5 psi to 15 psi.

API 650 *Welded Steel Tanks for Oil Storage*.

- temp not to exceed 100°C, pressure not to exceed 17 kPa. (0.5 psi) — steel only.

API 12B *Bolted Product tanks* (12th Edition 1977) (see Note 1).

API 12D *Field Welded Tanks for Storage of Production Liquids* (9th Edition 1982)

API 12F *Shop Welded Tanks for Storage of Production Liquids* (8th Edition 1982)

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<sup>3</sup>*.

NOTE: 1. API 12B is not approved for Class 3A products due to nature of product. Some situations however may require use of this type of tank — full details of proposal to be submitted to Chief Inspector for approval.

NOTE 2. Containers to NZS 5418 (multi-modal) are approved for storage under the following additional conditions:

- (a) container to be approved by Marine Division, Ministry of Transport;
- (b) containers manufactured to approved specifications are approved by an acceptable approving authority.

2.5.3 General principles of tank design are as follows:

- (a) Floating roof tanks — there are recommended for the storage of Class 3A liquids and for 3B and 3C liquids stored at temperatures at or above their flash points (roof pontoons shall be maintained free from leaks and be properly bonded in accordance with accepted practice to prevent rim fires). Crude oils may also be stored in these tanks.

- (b) Covered floating roof tanks — these may be used as above with a diameter no greater than 46m (due to floating roof binding on columns). Tanks are to be vented to API 650 where necessary. Rim fires are much less frequent with this design.
- (c) Cone roof tanks are preferable for Class 3B and 3C liquid, but not to be used if the vapour space is explosive at storage temperature unless it is inert gas blanketed. Tank vents to API 2000 shall be fitted.
- (d) Cone roof tanks with internal floating covers — if the cover is made of combustible material it is to be treated as a cone roof tank. For the storage of volatile liquids the tanks are to have venting in accordance with API 650 installed.

## 2.6 Tank Heating

- 2.6.1 This covers heating systems installed to heat Class 3 Dangerous Goods, generally inside above ground tanks in accordance with this code.

The heating system is to comply with the regulations, specifically regulations 113 (for C1 3(b) and 3(c)), 158 and 164 as applicable.

- 2.6.2 Tank heating to comply with the following requirements.

Heating system to be of sound engineering design including:

- (a) adequate strength for temperatures and pressure;
- (b) adequate support from vessel;
- (c) allowance for thermal expansion;
- (d) vessel nozzles for internal heating system to be reinforced for duty according to tank design code;
- (e) heating system material to be compatible with product over anticipated temperature range.

Tank liquid level to be controlled such that internal heating elements are not exposed to the vapour space.

Thermostats are to be installed and set as follows:

- (a) control under normal conditions;
- (b) additional unit set no higher than 20°C below flash point of the product or in any case such that the temperature of the heater surface exposed to the product is not higher than the boiling point of the liquid or its auto-ignition temperature.

Thermostats to be installed such that operation of either will isolate heating system, i.e. cut electricity, turn off steam, etc.

The maximum heat output of an electric element not to exceed 1.25 watts/cm<sup>2</sup>.

Heater installation to be in accordance with the manufacturers instructions.

- 2.6.3 For heating liquids above their flashpoints the following additional requirements shall be met:
- (a) Inert blanket to be used over liquid — this may be a flammable vapour of the liquid, provided no oxygen is present.
  - (b) The inert blanket shall be vented to a flare unless vapour recovery is used.
  - (c) Procedure for tank cleaning and maintenance to be drawn up ensuring no hazardous situations arise.
  - (d) Shall have interlock between tank heater and level control, such that heater can never be operated without liquid cover.
  - (e) Tank heater shall be to good “oil field practice”. Refer API 12K *Specification for Indirect-Type Oil Field Heaters*.

## 2.7 Testing

### 2.7.1 Above-Ground Tanks

Before entering service all above-ground tanks shall be tested for liquid tightness as follows:

- (a) vertical tanks to be tested, also to prove their foundations, by filling them to their maximum liquid capacity with water;
- (b) all other tanks shall be tested either with air at 35 kPa or water such that every part of the tank is subjected to the maximum static head.

The test pressure shall be held for a sufficient period such that the tank is thoroughly inspected for tightness and unacceptable deformation. Recommended minimum period is 30 minutes.

All tanks designed and constructed to an approved specification shall be tested in accordance with that specification or as above (whichever is the strictest requirement).

Tanks containing products with specific gravities above 1.0 may be required to be tested differently (see design specification).

### 2.7.2 Underground Tanks

Before entering service and while the tank is in the pit and before backfilling, the tanks are to be tested as follows:

- (a) with air or water to a pressure of 35 kPa (measured at the level of the bottom of the tank);
- (b) a certificate to be supplied to the licensing authority stating that the tank is free from leaks;
- (c) an Inspector may be required to witness the test;
- (d) if product head is higher than 4 m, the Inspector may require a higher hydraulic test pressure.

## 2.8 Corrosion Protection

- 2.8.1 Tanks shall be protected from internal corrosion by either:
- (a) provision of extra thickness in walls, ends, bulkheads;
  - (b) internal lining.

This shall be used to compensate for the corrosion loss expected during the design life of the tank.

- 2.8.2 Tanks shall be protected from external corrosion by the application of an applicable coating system normally consisting of sandblasting, primer and a cover coat.
- 2.8.3 Every above-ground tank shall be bonded and earthed. If considered necessary, a cathodic protection system shall be installed.

## 2.9 Tank Venting

- 2.9.1 Tanks shall be equipped with venting facilities for normal and emergency conditions. Refer Class 3 Regulations 60(7), 60(8), and 60(9).
- 2.9.2 In the event of a situation giving rise to excessive internal pressure under emergency conditions, the pressure shall be relieved by either of the following:
- (a) Provision of a “weak seam” at the top of the tank.
    - for a vertical tank at the joint between the shell and the roof;
    - for a horizontal tank or small vertical tank, suitably fitted manhole or lid; the weak seam is to be designed by an accepted method, e.g. as API 650 or UL 142 (*Standard for Steel Above Ground Tanks for Flammable and Combustible Liquids*).
  - (b) Approved venting facilities — design may include provision for inbreathing (vacuum relief) and outbreathing (pressure relief) under normal and emergency conditions.
- 2.9.3 Under normal conditions, including filling and discharge, excess pressure shall be relieved by a vent. These shall be screened with brass gauge of 500 microns nominal aperture size. The vent shall be no smaller than the filling or discharge connection and shall be sized on the maximum anticipated simultaneous flow. Generally internal pressures not to exceed design pressure of 17 kPa for atmospheric tanks. Vent outlets shall be arranged such that the discharge does not impinge on any part of the tank.
- 2.9.4 Venting shall be designed to an approved specification (e.g. API 2000 *Venting Atmospheric and Low Pressure Storage Tanks*, 3rd Edition 1982).
- 2.9.5 Flame arrestors may be required to be fitted.

## 2.10 Other Fittings

2.10.1 It is a requirement that all tanks shall have an effective contents gauging system. This may be carried out by dipping, approved sight glasses, etc. depending on tank size and product.

Gauging systems to accepted standards are preferred, e.g. API 2545: *Automatic Tank Gauging*.

## 2.11 Decommissioning Class 3 Tanks

2.11.1 Disused underground tanks containing Class 3 products must be removed. They may be allowed to remain only if it is impracticable to remove and written approval of the Local Licensing Authority has been obtained.

2.11.2 Removal of underground tanks shall only be carried out subject to:

- (a) all product is removed;
- (b) all openings in the tank and pipework are securely closed and made gas tight;
- (c) all adequate precautions are taken for the prevention of accidents from fire or explosion;
- (d) where tanks have leaked, permission to remove must be obtained from the Local Authority Dangerous Goods Inspector and, if need be, assistance requested from the New Zealand Fire Service.

2.11.3 Alterations and repairs to tanks may only be carried out with the approval of an Inspector.

## 2.12 Recommissioning Used Tanks

2.12.1 Where tanks are to be recommissioned the tank must be certified by a registered engineer or qualified person that it complies with the original specifications as to construction, plate thickness, etc. and has been effectively protected from corrosion.

2.12.2 Secondhand tanks must be cleaned out and certified gas free prior to recommissioning.

2.12.3 Normal procedures must then be followed for installation.

# SECTION 3: PIPELINES

## 3.1 General

- 3.1.1 The design, fabrication, assembly, test and inspection of piping systems containing liquids shall be suitable for the expected working pressures, temperatures and structural stresses. The materials used shall be compatible with the products. Above-ground pipelines shall be protected from mechanical damage. Pipelines outside bulk oil premises shall preferably be placed underground.
- 3.1.2 Low melting point materials (metals and non-metals) may be used underground for all liquids but above ground and outdoors only under the following conditions:
- (a) they are protected against fire exposure;
  - (b) any leak, fire, etc will not unduly expose people or property;
  - (c) they are located such that any leakage can be readily isolated.
- Non-metallic pipework shall not be used unless specifically approved by the Chief Inspector. Proof of manufacture to acceptable standards is required. Pipework to be designed and installed to the manufacturer's specification including:
- (a) temperature range;
  - (b) pressure rating, including vacuum where applicable;
  - (c) assembly, installation and support recommendations.
- 3.1.3 All pipe joints shall be liquid tight. All joints shall be readily accessible for inspection and repair.
- 3.1.4 All flexible hoses connecting pipelines to vessels shall be of approved quality with a safe working pressure at least 50% higher than the actual working pressure.
- 3.1.5 All pipelines with heating facilities shall comply with AS 1940, Section 7.6 or equivalent.
- 3.1.6 Threading of pipeline may be carried out in accordance with generally acceptable standards including:
- BS 21:1973 *Pipe threads for pressure tight joints.*
  - API 5B: *Specification for Threading, Logging and Thread Inspection of Casing, Tubing and Line Pipe Threads.*
  - AS 1722 *Pipe threads of Whitworth form (Pt 1 and Pt 2).*
- 3.1.7 Miscellaneous
- BS 729 *Hot dip galvanised coating on iron and steel articles.*
- AS 1650 *Galvanised coatings.*
- 3.1.8 Pipelines shall be located such that in the event of a leak or emergency, unimpeded access is available. In particular underground pipelines shall

not be located under significant structures, especially with public access.

## 3.2 Types of Pipeline

3.2.1 Pipelines may be conveniently divided into several types:

- (a) Wharf lines — generally involve a line on or under the wharf terminating in a connection, hose or loading arm to enable product to be charged or discharged into a ship, includes ship bunker lines.
- (b) Transfer piping — generally short, transferring product from one facility to another or wharf, plant, etc.
- (c) Compound pipework — piping within a compound transferring product to road/rail load-out or load-in.

## 3.3 Design Codes

3.3.1 Pipelines and piping components shall be designed, manufactured and installed in accordance with an acceptable code.

3.3.2 Acceptable piping codes are as follows:

ANSI B 31:3 *Chemical plant and petroleum refinery piping*

- covers materials, pressure design (including expansion and supports), fabrication inspection and testing;
- generally for piping within plant limits involved in processing or handling of liquids;
- excludes pressure vessels, heat exchanges, rotating machinery, fire protection systems.

ANSI B 31:4 *Liquid Petroleum Transportation Piping Systems.*

- covers, materials, pressure design (including expansion and supports), fabrication and inspection;
- generally for piping transferring petroleum products, including LPG between plants, terminals, etc.
- excludes pressure vessels, heat exchanges, rotating machinery, piping with internal pressure below 100 kPa, gas transmission and distribution piping.

ANSI B 31:8 *Gas Transmission and Distribution Piping Systems.*

BS 3351:1971 *Piping Systems for Petroleum Refineries and Petrochemical Plants.*

- similar to B31:3, also includes materials for low temperature service.

NZS 5223 *Code of practice for high pressure gas and petroleum liquids pipelines.*

DOT Departmental of Transportation (USA) *Code of Federal Regulations.*

### 3.4 Wharf Pipelines

- 3.4.1 Wharves containing pipelines carrying flammable liquids shall have adequate fire resistance. This generally applies to large vessel bunkering wharves and oil terminal wharves.
- 3.4.2 Loading pumps capable of building up pressures in excess of the pipeline maximum working pressure shall be provided with relief valves or similar.
- 3.4.3 Pipelines on wharves shall be designed with sufficient flexibility to protect them from relative movements resulting from wharf movement, etc.
- 3.4.4 Pipelines shall be provided with a readily accessible stopvalve situated as near as possible to the landward end of the wharf. In addition a stopvalve and a non-return valve shall be situated as near as possible to the waterway end of the wharf (note that the non-return valve may be temporarily bypassed during vessel loading operations). If considered necessary by the Chief Inspector, the line should be further divided into sections to minimise liquid spills.
- 3.4.5 Pipelines shall be adequately bonded and grounded. If deemed necessary, insulation joints shall be installed.
- 3.4.6 Loading Arms shall be designed, constructed, installed and tested in accordance with an acceptable code, e.g. *Design and Construction Specification for Marine Loading Arms* issued by the Oil Companies International Marine Forum. This specification includes provision for initial pressure testing to a minimum of 1.5 times the minimum design pressure for a minimum period of 30 minutes.

### 3.5 Testing

- 3.5.1 All pipelines, except as below, shall be tested after construction and prior to commissioning as follows:
  - (a) In accordance with the design specification;
  - (b) In accordance with the Dangerous Goods (Class 3 — Flammable Liquid) Regulations 1985.

Where it is impractical to test the line as above, alternative arrangements may be used as approved by the Chief Inspector.

Also refer API RP 110 *Recommended Practice on Pipeline Hydrostatic Testing*.

- 3.5.2 In the event where the design specification does not fully cover the testing procedure, Regulation 89 of the Dangerous Goods (Class 3 — Flammable Liquid) Regulations 1985 is to be complied with, as follows:
  - (a) Test pressure 1.5 times maximum working pressure or 750 kPa minimum with water as test medium;

- (b) Pipeline to remain above test pressure for 24 hours minimum;
- (c) Constant reading to be taken of pressure and temperature of test medium.

The test will be considered successful if there are no leaks and any pressure variation can be related to temperature variation.

- 3.5.3 In addition to the above, all oil pipelines (excluding those solely used for operations within licensed premises) shall be maintained as follows:
- (a) Shall be examined by the owner or representative at least once every five years;
  - (b) Shall be hydraulically tested (as 3.5.1) at six-monthly intervals or two-monthly intervals, if kept full of water. Test pressure 1.5 times maximum working pressure and may be carried out full of product. Test pressure to be held without loss for either 8 hours minimum (buried lines) or 4 hours minimum (uncovered lines). Results of tests to be kept by line owner or representative for inspection.
  - (c) A greater frequency of testing may be required by the Chief Inspector, if circumstances dictate.

It is recommended that pipelines within licensed premises are maintained to a similar standard.

- 3.5.4 All flexible hoses used for connecting pipelines to vessels shall be regularly inspected both internally and externally. Hoses shall be tested at intervals of six months maximum or 1000 pumping hours (whichever comes sooner). Results to be kept for inspection.

## 3.6 Operations and Maintenance

- 3.6.1 Flexible hoses shall be properly and adequately supported to prevent chafing and kinking during operation.

## 3.7 Emergency Repair Procedures

### 3.7.1 General

Pipelines shall only be repaired in accordance with their design and construction specification. See also Appendix F.

### 3.7.2 Hot-Tapping

Pipelines may be hot-tapped for repair or the addition of branch lines. Hot-tapping shall only be carried out in accordance with an accepted specification.

Also refer: *API 2201 Procedures for Welding or Hot-Tapping on Equipment Containing Flammables*

### 3.7.3 Slewing

Pipelines may be sleeved to cover an irregularity (e.g. dent). Slewing shall only be carried out in accordance with an accepted specification.

## 3.8 Leak Detection Systems

- 3.8.1 Pipeline leak detection systems are generally of two types:
- (a) Static — based on pressure monitoring.
  - (b) Dynamic — based on metering the product at each end of the line and comparing quantities.
- 3.8.2 A static leak detection system using pressure monitoring is considered as meeting the requirements for periodic pressure testing.

## 3.9 Corrosion Protection

- 3.9.1 Pipelines shall be protected from corrosion by a combination of the following two systems:
- Below ground:**  
Steel properly prepared (preferably soundblasting to SA 2.5) and wrapped or coated with suitable protection system (generally bitumastic wrapping or extruded polyethylene coating).
- Above ground:**  
Steel properly prepared (as above) and painted with suitable protection system.
- 3.9.2 All underground pipelines shall be protected by a cathodic protection system unless it is proven by a competent person (nominally an engineer experienced in cathodic system designs) that this is not necessary. In particular refer to design specification, e.g. ANSI 31.3 section 4.6.1.

## 3.10 Loading and Unloading Facilities

### 3.10.1 General

Loading and unloading facilities for tankwagons shall be isolated from storage areas in accordance with the regulations.

- 3.10.2 Bottom loading — a positive means shall be used to ensure that the tank is not overfilled, with an automatic secondary shutoff.
- 3.10.3 Top loading — valves shall be self-closing and manually or automatically held open while filling.

### 3.10.4 Static Protection

Facilities shall be provided to protect against sparks from static electricity. Such facility to be in place before transfer of product starts. This facility is not required with products without proven static accumulation tendencies.

## 3.11 Supports

- 3.11.1 Pipe supports shall be designed to withstand all foreseeable loads, including temperature variation, seismic forces and wind forces. They shall also offer the piping system protection from physical damage and excessive stresses from settlement, vibration, expansion and

contraction. The installation of non-metallic piping shall be in accordance with the manufacturer's instructions.

3.11.2 Supports shall be constructed to general sound engineering principles including:

- (a) Concrete to NZ 3104
  - steel reinforcement to NZ 3402P
  - concrete pipes to NZ 3107.
- (b) Structural steelwork to generally acceptable NZS, BSS or AS specifications:
  - bolts, nuts and washers to AS 1110 and A1112
  - galvanising to BS 729
  - blast cleaning to BS CP 2008:1966 or 515
  - testing of welds to BS 709

# SECTION 4: EQUIPMENT

## 4.1 Valves

### 4.1.1 General

Piping systems shall contain sufficient valves to properly operate the system and protect the plant. To include as follows:

- (a) All equipment to be capable of being isolated for removal or repair;
- (b) Check valves to be installed where backflow is undesirable.

### 4.1.2 Valve Standards

**BS 1414** Flanged and butt welding end steel outside

Screw-and-yoke wedge gate valves for the petroleum industry.

**BS 1868** Flanged steel check valves for the petroleum industry.

**BS 1873** Flanged steel globe valve for the petroleum industry.

**BS 2080** Steel valves for the petroleum, petrochemical and allied industries.

Summary of face-to-face dimensions of flanged ferrous valves for the petroleum industry.

**BS 3952** Cast iron butterfly valves (withdrawn).

**BS 5146** Steel valves for the petroleum, petrochemical and allied industries: Inspection and test — Part 1 and 2.

**BS 5150** Cast iron wedge and double disc gate valves for general purposes.

**BS 5325** Steel wedge gate, globe and check valves, 50 mm and smaller for the petroleum, petrochemical and allied industries.

**BS 5351** Steel Ball valves for the petroleum, petrochemical and allied industries.

**BS 5353** Plug Valves.

**API 600** Steel gate valves — flanged and butt welding ends.

**API 602** Compact design carbon steel gate valves for refinery use.

**ANSI B16.34** Valves — flanged and butt welding end, additional requirements may be specified, e.g.:

**API RP 6F** Recommended practice for fire test for valves

**API 607** Fire test for soft-seated ball valves.

**FM 6033** (Factory Mutual) fire safe valves.

## 4.2 Heaters

4.2.1 Indirect heaters shall be designed and constructed to:

API 12K Indirect type oil-field heaters — design specification, including heat calculations, generally for water bath heaters.

## 4.3 Flanges, Fittings and Pipe

4.3.1 Flanges, fittings and pipe shall be designed and constructed to an accepted Standard.

4.3.2 Acceptable Standards for flanges and fittings are as follows:

**BS 10** (obsolescent) Flanges and bolting for pipes, valves and fittings — grey cast iron, copper alloy, cast or wrought steel.

**BS 143 and 1256** Malleable cast iron and cast copper alloy screwed pipe fittings for steam, air, water, gas - pressures up to 1030kPa (150 psi)

**BS 1560** Steel pipe flanges and flanged fittings (nominal sizes 1/4" to 24") for the petroleum industry.

Part 2:1970 Metric dimensions.

**BS 1640** Steel butt-welding pipe fittings for petroleum industry.

**BS 4505** Flanges and bolting for pipes, valves and fittings. Metric (Parts 1 and 2).

**BS 1740:1971** Wrought steel pipe fittings.

**BS 1965** Butt-welding pipe fittings for pressure purposes. Part 1 and 2.

**BS 3293:1960** Carbon steel pipe flanges (over 24" nominal size) for the petroleum industry.

**BS 3799** Steel pipe fittings, screwed and socket-welding for the petroleum industry.

**BS 4882** Bolting for flanges and pressure containing purposes (supersedes BS 1750).

**ANSI B16.5:1981** Pipe flanges and flanged fittings, steel nickel alloy and other special alloys.

**ANSI B 16.9** Butt-weld fittings.

**ANSI B16.11:1980** Forged steel fittings, socket-welding and threaded.

**MSS-SP-44** Pipe flanges (sizes above 24" or 625 mm)

**MSS-SP-75** Butt weld fittings (sizes above 16" or 410 mm)

**BS 3799:1974** Steel pipe fittings, screwed and socket welding for the petroleum industry.

**AS 2129:1982** Flanges for pipes, valves and fittings.

For the above fittings (as allowed by the standard) material to ASTM A105 Grade I or Grade II (for forgings) and API SL Grade B or ASTM A106 Grade 8 (for fittings) are acceptable.

4.3.3 Acceptable standards for pipe are:

**API 5L and 5LX**

**ANSI B16.10** Steel Pipes.

**ANSI B36.19** Stainless steel pipes (note Schedule 5S and 10S do not permit threading in accordance with ANSI B2.1).

**BS 3601** Steel pipes and tubes for pressure purposes.

**BS 1387** Steel pipes and tubulars suitable for screwing to BS 21 pipe threads.

**AS 1074** Process piping (identical to **BS 1387**).

**AS 1836** Refrigerant piping (was ammonia piping).

**AS 1450** Circular steel tubes for mechanical and general engineering purposes (structural tubing).

## 4.4 Pumps

- 4.4.1 Pumps pumping Class 3 products shall be approved and shall be installed in an approved location.
- 4.4.2 Pumps installed in hazardous areas shall comply with the requirements for the area.

## 4.5 Miscellaneous

- 4.5.1 Small piping for instrumentation purposes shall be austenitic stainless steel to ASTM A312-806 or ASTM A403 806 or equivalent. Also acceptable are ASTM A213, A249 and A269.

Joints using compression type fittings shall have a maximum pipe size of 12.5 mm nominal bore and a minimum bursting pressure of four times the maximum operating pressure.

Copper pipe shall comply with BS 2017:1983 (withdrawn) or BS 2871 Part 1 1971.

Also refer to AS 1432 — *Seamless copper tubes (Types A, B, C and D)* — intended for use in water, gas and sanitary plumbing installations.

The manufacturer's recommendations are to be followed in the design and construction of instrument tubing. See information by Crawford Filling Company for Swagelok tube fittings, etc.

- 4.5.2 Gaskets shall be to B5 2815 Grade A for compressed asbestos fibre (or equivalent) or ASTM requirements for spiral wound.
- 4.5.3 Bolting shall be carbon steel to B5 4882 (UNC thread) or ASTM A193 and A194 or equivalent.
- 4.5.4 For inspection of equipment also refer to API *Guides for Inspection of Refinery Equipment* (Chapter I-XX and Appendix).

## 4.6 Class Ratings

The ANSI class rating system as generally used throughout the industry is as follows:

<b>Class</b>	<b>Maximum</b>	<b>Working Pressure kPa</b>	<b>Maximum Hydrostatic Test Pressure kPa</b>
150	1,965 (285 psi)	2,999	(435 psi)
300	5,102 (740)	7,757	(1,125)
400	6,826 (990)	10,343	(1,500)
600	10,205 (1,480)	15,514	(2,250)

This is based on carbon steel (e.g. ASTM A105 material) at a service temperature of -20° to 100°C. Note that different materials and temperatures will have different ratings.

# SECTION 5: PRESSURISED PIPEWORK AND TANKS

## 5.1 General

Pipework and tanks (or vessels) that have a maximum working pressure greater than 200 kPa are generally required to be approved by the Ministry of Transport, Marine Division under the Boilers, Lifts and Cranes Act.

The equipment, layout, isolation distances and other aspects are regulated under the Dangerous Goods (Class 2 - Gases) Regulations 1980.

For precommissioning certification requirements refer Section 1.5.

For LPG also refer:

**API 2508** *Design and Construction of Ethane and Ethylene Installations.*

**API 2510** *Design and Construction of LP-Gas Installations at Marine and Pipeline Terminals, Natural Gas Processing Plants, Refineries, Petrochemical Plants and Tank Farms (4th Edition 1978).*

**ANSI K61.1:1981** *Safety Requirements for the Storage and Handling of Anhydrous Ammonia.*

The Liquefied Petroleum Gas Industry Technical Association UK: *Code of Practice for the Installation and Maintenance of Bulk LPG Storage at Consumers' Premises.*

**AS 1596:1983** *SAA LPG Gas Code.*

Note that vapour phase LPG pipework operating up to 200kPa working pressure is subject to the Gas Act 1982, administered by the Ministry of Energy, and applies to every franchise holder, gas supplier and consumer (the Dangerous Goods Act applies also above 7 kPa but generally only in the case of transfer systems in bulk installations). Liquid phase LPG is administered under the Dangerous Goods Act 1974.

For other gases refer: **NFPA 59A** *Standard for the Production, Storage and Handling of Liquefied Natural Gas (LNG).*

## 5.2 Tanks

- 5.2.1 The materials of construction shall be steel alloy or other as approved by Marine Division, Ministry of Transport. Refer section 2.5 for list of acceptable specifications. noting that approval by Marine Division, MOT is required.
- 5.2.2 For the purposes of the regulations and this code 0.5 kg of LPG is regarded as equivalent to one litre.

The maximum filling ratio of LPG shall be such that:

- (a) The container does not become liquid full at a temperature of less than:
  - for tanks 5,000L and below — 47.5° C
  - for tanks exceeding 5,000L — 45°C
- (b) The liquid will not exceed 97% of total liquid capacity under normal conditions of storage.

The maximum filling ratios as given below will comply with the above requirement:

	<b>For tanks 5,000L and below</b>	<b>For tanks exceeding 5,000L</b>
n - butane	0.533	0.535
iso - butane	0.512	0.515
propane	0.449	0.454

For mixtures, use filling ratio to comply with (a) above.

- 5.2.3 The maximum pressure attained by LPG at a temperature of 40°C (for containers over 5,000L but not exceeding 26,000L) or 40°C (for containers exceeding 26,000L) shall be used for the minimum allowable working pressure of the vessel.
- 5.2.4 For other gases contained under pressure refer Dangerous Goods (Class 2 - Gases) Regulations 1980.

## 5.3 Valves and Fittings

- 5.3.1 Every tank shall be fitted with the following devices located for easy access or with provision for easy access:
  - (a) Pressure gauge (in MPa) and liquid contents gauge (indicating a percentage of water capacity, as a percentage of LPG capacity, in litres or tonnes).
  - (b) At the delivery connection to the tank, a quick closing internal valve, designed to close automatically on the operation of a fusible link and manually by release from either of two remote points.
  - (c) An external shut-off valve on any connection with an opening exceeding 1.4 mm diameter located as close to the tank as practicable.
  - (d) A liquid drain incorporating an excess flow valve plus a shut-off valve or alternatively a check-lock valve and a means for attaching a hose.

Every tank shall be fitted with a pressure relief valve (or safety valve) in accordance with the requirements of the Marine Division, Ministry of Transport.

Also refer API RP 520 - *Recommended Practice for the Design and Installation of Pressure - Relieving Systems in Refineries*, Parts 1 and 2.

- 5.3.2 For LPG service the following shall also apply:
- (a) All liquid pipelines and vapour lines should be seamless and conform to BS 3601 or equivalent.
  - (b) Vapour lines operating below 480 kPa (70 psi) may conform to BS 1387 (medium or heavy gauge) or equivalent.
  - (c) Copper tubing should be seamless conforming to BS 2017 or equivalent. For vapour service above 480 kPa copper tubing should not exceed 12.5 mm nominal bore.
  - (d) Flanges and fittings for liquid and vapour lines shall be to BS 1560 or equivalent. Flanges on vapour lines operating below 480 kPa may conform to BS 10 or BS 4505. Bolting shall be to BS 4882 or equivalent.
- 5.3.3 All pipelines shall be supported with adequate flexibility allowing for thermal and other stresses.

## 5.4 Pumps and Compressors

Liquid transfer pumps and gas compressors shall be designed for use with the product. Compressors shall take suction from the vapour space of the tank. Pumps with a self-priming bypass shall have a check valve fitted where the bypass enters the tanks and a manually operated shut-off valve as close as possible to the tank (this valve shall be fitted with an extension spindle for easy operation from the side or end of the tank).

Pumps for flammable gases shall be powered by one of the following:

- (a) By a flameproof electric motor complying with the Electrical Wiring Regulations 1976.
- (b) Diesel engine fitted as follows:
  - (i) all electrical equipment removed;
  - (ii) air intake terminating above the level of the top of the tank;
  - (iii) an air intake strangler with dual controls situated one near the controls and the other remote; strangler to be clearly identified by a label and easily accessible;
  - (iv) exhaust pipe terminating above the tank or remote from the pump and control valves;
  - (v) engine fuel lines, including contents sight glasses to be of fire-resisting material.

## 5.5 Pipework and Hoses

- 5.5.1 Pipework shall be made from seamless pipe designed to allow for expansion and comply with any requirements of the Marine Division, Ministry of Transport. All pipework and hoses shall be suitable for the

required duty. Design shall be to an approved code (BS 3351 is acceptable for above-ground and underground piping).

Piping, valves and fittings shall be located, protected and secured to provide protection from damage. Screwed joints shall only be used on 50 mm diameter pipe and smaller. Pipework shall be maintained free from leaks.

- 5.5.2 Flexible hose shall be of an approved type and shall be marked with the design working pressure (together with “LP GAS” or “LPG” for LPG hose) or the number of the specification to which it was manufactured.

Hoses which may be subjected to container pressure shall be tested to the design working pressure without leaking.

Also refer to BS 3212:1975 *Flexible Tubing or Hose for Use in Butane/Propane Gas Installations*.

- 5.5.3 For liquefiable gases, a relief valve shall be installed between two shut-off valves in any pipe and shall discharge to a safe location.
- 5.5.4 The following requirements are to be followed for pressurised pipework (in particular LPG) installed underground:
- (a) Pipework to be underground only where necessary and to be installed separately from other services and in any case not in general service ducts. Pipework may be installed in ducts that are filled with sand or equivalent.
  - (b) Pipe shall be protected from corrosion by coating, and cathodic protection or earthing. Care to be taken to protect the coating during backfilling (backfill to consist of clean soft sand approximately 150mm in depth).
  - (c) Pipes to be well identified on entry and exit from ground with warning notices if necessary.

## 5.6 LPG Low Pressure Systems

Low pressure systems (with pressure between 7 kPa and 200 kPa) for LPG shall be designed and installed in accordance with specifications approved by the Ministry of Energy. The codes of practice published by the Gas Association of NZ Inc. (GANZ) shall be complied with.

It is the responsibility of the installer to ensure that the work complies with the applicable codes. Also, the installer is to ensure that the appliances are suitable for LPG and meet acceptable safety standards (appliance shall be approved by GANZ where applicable).

## 5.7 Testing

The pipework shall be tested in accordance with the design specification and Marine Division, MOT, requirements at least once every 5 years. This includes a hydrostatic test and a leak test (e.g. soap bubble). Where possible during construction, underground lines should be tested before backfilling.

Flexible hoses shall be tested as follows:

- (a) Visually once every month.
- (b) Hydrostatically at a pressure not less than the design pressure once a year.

A written record of every test shall be kept by the operator.

## 5.8 Decommissioning LPG Tanks

This is considered an extremely hazardous operation and as such, the following precautions must be adhered to:

- (a) Before any LPG tank is decommissioned the owner shall, not less than one week prior to the emptying of the tank, notify the licensing authority giving such details as may be required.
- (b) Prior to removal, the tank must be cleared of all traces of dangerous goods by an approved method. Generally flaring the contents then flushing with water is acceptable.
- (c) In built up areas, consideration must be given to ensuring an enclosed vapour extraction system to ensure minimum release of vapour to atmosphere.
- (d) All sources of ignition must be excluded from the surrounds of the vessel to the appropriate public place isolation distance.
- (e) Vapour detectors to be available during the decommissioning period.
- (f) All other necessary precautions are taken to ensure for the prevention of accidents from fire or explosion.

# SECTION 6: HAZARDOUS AREAS AND ELECTRICAL EQUIPMENT

## 6.1 General

In order to minimise the risk of fire or explosion in an area where dangerous goods are present, precluding sources of ignition is an important aspect. This is achieved in three ways:

1. general isolation distances (refer regulations);
2. limits on electrical equipment;
3. limits on other sources of ignition.

## 6.2 Sources of Ignition

A source of ignition is defined as any agency capable of igniting a flammable vapour and includes naked flames, sparks from electrical equipment or other sources.

## 6.3 Electrical Installations Within Hazardous Areas

6.3.1. Electrical equipment to be installed within defined hazardous areas shall be approved by the Electrical Supply Authority under the Electrical Wiring Regulations 1976 and shall also comply with current Local Body Supply Regulations.

6.3.2 The following codes and standards are approved for the design, manufacture and installation of electrical equipment within defined hazardous areas:

*BS 229 Flameproof enclosure of electrical apparatus.*

*BS 4137 A guide to the selection of electrical equipment of use in Div 2 areas.*

*BS 4683 Electrical apparatus for explosive atmospheres.*

*BS 5345 Part 1 to 8. Code of Practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres.*

*BS 5501 part 1 to 7. Electrical apparatus for potentially explosive apparatus.*

*BS CP 1003 Electrical apparatus and associated equipment for use in explosive atmospheres of gas or vapour other than mining applications (Parts 1, 2, 3).*

*MP 6105 1976 Electrical Wiring in Hazardous Locations.*

In addition, the following relate to specific equipment, some of which is in a hazardous area:

NZS 5425:1980 Part 1 *Code of practice for CNG compressor and refuelling stations.*

AS 1593 *Electrical equipment for explosive atmospheres.*

AS 1939 *Classification of degrees of protection by enclosures.*

AS 2229:1979 Part 1 and 2. *Electrical equipment for explosive atmospheres (dispensary systems).*

(Also see AS 1829, 1482, 1826)

AS 2380 *Electrical equipment for explosive gas atmospheres.*

BS 4533 Part 2, Section 2 *Light fittings for Division 2 areas.*

- 6.3.3 Electrical apparatus for potentially explosive atmospheres is divided by BS 5501:1977 Part (European Standard EN 50 014) into:

Group I: electrical apparatus for mines susceptible to firedamp.

Group II: electrical apparatus for places with a potentially explosive atmosphere.

For certain types of protection Group II is subdivided according to the nature of the potentially explosive atmosphere for which it is intended. In these cases subdivisions A, B and C are prescribed based on the maximum experimental safe gap (MESG) for flameproof enclosures or on the minimum ignition current (MIC) for intrinsically safe electrical apparatus.

- 6.3.4 Electrical apparatus shall be tested and certified and marked for a particular explosive atmosphere by an acceptable testing organisation, e.g. BASEEFA (British Approvals Service for Electrical Equipment in Flammable Atmospheres), UL (Underwriters Laboratories) and FM (Factory Mutual).

See also BASEEFA's *List of Certified Electrical Equipment.*

## 6.4 Hazardous Areas

- 6.4.1 Where there is a requirement to limit the sources of ignition, the hazardous area may be divided into zones of differing degree of hazard.

- 6.4.2 Most codes recognise three principal zones according to the duration of the presence of explosive gas/air mixtures. These are as follows:

Zone O (BS 5345) or Class 1 Zone O (MP 6105).

- area generally where explosive gas/air mixture is continuously present or present for long periods.

Zone 1 (BS 5345) or Class 1 Zone 1 (MP 6105).

- explosive mixtures present intermittently or periodically, e.g. leaks (likely to occur in normal operation).

Zone 2 (BS 5345) or Class 1 Zone 2 (MP 6105).

- explosive mixtures not likely to occur under normal operation or, if so, only for short time.

Under MP 6105 there are two classes of hazardous areas:

Class I - Hazardous Gases and Vapours Class II - Hazardous dusts, fibres or flyings (with Division I and Division II)

NOTE: Some standards divide Class II into Class II (combustible gases) and Class III (Ignitable fibres or flyings) — see *National Electrical Code* (USA).

6.4.3 The following codes and standards are approved for use in delineating hazardous areas:

NZ 6101:1972 P (Provisional) *Classification of hazardous locations*.

IP *Model Code of Safe Practice Area Classification*.

AS 2430 *Classification of hazardous areas. Part 1: Explosive gas atmospheres. Part 3: Specific occupancies*.

API RP 500C *Classification of Locations for Electrical Installations of Pipeline Transportation Facilities*.

6.4.4 Several factors affect the classification of areas where flammable liquids or vapours are present:

- (a) legislation — regulations;
- (b) flash point of substance;
- (c) flammable limits of substance;
- (d) auto-ignition temperature. MP6105 classifies electrical equipment in terms of its maximum surface temperature.

CLASS	MAX SURFACE TEMP °C
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

- (e) rate of vapour release;
- (f) ventilation of area;
- (g) probability of vapour release;
- (h) specific location and features.

## 6.5 Ventilation

Ventilation, either natural or forced, should be employed to discharge vapours clear of unapproved electrical equipment — ducts shall discharge into open air and vent openings must not be situated close to an opening in a building. Systems shall ensure that under normal working conditions the vapour concentration will not exceed 25% of the lower flammable limit of the vapour.

# APPENDIX A: PIPELINE TEST SHEET

PLANT:

OWNER OF PLANT:

PRODUCT: LPG/3A/3B/3C/OTHER:

DATE OF TEST:

DESCRIPTION OF PIPEWORK:

SIZES:

LENGTH:

IN GROUND:

EXPOSED:

PLANT DESIGN CODE:

DESIGN PRESSURE:

TEST PRESSURE:

TEST PROCEDURE:

TEST MEDIUM:

AIR/HYDRAULIC ADDITIVES:

LOCATION OF TEST GAUGE:

CALIBRATION:

TIME	PRESSURE	TEMPERATURE	SIGN	COMMENTS
START				
1HR				
2HR				
3HR				
4HR				
COMMENTS:				

I HEREBY CERTIFY THAT THE PIPEWORK DESCRIBED AND TESTED AS ABOVE HAS BEEN TESTED AND ACCEPTED FOR OPERATION IN ACCORDANCE WITH THE DESIGN CODE REQUIREMENTS AS REQUIRED UNDER THE DANGEROUS GOODS ACT 1974.

SIGNED:

WITNESSED:

DATE:

NOTES:

1. Attach any information or drawings showing relevant pipework
2. Test Procedure to be approved by Inspector of Explosives
3. Refer:
  - (a) Dangerous Goods (Class 3 - Flammable Liquids) Regulations 1985
  - (b) Dangerous Goods (Class 2 - Gases) Regulations 1980

# APPENDIX B: STATIC TANK DESIGN CHECKSHEET

DATE:

FILE No:

**1. OWNER:**

SERVICE:

---

**2. TANK:**

MANUFACTURER:

DESIGN CODE:

DESIGN PRESSURE:

DESIGN TERM:

DIMENSIONS:

CAPACITY:

MATERIAL:

SHELL THICKNESS:

END DESIGN: Base  
Roof

END THICKNESS: Base  
Roof

HOLDING DOWN:

SEISMIC DESIGN:

WIND DESIGN:

---

**3. NOZZLES:**

INLET:

OUTLET:

MANWAY:

OTHER:

FLANGES:

---

**4. EQUIPMENT:**

---

**5. DRAWINGS:**

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**6. COMMENTS:**

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# APPENDIX C: ENGINEER'S CERTIFICATE BULK INSTALLATION FACILITIES

I \_\_\_\_\_ a Registered Engineer and holder of a current Annual Practising Certificate certify that I have inspected the design/construction (delete as required) of

(description of plant/equipment) and made such detailed examinations and checks as I considered necessary and it is my opinion that:

- the design is in accordance with \_\_\_\_\_  
(state codes or specifications)
- the construction is in accordance with good and widely accepted engineering practice and the design as shown on the drawing list attached.
- The inspection has been carried out in accordance with the requirements of the design code.
- I have witnessed and/or verified non-destructive testing/hydrotesting.
- This tank/installation is subject to further conditions as follows:

Therefore, I recommend that this tank/installation be approved under the Dangerous Goods (Class 3 - Flammable Liquids) Regulations 1985/Dangerous Goods (Class 2 - Gases) Regulations 1980.

Signed: \_\_\_\_\_

Registered Engineer No. \_\_\_\_\_

for and on behalf of \_\_\_\_\_

## APPENDIX D: **APPROVAL OF INSTALLATIONS**

### 1. Underground Tanks

Before the installation of any underground tank intended for the storage of dangerous goods of Class 3 the installer shall, not less than one week prior to the installation of the tank, notify the licensing authority of the proposed installation giving the following details of the proposal.

This information is required by the Dangerous Goods Inspector when approval is requested and a form of application for licence to store Dangerous Goods is to be completed.

- (a) General details including name of owner and address.
- (b) Function of installation, i.e. whether bulk installation, etc.
- (c) Mode of delivery to installation.
- (d) Site plans showing layout of all equipment.
- (e) Details of tanks including specification, foundation, fittings and corrosion protection.
- (f) Certificate of test to be supplied after installation.
- (g) Details of tank tagging.

### 2. Bulk Installation

Inspection of bulk installations will generally be carried out to the following checklist:

- (a) Details of installation including owner, tanks (number and capacities).
- (b) Initial approval of installation plans subsequent modifications — conditions of approval, etc.
- (c) Bonding — whether effective, especially in view of modification.
- (d) Drainage and flame traps.
- (e) Bonding and earthing, including, cathodic protection systems of tanks and pipelines.
- (f) Tank operation including vents, level devices, stop valves — operation and condition.
- (g) Electrical equipment - correct type for hazardous area (including forklift trucks).
- (h) General — tidiness, notices, fencing.
- (i) Operator training on hazards and emergency procedures.
- (j) Tankwagon parking.
- (k) Tankwagon/rail tanks car filling/discharging facilities.

- (l) Drum facilities — filling, isolation, notices, etc.
- (m) Pipelines — maintenance, valves, check of test records.
- (n) Fire fighting facilities — maintenance and operation, communication with Fire Service.

For pressurised systems and tanks (e.g. LPG installations) the following additional checks will be carried out:

- (a) Tank valves and other fittings to comply including pressure gauge, contents gauge, excess flow valves, external shut-off valves, drain valves;
- (b) Vapourisers;
- (c) Pipeworks, including flexible hoses, relief valves;
- (d) Medium pressure system (200kPa — 7kPa) including valves, flexible connections, pressure relief, certification of installation by qualified gas fitter;
- (e) Underground pipework including corrosion protection, pipe coating.

## APPENDIX E: **STORAGE OF DANGEROUS GOODS OTHERWISE THAN IN BULK**

1. This Appendix relates to the construction of storage depots, generally for drums of Class 3A, 3B and 3C dangerous goods. For further information refer Regulations 30-43 inclusive of the Dangerous Goods (Class 3 - Flammable Liquids) Regulations 1985.
2. Storage depots shall be located in an approved location either in the open air or in a building constructed to approved specifications. No explosives, article or substance liable to spontaneous ignition and no source of ignition shall be permitted within 15 metres of any depot or dangerous goods in the premises unless separated by a screen wall. For Class 3b the distance shall be 6 metres. An approved fire extinguisher is to be provided, and the depot is to be clearly marked "FLAMMABLE LIQUIDS STORE — NO SMOKING".
3. Depots shall not be situated within or attached to a building which is a protected work (unless approved by an Inspector) nor shall any opening be within 3 metres of such a building unless that portion of the protected works is of fire resisting construction.
4. Depots are rated as follows:
  - TYPE A: Depots consisting of an earth or concrete compound erected in the open with a shelter roof of iron and protected against unauthorised access.
  - TYPE B: Wooden frame building covered externally with non-combustible material and compounded.
  - TYPE C: Depot with walls of brick or concrete with roof of wood and iron and compounded.
  - TYPE D: Depot with walls of brick or concrete and roof of reinforced concrete and compounded.
  - TYPE E: Such type of building as approved by an Inspector.Isolation distances from protected works to be not less than as laid down in Regulations 35 and 36.
5. The depot as above shall be compounded by having a sill constructed across the doorway or formed by the floor or other as approved.

The compound shall have a capacity as follows:

  - (a) containers under 60 litres:
    - if total quantity under 5,000 litres, minimum compound capacity one half total quantity if total quantity over 5,000 litres, minimum compound capacity of one quarter total quantity or 2,500 litres;
  - (b) containers over 60 litres:
    - if total quantity under 5,000 litres, minimum compound capacity

is total quantity if total quantity over 5,000 litres minimum  
compound capacity of one half total quantity or 5,000 litres.

6. Other construction requirements include:
  - (a) no artificial light or fittings which could be a source of ignite-  
shall be installed inside the depot;
  - (b) depots shall be ventilated at high and low levels by openings  
direct to the open air above the compound level. Openings shall  
be covered with brass gauze of 500 microns nominal aperture  
size.

## APPENDIX F: **RECOMMENDED GAS FREEING METHODS**

All tanks, containers and pipelines shall be thoroughly cleared of dangerous goods and, if necessary, purged of flammable vapours before hot repair work is commenced.

Recommended methods of cleaning are as follows:

1. Flush with water — where substance is readily soluble in water (i.e. alcohol or acetone). Flush several times.
2. Steam clean — ensure adequate steam outlet and condensate outlet. Its recommended to earth the tank and steam pipe.
3. Boil in hot water — immerse tank in boiling water containing a weak alkaline degreasing agent.
4. Fill with an inert gas (e.g. carbon dioxide, nitrogen). To prevent overpressure fit non-return valve with vent to tank.
5. Fill with water — fill to within 5 cm of weld area, vent air space. May need to fill air space with an inert gas.

Also note that:

- (a) The method to be used depends on the product that was contained.
- (b) Care to be taken to remove solid residues, waxes, etc;
- (c) Never blow the container out with air;
- (d) Carbon tetrachloride is not recommended for cleaning (highly toxic and can form phosgene gas when heated, may also react with metal).

Also refer:

*API 2013 Recommended Practice for Cleaning Mobile Tanks in Flammable or Combustible Liquid Service (5th Edition 1975).*

# APPENDIX G: FIRE PROTECTION PRINCIPLES

## 1 Halon Systems

The halon family of chemical fire extinguishing agents was developed for commercial use after World War II. Three fluorinated compounds are generally recognised:

- Halon 1301 (CF<sub>3</sub>Br) — used extensively in fixed systems in North America.
- Halon 2402 (C<sub>2</sub>F<sub>4</sub>Br<sub>2</sub>) — used predominantly in Eastern Europe.
- Halon 1211 (C<sub>2</sub>F<sub>2</sub>ClBr or BCF) — used in portable fire extinguishers.

These compounds do not corrode or damage equipment and will result in a minimum of decomposition products during use on a fire.

Many halon 1301 systems are based on total flooding in a closed area. The level of 1301 required is less than that at which significant toxic effects have been reported but sufficient to suppress the fire regardless of the exact site of it.

Halon 1301 is generally stored in liquid form within cylinders, pressurised to 2480 kPa (360 psi) with nitrogen which provides the pressure to discharge the halon within the time required (refer NFPA standards, etc.). The system is generally designed to rapidly mix halon and air to a specified concentration (generally 5% v/v).

## 2 Foam Systems

- (a) Foam systems consist of a water supply, foam concentrate, a proportioner (mixes foam and water in the desired proportions — usually 3 - 6%) an aspirator (mixes air with the foam solution) and an applicator (applies foam to the fire). The foam concentrate is required to meet acceptable requirements (e.g. UL).

There are six basic types of foam concentrate:

1. protein foam (P)
2. fluoro — protein foam (FP)
3. synthetic foam (S)
4. aqueous film forming foam (AFFF)
5. film forming fluoroprotein foam (FFFP)
6. alcohol resistant foam (AR).

These are generally divided into three types with the following characteristics:

1. Low expansion — up to 20:1 (P, FP, AFFF, FFFP):

These have good water retention and heat resistance with long term stability. Also they flow readily and can be thrown long distances but have limited volume and fill capacity.

2. Medium expansion — from 21:1 to 200:1 (S. FP, AFFF, FFFP):

These have medium properties of the low expansion type but cannot be thrown long distances as they are affected by the wind.

3. High expansion — from 201:1 to 1000:1 (S):

These are very voluminous and cannot be thrown as they are severely affected by the wind. Also they have limited water retention, heat resistance and stability.

The foam is required to be stable for long-term storage. Some foams are corrosive and require special conditions of storage to prevent sludge formation. Foam shall be formulated specifically for use in conditions where ambient temperature is below — 12°C and it shall not be heated above 38°C.

- (b) Chemical foam is produced by the reaction of an alkaline and an acid solution. These are two basic systems:

1. Stored solution (wet storage) — requires large tanks, pumps and a fixed piping system.
2. Dry powder - uses trooper-type generators where water is mixed with the powder when the foam is required either a single or two (A and B) powder system is used. For large diameter tanks handling the amount of powder required is a problem therefore use of chemical foam is not recommended.

Rates of application of foam are prescribed in various standards, e.g. NFPA 11. For open top floating roof tanks greater than 46 m diameter, fixed systems are recommended.

### 3 Water Supply

In addition to water for foam systems, water is required for tank cooling.

In general, for large installations, the fire water mains shall be arranged as a loop or grid system. The design water flow is generally based on the largest tank requirement plus cooling for adjacent unshielded tanks. The system should also be designed to provide at least 0.90kPa residual hydro.- pressure when cooling streams are used. If fire trucks supply additional Taxiing water this may be reduced.

Generally, ring mains are 200 mm diameter minimum and have a sufficient number of isolation valves such that fire protection is maintained if a pipe section is damaged or broken.

### 4 NFPA National Fire Codes

- 10 Portable Fire Extinguishers 1984
- 11 Foam Extinguishing Systems 1983
- 11A Medium and High Expansion Foam Systems 1983
- 11C Mobile Foam Apparatus 1986
- 12 Carbon Dioxide Extinguishing Systems 1985

- 12A Halon 1301 Fire Extinguishing Systems 1985
- 12B Halon 1211 Fire Extinguishing Systems 1985
- 13 Installation of Sprinkler Systems 1987
- 14 Standpipe and Hose Systems for Fire Protection
- 16 Deluge Foam-Water Sprinkler Systems and Foam-Water Spray Systems 1986
- 17 Dry Chemical Extinguishing Systems 1985
- 17A Wet Chemical Extinguishing Systems 1986
- 18 Wetting Agents 1986
- 20 Centrifugal Fire Pumps, Installation of 1987

## APPENDIX H: INTERNATIONAL FLAMMABILITY CLASSIFICATIONS

This code uses the NZ classification of Class 3 (UN Dangerous Goods Classification) flammable liquids as follows:

- Class 3 A flash point less than 23°C
- Class 3 B flash point above 23°C and less than 61°C
- Class 3 C fuel oil

In international operations a number of different classifications systems are used. Some of these are:

- Australia:
  - Class A flash point up to 23°C
  - Class B flash point 23°C and up to and including 61°C
  - Class C flash point more than 61°C and up to and including 150°C
  - Class D flash point more than 150°C (flammable liquids are any Class A and B, combustible liquids are any Class C and D)
- France:
  - Category A vapor pressure in excess of one atmosphere at 15°C
    - Category A.1 stored at less than 0°C
    - Category A.2 stored under other conditions
  - Category B flash point up to and including 55°C
  - Category C flash point above 55°C up to and including 100°C
  - Category D flash point above 100°C
- Germany:
  - Class I flash point below 21°C
  - Class II flash point at and above 21°C, to and including 55°C
  - Class III flash point above 55°C to 100°C
- Holland:
  - K-O vapor pressure greater than one atmosphere at 37°C
  - K-1 flash point of 21°C or less
  - K-2 flash point above 21°C up to and including 55°C
  - K-3 flash point above 55°C up to and including 100°C
- Italy:
  - Category A flash point below 21°C
  - Category B flash point from 21°C up to and including 65°C
  - Category C flash point above 65°C

Sweden:	K-1	flash point of 21°C or less
	K-2A	flash point above 21°C up to and including 30°C
	K-2B	flash point above 30°C up to and including 60°C
UK:	K-3	flash point above 60°C
	Class A	flash point below 22.8°C
	Class B	flash point from 22.8°C up to and including 65.6°C
United States:	Class C	flash point above 65.6°C
	Class I	flash point below 37.8°C
	Class IA	flash point below 22.8°C and boiling below 37.8°C (100°F)
	Class IS	flash point below 22.8°C and boiling at or above 37.8°C (100°F)
	Class IC	flash point at or above 22.8°C and below 37.8°C
	Class II	flash point at or above 37.8°C and below 60°C
	Class IIIA	flash point at or above 60°C
	Class IIIB	flash point at or above 93.4°C, flammable liquids are Class 1 and combustible liquids are Class II and IIIA