AS 1940—2004
(Incorporating Amendment Nos 1 and 2)

AS 1940—2004

Australian Standard®

The storage and handling of flammable and combustible liquids

This Australian Standard® was prepared by Committee ME-017, Flammable and Combustible Liquids. It was approved on behalf of the Council of Standards Australia on 2 September 2004.
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- Australian Industry Group
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- Queensland Department of Emergency Services
- Victorian WorkCover Authority

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- Petroleum Industry Contractors' Association
- Winemakers Federation of Australia
- WorkCover New South Wales

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The storage and handling of flammable and combustible liquids

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PREFACE

This Standard was prepared by Standards Australia Committee ME-017, Flammable and Combustible Liquids, to supersede AS 1940—1993, *The storage and handling of flammable and combustible liquids*. This new edition is the result of a comprehensive review of the Standard.

This Standard incorporates Amendment No. 1 (November 2004) and Amendment No. 2 (November 2006). The changes required by the Amendment are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure or part thereof affected.

This Standard deals with flammable liquids of dangerous goods Class 3, as classified in the UN *Recommendations on the Transport of Dangerous Goods—Model Regulations*, and combustible liquids. The objective of this Standard is to promote the safety of persons and property where flammable or combustible liquids are stored or handled, by providing requirements and recommendations that are based on industry best practices.

This new edition of the Standard has been aligned with the current needs of regulatory authorities, emergency services and environmental authorities, and the various publications of the National Occupational Health and Safety Commission.

This Standard has been revised to reflect control philosophies and innovative designs that have been developed since the last edition. One major change in this revision of the Standard is the inclusion of requirements and recommendations for the storage and handling of potable alcohols in bulk and having a strength of greater than 24% v/v ethanol. Another is the inclusion of informative appendices providing guidance on the design and location of blending plants and batch blending and filling operations.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

Statements expressed in mandatory terms in notes to tables are deemed to be requirements of this Standard. Notes that appear in the main text of this Standard provide information only.

The series of Standards covering the storage and handling of dangerous goods presently comprises the following Standards:

AS 1894	The storage and handling of non-flammable cryogenic and refrigerated liquids
2022	Anhydrous ammonia—Storage and handling (known as the SAA Anhydrous Ammonia Code)
2507	The storage and handling of agricultural and veterinary chemicals
2714	The storage and handling of hazardous chemical materials—Class 5.2 substances (organic peroxides)
3780	The storage and handling of corrosive substances
3846	The handling and transport of dangerous cargoes in port areas
3961	Liquefied natural gas—Storage and handling
4326	The storage and handling of oxidizing agents
AS 4332	The storage and handling of gases in cylinders

AS/NZS

1596 The storage and handling of LP Gas

2927 The storage and handling of liquefied chlorine gas

3833 The storage and handling of mixed classes of dangerous goods in packages and intermediate bulk containers

4081 The storage, handling and transport of liquid and liquefied polyfunctional isocyanates

4452 The storage and handling of toxic substances

4681 The storage and handling of Class 9 (miscellaneous) dangerous goods and articles

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SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard sets out requirements and recommendations for the safe storage and handling of flammable liquids of dangerous goods Class 3, as classified in the UN *Recommendations for the Transport of Dangerous Goods—Model Regulations* and listed in the ADG Code. This Standard also provides requirements and recommendations for the storage and handling of combustible liquids, as defined in Clause 1.4.9.

This Standard provides minimum acceptable safety requirements for storage facilities, operating procedures, emergency planning and fire protection. It provides technical guidance that may assist in the storage and handling of flammable and combustible liquids in accordance with the risk management requirements of NOHSC:1015 and legislation which draws on that document.

This Standard provides requirements for commonly used flammable and combustible liquids such as hydrocarbons and industrial solvents. Some flammable and combustible liquids have other physical and chemical properties that require additional precautions and design considerations. Examples of these are—

(a) liquids that can polymerize;

(b) liquids that require blanketing with inert gas;

(c) liquids that are heated; and

(d) liquids that are assigned a subsidiary risk.

Any special precautions and considerations necessary for the safe storage and handling of such liquids are additional to the requirements and recommendations provided in this Standard.

For the storage and handling of dangerous goods of another class but having a Class 3 subsidiary risk, this Standard is relevant to their flammability aspects.

1.2 APPLICATION

1.2.1 Where this Standard applies

This Standard applies to the storage and handling of Class 3 dangerous goods as described and listed in the ADG Code, with the exception of desensitized explosives of Class 3. It also applies to the storage and handling of combustible liquids. The requirements of this Standard apply in conjunction with, but do not take precedence over, any government regulations that apply in any area.

NOTE: Further information on the classification of flammable liquids, based on the 6th edition of the ADG Code, is given in Appendix A.

Where the flammable liquid being kept has one or more Subsidiary Risks, reference shall be made to the Australian Standards relevant to the classes of those risks and the more stringent requirements shall apply. Where any combustible liquid being kept has risks of other Classes, the relevant Australian Standard for that Class shall be consulted, but for requirements relating to its combustible properties and fire safety, this Standard shall apply.

NOTE: As there is no legal requirement to label combustible liquids as such, it is often difficult to ascertain whether liquid in a drum or other package is a C1 or C2 combustible liquid. Only rarely do material safety data sheets (MSDS) indicate that a liquid is combustible. The actual classification can be determined by reference to the flash point (see Clause 1.4.29). If the flash point is not provided on the MSDS, it should be ascertained from the manufacturer or Australian supplier of the liquid.

This Standard applies in locations that are generally industrial, commercial or rural in nature, including laboratories where the provisions of this Standard are additional to those of AS 2243.10.

1.2.2 Where this Standard does not apply

This Standard does not apply to the following:

(a) The transport of flammable liquids, which is covered by other regulations, rules and codes, e.g. the ADG Code, the International Maritime Dangerous Goods (IMDG) Code.

(b) The handling of flammable liquids in port areas, where covered by AS 3846.

(c) Shipboard installations.

(d) The storage and handling of potable spirits having less than 24% v/v ethanol, and potable spirits with greater than 24% v/v ethanol in containers of less than 5 L capacity. A2

(e) Residential-type heating oil installations comprising Category 1 tanks.

NOTE: Tank categories are described in Clause 1.4.7.

(f) Liquefied gases that are maintained in the liquid phase for storage by means of pressure or refrigeration.

(g) Fuel tanks of any mobile vehicle or equipment, including those on large mining vehicles.

(h) Temporary field storages and associated facilities in remote locations for Australian Defence Force exercises or operations, or declared states of emergency.

1.3 REFERENCED DOCUMENTS

A list of the documents referred to in this Standard is provided in Appendix B.

1.4 DEFINITIONS

For the purpose of this Standard, the definitions below apply.

1.4.1 Access

A means by which a person or vehicle can approach or leave a specific location. The term includes walkways, platforms, stairways, ladders, roads and all provisions for safe entry and exit.

1.4.2 ADG Code

The *Australian Dangerous Goods Code*, which comprises—

(a) the *Australian Code for the Transport of Dangerous Goods by Road and Rail*;

(b) the *Rail (Dangerous Goods) Rules*;

(c) the *Road Transport Reform (Dangerous Goods) Regulations*; and

(d) technical appendices.

1.4.3 Boundary

The perimeter of the whole of the site under the same occupancy as the storage area.

1.4.4 Bulk

In relation to dangerous goods, dangerous goods which are not in packages.

1.4.5 Bund

An embankment or wall which may form part or all of the perimeter of a compound.

1.4.6 Capacity

The maximum volume or space within a container or compound.

NOTE: The available capacity of a container is normally less than its full capacity, to allow for ullage or vapour expansion.

1.4.7 Category of tank

That category of a tank, as classified in AS 1692 and as follows:

(a) *Category 1*—Tanks of up to 1200 L capacity, for aboveground use, intended principally for the storage of oil fuel in domestic type applications.

NOTE: Category 1 tanks should not be used for the storage of flammable liquids as they do not incorporate a liquid seal.

(b) *Category 2*—Vertical or horizontal cylindrical tanks of up to 2500 L capacity, for aboveground use, intended principally for farms and similar open space locations.

(c) *Category 3*—Rectangular tanks and tanks with unconventional shapes, intended principally for industrial use above-ground as either head tanks or storage tanks.

(d) *Category 4*—Horizontal cylindrical tanks of up to 150 m^3 capacity, for underground or above-ground use, intended principally for industrial or service station use.

(e) *Category 5*—Vertical cylindrical tanks of up to 150 m^3 capacity, for above-ground use, intended for industrial use.

(f) *Category 6*—Vertical tanks of any capacity, of a size and type that is usually erected on site.

1.4.8 Class (of dangerous goods)

The number assigned to dangerous goods which exhibit a common single or most significant risk, determined from the criteria given in the UN *Manual of Tests and Criteria* and listed in the ADG Code.

1.4.9 Combustible liquid

Any liquid, other than a flammable liquid, that has a flash point, and has a fire point that is less than its boiling point.

For the purpose of this Standard, combustible liquids are divided into two classes as follows:

Class C1—A combustible liquid that has a flash point of 150°C or less.

Class C2—A combustible liquid that has a flash point of greater than 150°C.

NOTES:

1 The boiling point is that point at which it is no longer possible to achieve the rate of temperature rise required by ISO 2592 for the determination of fire point.

2 ISO 2592, IP 36 and ASTM D92 are technically equivalent test methods for the determination of flash and fire point by Cleveland open cup tester.

1.4.10 Combustible materials

Materials deemed to be combustible when tested in accordance with AS 1530.1.

1.4.11 Commercial building

Any building that is partly or wholly used for offices, professional rooms, consulting rooms, or the like.

1.4.12 Compound

An area bounded by ground contours or by a bund, and intended to retain spillage or leakage. This includes the floor of the compound.

1.4.13 Confined space

A space of any volume as defined by AS/NZS 2865.

1.4.14 Container

Anything in which dangerous goods are wholly or partly encased, covered, enclosed, contained or packed, whether such a thing is empty or partially or completely full, but does not include a vehicle or freight container.

1.4.15 Dangerous goods

Substances and articles that—

(a) satisfy the UN tests and criteria for determining whether they are dangerous goods; or

(b) are listed in the ADG Code; or

(c) are determined to be dangerous goods by the competent authority under Regulation 2.2 of the *Road Transport Reform (Dangerous Goods) Regulations*.

NOTE: UN tests and criteria are specified in the UN *Manual of Tests and Criteria* and the UN *Recommendations on the Transport of Dangerous Goods—Model Regulations*.

1.4.16 Decant

To pour from one container into another.

1.4.17 Desensitized explosives

Explosive substances which are dissolved or suspended in water or other liquid substances, to form a homogeneous liquid mixture to suppress their explosive properties.

NOTE: Entries in the dangerous goods list of the 13th revised edition of the UN *Recommendations on the Transport of Dangerous Goods—Model Regulations* are UN 1204, UN 2059, UN 3064, UN 3343, UN 3357 and UN 3379.

1.4.18 Dispenser

A fuel transfer unit, usually combined with a metering device, that is intended principally for the dispensing of liquids from a storage tank to the fuel tank of a vehicle, boat, or aircraft.

1.4.19 Distillery

A place or establishment where the distilling of alcoholic spirits, for use in the production of potable spirits, is carried out.

1.4.20 Dwelling

A place of residence or abode.

1.4.21 Environmentally sensitive area

The term includes, but is not limited to—

(a) a water catchment area;

(b) a reservoir for drinking water;

(c) a freshwater or marine environment; and

(d) a national park or equivalent.

1.4.22 Explosive limit

1.4.22.1 *Lower explosive limit (LEL)*

The concentration of flammable gas, vapour or mist in air, below which an explosive atmosphere will not be formed.

1.4.22.2 *Upper explosive limit (UEL)*

The concentration of flammable gas, vapour or mist in air, above which an explosive atmosphere will not be formed.

1.4.23 Fire point

In relation to a liquid, the fire point is the temperature at which the liquid, when tested according to the method set out in ISO 2592, first evolves vapour at a sufficient rate to sustain burning for at least 5 seconds after application of the specified test flame.

NOTE: ISO 2592, IP 36 and ASTM D92 are technically equivalent test methods for the determination of flash and fire points by Cleveland open cup tester.

1.4.24 Fire-safe valve

A valve complying with BS 6755-2, API 6FA, API 607 or other recognized Standard, incorporating a handle of fire resistance not inferior to the body material and having no brass or bronze internal parts.

1.4.25 Fire resistance level (FRL)

The grading period, in minutes, determined in accordance with AS 1530.4 for—

(a) structural adequacy;

(b) integrity; and

(c) insulation;

and expressed in that order (e.g. 60/60/30).

1.4.26 Firewall

A wall or other barrier having a specified fire resistance level, constructed and placed for the purpose of preventing the spread of fire.

1.4.27 Flame arrester

A device consisting of an arrester element, arrester housing and associated fittings, used to prevent the passage of a flame.

1.4.28 Flammable liquids

Liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (e.g. paints, varnishes, lacquers, etc., but not including substances otherwise classified on account of their dangerous characteristics) which give off a flammable vapour at temperatures of not more than 60.5°C, closed cup test, or not more than 65.6°C, open cup test, normally referred to as the flash point.

NOTE: Potable spirits, as defined in Clause 1.4.53, are included in this definition.

This class also includes—

(a) liquids offered for transport at temperatures at or above their flash point; and

(b) substances that are transported or offered for transport at elevated temperatures in a liquid state and which give off a flammable vapour.

Class 3 flammable liquids are divided into 3 Packing Groups, as follows and as summarized in Table 1.1:

PG I—high danger; initial boiling point ≤35°C.

PG II—medium danger; flash point (closed cup) <23°C; initial boiling point >35°C.

PG III—low danger; flash point (closed cup) ≥23°C–≤60.5°C; initial boiling point >35°C.

TABLE 1.1

HAZARD GROUPING BASED ON FLAMMABILITY

Packing Group (PG)	Flash point (closed-cup)	Initial boiling point
I	—	≤35°C
II	<23°C	>35°C
III	≥23°C ≤60.5°C	>35°C

NOTE: Reference should be made to the ADG Code.

1.4.29 Flash point

The lowest temperature, corrected to a barometric pressure of 101.3 kPa, at which application of a test flame causes the vapour of the test portion to ignite under the specified conditions of test.

NOTE: Closed-cup flash point methods are given in the AS/NZS 2106 series.

1.4.30 Foam (firefighting foam)

A stable aggregation of small bubbles, of lower density than oil or water, whose properties are such that the foam may be used as a flame-smothering blanket, or to prevent the entry of air, or to suppress vapour.

NOTES:

1 Foams are defined by their expansion rate and are divided into three expansion ranges:
   (a) Low-expansion foam—expansion up to 10.
   (b) Medium-expansion foam—expansion from 20 to 200.
   (c) High-expansion foam—expansion from 200 to approximately 1000.

2 Foam is made by mixing air into a solution of water and foam concentrate, by means of suitably designed equipment. Such foam flows freely over the surface of burning liquid and forms an air-excluding, continuous blanket that seals volatile vapours from contact with air. It resists disruption from wind, drafts, heat or flame and is capable of resealing in case of mechanical rupture. Firefighting foams retain these properties for relatively long periods of time.

1.4.31 Foam application methods

(a) *Surface application*

A method of applying firefighting foam to the surface of a liquid. One of three types of discharge device may be used; these are classified according to the way that they apply foam to the surface, as described below:

(i) A Type I discharge outlet is one that conducts and delivers the foam gently onto the liquid surface without submerging the foam or agitating the surface of the liquid.

(ii) A Type II discharge outlet is one that does not deliver the foam gently onto the liquid surface, but is designed to lessen the submergence of the foam and agitation of the liquid's surface.

(iii) A Type III discharge outlet is one that causes the foam to fall directly onto the surface of a burning liquid, causing general agitation.

(b) *Sub-surface injection method*

A method of conducting and applying foam in which the foam is discharged into the tank from below the liquid surface.

1.4.32 Foam concentrate

A concentrated liquid foaming agent, as received from the manufacturer.

1.4.33 Foam solution

A homogeneous mixture of water and foam concentrate in the proportions specified by the manufacturer.

1.4.34 Hazardous area

An area in which an explosive atmosphere is present, or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of potential ignition sources.

NOTE: A classification system for hazardous areas in relation to flammable liquids is given in AS/NZS 2430.3 series of Standards.

1.4.35 Hot work

The use or operation of any of the following:

(a) Welding or flame cutting equipment.

(b) Grinders, electric drills or other non-flameproof electrical equipment.

(c) Hot tapping equipment.

(d) Spark ignition engines or non-approved compression ignition engines.

(e) Matches, naked lights, cigarettes, cigarette lighters, flame or sparks.

(f) Hand tools that could create a spark.

(g) Non-flameproof electric cables, cords, switches, lights, connectors or fittings.

(h) Any other thing that is likely to produce a source of ignition or be an ignition source.

1.4.36 Ignition source

A source of energy sufficient to ignite a flammable atmosphere. Examples of ignition sources include naked flames, exposed incandescent material, electrical welding arcs, mechanical or static sparks, and electrical, electronic or mechanical equipment not suitable for use in hazardous locations.

1.4.37 Incompatible

(a) In relation to dangerous goods or other goods, goods that are—

(i) likely to interact with the dangerous goods so as to increase the hazard when mixed or otherwise brought into contact with the liquids; or

(ii) listed in the ADG Code as being incompatible; or

(iii) declared by the regulatory authority to be incompatible.

(b) In relation to packaging or transfer equipment, a container or item of equipment that is constructed of a material likely to interact with the liquids such that it is weakened or damaged to the extent that risk increases.

1.4.38 Installation

All the facilities on a site used for storing or handling flammable or combustible liquids.

1.4.39 Intermediate bulk container (IBC)

Rigid or flexible portable packagings for the transport of dangerous goods that —

(a) have a capacity of—

(i) not more than 3.0 m^3 (3000 litres) for solids and liquids of Packing Groups II and III;

(ii) not more than 1.5 m^3 for solids of Packing Group I when packed in flexible or rigid plastics, composite, fibreboard and wooden IBCs;

(iii) not more than 3 m^3 for solids of Packing Group I when packed in metal IBCs; and

(iv) not more than 3.0 m^3 for radioactive material of Class 7.

(b) are designed for mechanical handling;

(c) are resistant to the stresses produced in usual handling and transport; and

(d) comply with the UN *Recommendations on the Transport of Dangerous Goods—Model Regulations.*

NOTE: *Specifications for Intermediate Bulk Containers for the Transport of Dangerous Goods* is published as a supplement to the ADG Code.

1.4.40 Liquids

Where the word ‘liquids’ is used without further qualification, it includes both flammable and combustible liquids.

1.4.41 Manufactured product

Dangerous goods of Class 3 Packing Group II or III—

(a) that are a suspension or solution of at least 10% non-volatile materials as determined by AS 1580.301.1;

(b) of which less than 3% of the mobile solvent layer separates in the solvent separation test specified in the UN *Manual of Tests and Criteria*; and

(c) the viscosity of which meets the criteria specified in the ADG Code.

NOTES:

1 The term includes most solvent-base paints, lacquers and polishes.

2 Reference should be made to ADG Code.

1.4.42 Material safety data sheet (MSDS)

A document which provides information on the identification, health hazards, precautions for use and safe handling of a specific chemical product, and which complies with NOHSC:2011.

1.4.43 May

Indicates the existence of an option.

1.4.44 Minor storage

The storage of flammable and combustible liquids, in various locations, in quantities conforming to the criteria specified in Section 2 of this Standard.

1.4.45 Non-combustible

Material that does not support combustion or is deemed to be non-combustible when tested in accordance with AS 1530.1.

1.4.46 On-site protected place

A building where people are employed within the property boundary, including offices, warehouses, manufacturing or processing areas, amenities and other dangerous goods stores where quantities exceed minor storage.

1.4.47 Package

The complete product of the packing operation, consisting of the packaging and its contents prepared for transport.

1.4.48 Packaging

A receptacle and any other components or materials necessary for the receptacle to perform its containment function, and—

(a) in relation to dangerous goods of Class 2, a container having a capacity not exceeding 500 L; and

(b) in relation to dangerous goods of any other class, a container having a capacity not exceeding 450 L and having a net mass of not more than 400 kg.

1.4.49 Packing Group (PG)

One of three hazard groups to which dangerous goods (of Classes other than 1, 2, 6.2 and 7) are assigned in the ADG Code, in decreasing order of hazard, by the Roman numerals 'I' (high danger), 'II' (medium danger) and 'III' (low danger).

NOTE: The UN *Recommendations on the Transport of Dangerous Goods—Model Regulations* provide criteria for the assignment of packing groups. A list of those already assigned is given in the ADG Code. Criteria for assigning packing groups is also given in the ADG Code.

1.4.50 Pipework

An assembly of pipes, hoses, valves, fittings and associated appliances.

1.4.51 Polymerizable material

Any liquid, solid, or gaseous material which may polymerize (combine or react with itself) so as to expand or cause dangerous evolution of gas or heat.

1.4.52 Port area

The land and sea area established by legislation.

NOTE: Some port areas may overlap and legal requirements should take account of this possibility.

1.4.53 Potable spirits

Liquids that are intended for human consumption, or are ingredients used in the production of such liquids, and which have a degree of strength not less than 24% alcohol (ethanol) by volume (v/v).

1.4.54 Premises

The area under the control of the occupier.

1.4.55 Protected place

Any of the following:

(a) A dwelling, residential building, place of worship, public building, school or college, hospital, theatre, and any building or open area in which persons are accustomed to assemble whether it is within or outside the property boundary of the installation.

(b) A factory, workshop, office, store, warehouse, shop, or building where persons are employed, that is outside the property boundary of the installation.

(c) A ship lying at permanent berthing facilities.

(d) Any storage facility for dangerous goods outside the property boundary of the installation, except for those defined as minor storages in this or other Standards or regulations.

1.4.56 Public place

Any place other than private property, open to the public, which the public has a right to use and which includes a public road. Parking areas for commercial buildings are not considered to be public places.

1.4.57 Rail tank vehicle (rail tanker)

A rail wagon, of which a tank forms an integral part.

1.4.58 React dangerously

The reaction of substances in a manner that directly creates a hazard due to the reaction—

(a) being violent;

(b) producing an explosion;

(c) producing a potentially explosive combination of products;

(d) producing fire or rapid evolution of heat; or

(e) producing toxic vapour or toxic gas.

NOTE: Examples of substances that react dangerously are—

(a) calcium hypochlorite (‘pool chlorine’) and oil or petrol; and

(b) hydrogen peroxide and organic substances.

1.4.59 Regulatory authority

The authority responsible for the administration of control of the storage, transport and use of dangerous goods.

NOTE: More than one authority may be involved in relation to such matters.

1.4.60 Restricted area

An area to which access is available only to persons authorized by the occupier.

1.4.61 Road tank vehicle (road tanker)

A road vehicle, of which a tank forms part, or to which a tank (other than a portable tank) is attached.

1.4.62 Segregated

Isolated from each other within the store.

1.4.63 Separated

Isolated from the storage by a given minimum distance.

1.4.64 Shall

Indicates that a statement is mandatory.

1.4.65 Should

Indicates a recommendation.

1.4.66 Subsidiary Risk (subrisk)

A reference to any additional hazard that the dangerous goods might have, indicated by the Subsidiary Risk number to which the dangerous goods are assigned. Dangerous goods are assigned a Subsidiary Risk if they—

(a) satisfy the criteria specified in the UN *Manual of Tests and Criteria* for their assignment to a Subsidiary Risk;

(b) are assigned a Subsidiary Risk in the ADG Code; or

(c) are assigned a Subsidiary Risk by the regulatory authority.

1.4.67 Tank

A container other than a package or IBC, intended for the storage or transport of a liquid and having a capacity greater than 450 L. Where a tank category is mentioned, it means the category specified in AS 1692 and defined in Clause 1.4.7 of this Standard.

A tank may be one of the following types:

(a) *Static storage tank*—A tank of a type described in AS 1692, intended to remain permanently in place once installed.

(b) *Demountable delivery tank*—A tank intended to be placed on a vehicle from time to time to enable use as a temporary delivery tanker.

(c) *Tank container*—A tank fitted with frames to international freight container dimensions in accordance with AS 3711.6. (This type of tank is also referred to as an 'ISO Tank'.)

(d) *Underground tank*—A static storage tank wholly or partially buried below the surrounding ground gradient.

(e) *Above-ground tank*—A static storage tank which is not an underground tank.

(f) *Portable tank*—A multimodal portable tank, including a shell fitted with service equipment and structural equipment necessary for the transport of dangerous substances.

A portable tank meeting this definition is capable of being loaded and discharged without the need of removal of its structural equipment. It possesses stabilizing members external to the shell, and is capable of being lifted when full. It is designed primarily to be loaded in a transport vehicle or ship and is equipped with skids, mountings or accessories to facilitate mechanical handling.

1.4.68 Tank vehicle (tanker)

A road tank vehicle or a rail tank vehicle.

1.4.69 Tinting

The opening, reclosing and shaking of a can to permit addition of a concentrated colourant to a base paint in order to produce the required colour.

1.4.70 Transit storage

The storage of flammable or combustible liquids for at least 12 h and less than five days, where such liquids are intended for further transport to another location.

1.4.71 Vapour barrier

A wall or other barrier constructed and placed with the object of preventing the passage of vapour from any one place to another.

1.4.72 Winery

An establishment for making wine.

1.4.73 Work permit

A written document which stipulates the conditions under which work within a specified area may be carried out.

SECTION 2 MINOR STORAGE

2.1 SCOPE OF SECTION

This Section specifies the criteria for 'minor storage' of flammable and combustible liquids, and the requirements for such storage.

Storage of flammable or combustible liquids in quantities not exceeding those listed in Table 2.1 and complying with the requirements of this Section, may be classified as minor storage and are exempted from the other sections of this Standard except as required by this Section.

The storage of minor quantities of liquids under conditions that do not comply with the requirements of this Section, or of quantities of liquids greater than those given in Table 2.1, shall comply with the requirements of other relevant Sections of this Standard.

Minor storage may exist as a part of a premises or complex in which no other flammable or combustible liquids exist, or may be part of a premises whose function is to use flammable or combustible liquids in processes or storage.

NOTES:

1 Workplace safety regulations and guidelines may apply even to quantities defined as minor storage.

2 For liquids with subsidiary risks, or in areas where decanting, package filling or processing occur, additional safety precautions (e.g. ventilation), may be required. Guidance may be found in relevant exposure standards, MSDS and product labels.

2.2 MINOR STORAGE QUANTITIES

2.2.1 Quantities allowable as minor storage

The quantities of flammable and combustible liquids allowable as minor storage are given in Table 2.1.

2.2.2 Quantities of Packing Group I

Flammable liquids of PG I, in containers larger than 2.5 L, shall not be kept in minor storage unless they are essential for daily operations and handled only by trained personnel.

2.2.3 Multiple minor storages

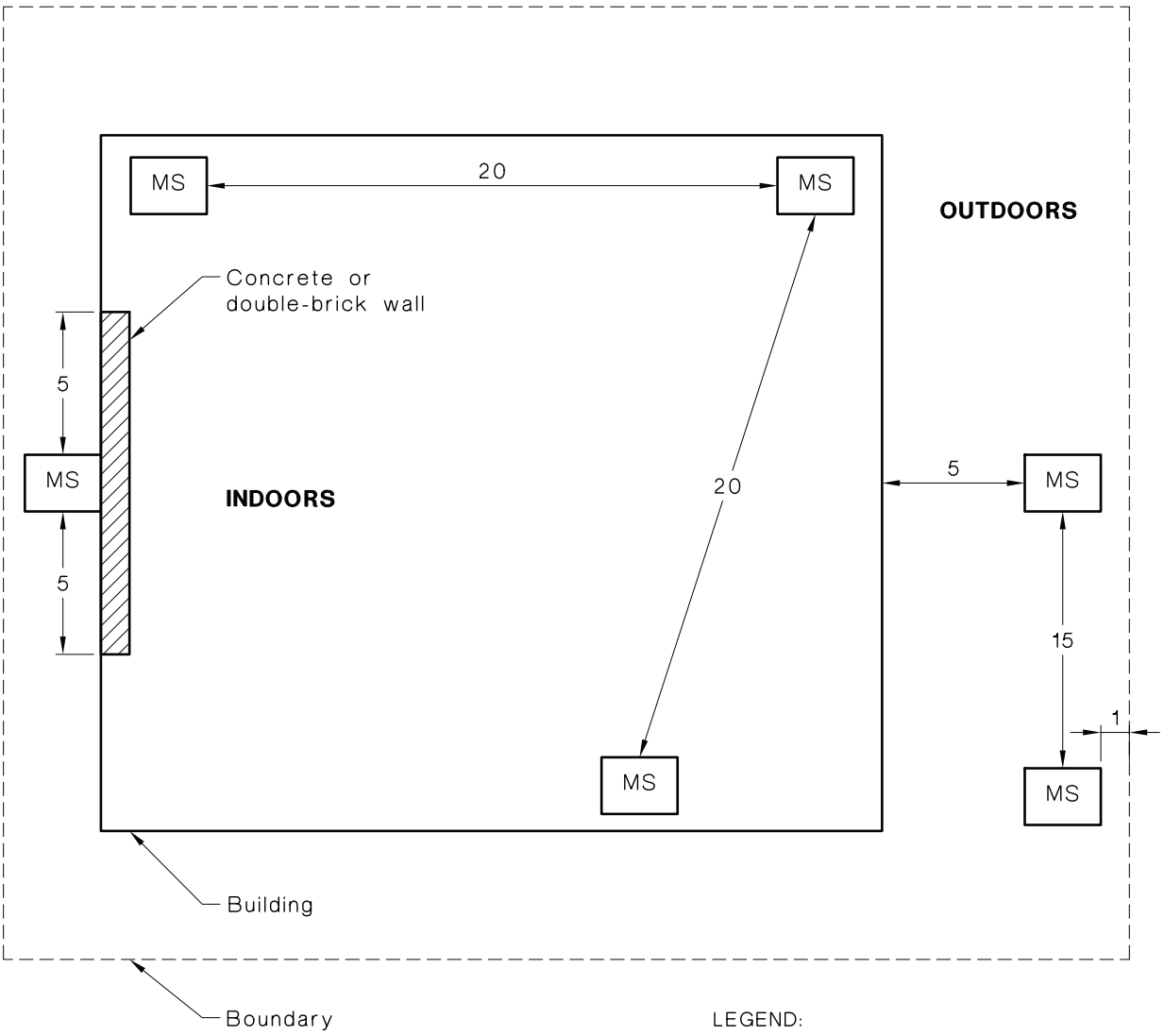
Where there is more than one minor storage on the same premises, such storages shall be separated by a distance of at least—

(a) 20 m, if they are indoors; or

(b) 15 m, if they are outdoors.

This distance shall be measured from the outermost package or tank in the minor storage (see Figure 2.1).

If two or more buildings are separated by at least 5 m of open space (i.e. an area without a roof and accessible for firefighting at all times), or by a concrete or double-brick wall capable of preventing the spread of a fire, a separate indoor minor storage quantity may be applied to each building.



DIMENSIONS IN METRES

FIGURE 2.1 EXAMPLES OF LOCATIONS OF MINOR STORAGE

2.2.4 Separation between minor storage and other stores

A minor storage shall be separated from any other store of flammable and/or combustible liquids that is larger than minor storage by—

(a) the distance to an on-site protected place (as given in Clause 4.3.1(b)); or

(b) at least 5 m,

whichever is the greater.

This clause (Clause 2.2.4) does not apply to storage cabinets having a maximum capacity of 250 L.

2.2.5 Minor storage on open land

The following requirements and conditions shall apply to minor storage on open land having an area greater than 2 ha:

(a) The storage shall be on land that is used, or intended to be used, for agricultural, horticultural, floricultural or pastoral purposes, including golf courses and national parks.

(b) Liquids shall not be for sale or commercial distribution.

(c) Liquids shall be kept at least 1 m away from any boundary, workshop, dwelling or protected place, body of water, watercourse or environmentally sensitive area.

(d) The ground around the store shall be kept clear of combustible vegetation or refuse for a distance of at least 3 m.

(e) Any potential flow of spillage shall be prevented from reaching a protected place, watercourse or property boundary by such means as the use of natural ground slope, or the provision of a diversion channel, kerb or bund.

2.2.6 Minor storage on construction sites

The requirements and conditions set out in Clause 2.2.5, with the exception of Item (a), shall apply to minor storage on construction sites.

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TABLE 2.1
MINOR STORAGE

Location	Flammable liquids		Combustible liquids	Manufactured products
	PG I or PG II	PG III	C1, C2	
Residential buildings of any type				
Within a residence	5 L	25 L	50 L total C1 and C2	50 L
In a garage attached to a residence with a 60/60/60 FRL separating wall	25 L	50 L	100 L total C1 and C2	250 L
Outdoors, or in a shed or garage, separated from the residence or any other building by 1 m space	100 L	250 L	500 L total C1 and C2	250 L
Outdoors, uncovered, or in a shed or garage, separated from the residence or any structure or boundary by either 3 m of space or a wall having an FRL of 180/180/180	250 L	250 L	500 L total C1 and C2	250 L
A supply tank for domestic oil-fired appliances installed in accordance with AS 1691 is excluded from any calculation of the quantity stored on the premises				
Educational establishments (excluding laboratories)	5 L per 50 m^2 of floor space	10 L per 50 m^2 of floor space	500 L total C1 and C2 per 50 m^2 of floor space	The limit for any manufactured product is the same as for a liquid of the same Packing Group
For storage outdoors, or in sheds or attachments, the limits for the corresponding entry in residential buildings shall apply				
Laboratories (see Notes 1, 2 and 5)	50 L per 50 m^2 of floor space, or 50 L in a room of up to 50 m2 of floor space	100 L per 50 m^2 of floor space	200 L total C1 and C2	
Commercial buildings	10 L per 50 m^2 of floor space, but 5 L for any tenancy of less than 50 m2 area	25 L per 50 m^2 of floor space, but 25 L for any tenancy less than 50 m2 area	500 L total C1 and C2 per 50 m^2 of floor space but 500 L for any tenancy less than 50 m2 area	
Indoors				

(*continued*)

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TABLE 2.1 (*continued*)

Location	Flammable liquids		Combustible liquids	Manufactured products
	PG I or PG II	**PG III**	**C1, C2**	
Hospitals Indoors	10 L per 50 m^2 of floor space	25 L per 50 m^2 of floor space	500 L total C1 and C2 per 50 m^2 of floor space	The limit for any manufactured product is the same as for a liquid of the same Packing Group
Factories, workshops Indoors	1 L per 2 m^2 of floor space with no more than 250 L in any 500 m2 area	1 L per 1 m^2 of floor space with no more than 500 L in any 500 m2 area	4 L per 1 m^2 of floor space with no more than 2000 L in any 500 m2 area	In packages only—2000 L
At commercial buildings, factories, workshops, hospitals and warehouses Outside the building— (a) in attached outhouses or sheds if separated by a partition having an FRL of 60/60/60; or (b) outside, or in a detached shed or outhouse separated from the factory or workshop by at least 1 m	 250 L As immediately above	 As immediately above 1 400 L in tanks not over 700 L each, or in packages	 2 500 L 5000 L	
Shops	As for factories and workshops (above) but no container for PG I or PG II liquid may exceed 20 L capacity			Flammable products: 10 000 L, of which no more than 2000 L are PG II, provided that storage is closed packages, not to be opened except for tinting paint for immediate sale
Warehouses	As for factories and workshops (above)			
Service stations Indoors	500 L total in packages Any packages kept in a sales area shall be unopened packages not over 20 L capacity	1 250 L total in tanks or packages	3000 L total C1 and C2	As for factories, workshops

(*continued*)

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TABLE 2.1 (*continued*)

Location	Flammable liquids		Combustible liquids	Manufactured products
	PG I or PG II	PG III	C1, C2	
Service stations Outdoors		An additional 1000 L in packages can be kept outdoors		As for factories, workshops
Open land				
Outdoors above ground	5000 L	5000 L	10 000 L	
Underground tank(s)	5000 L	5000 L	10 000 L	As for shops
Construction sites	2 500 L	5000 L	10 000 L	As for shops

NOTES

1 In the case of laboratories, commercial buildings and the like, Table 2.1 is intended to cater for the day-to-day working stock in the laboratory or workroom. If these quantities are to be exceeded, it will be necessary to install a cabinet or major store facility according to the scale needed.

2 Laboratories that are constructed, operated and equipped in the form of a flammable liquid storage room and are used for the analysis of flammable liquids being processed are exempt from Table 2.1.

3 It is permissible to store at the same time on the same area, the maximum permissible allowance for each or all of the other packing groups of flammable liquids or classes of combustible liquids.

4 Where the maximum allowance is specified in terms of quantity per unit area, any arrangement which results in concentration at one point should be avoided. Such aggregation contravenes the intent of minor storage, which is dispersal, and proper storage provisions as in Section 4 could be necessary.

5 Materials being analyzed, used, mixed, blended or reacted upon on laboratory benches or in fume cupboards are exempt from the limitations of Table 2.1.

2.3 PRECAUTIONS APPLYING TO MINOR STORAGE

2.3.1 Location of minor storage

The following requirements and recommendations apply to the location of an indoor minor storage:

(a) If the storage is located on a floor that is above the building's lowest floor (i.e. on a floor that is above the ground floor or basement), its location shall not jeopardize the safety of any areas on lower levels of the building or impede firefighting operations.

(b) Flammable vapours and spilt liquids shall be prevented from escaping to any lower levels of the building.

(c) Concentrated storage of liquids in any one area shall be avoided, so as to reduce the fire load and the potential rate of fire spread.

(d) The storage area shall be adequately ventilated.

(e) The build-up of flammable vapours should be avoided (see Clause 2.3.3 below).

2.3.2 Operations

The following handling requirements and precautions apply:

(a) Persons who handle the liquids shall be fully aware of the hazards involved.

(b) All storage areas shall be secured against access by unauthorized persons at all times.

(c) Packages shall not be placed where they could hinder escape from a building in an emergency.

(d) Care should be taken when decanting or transferring flammable liquids. Dispensing pumps or self-closing metal taps should be used, in order to reduce the hazards of splash filling, spillage and vapour escape.

(e) Packages shall be kept closed when not in use. Packages containing flammable liquids should only be opened or decanted in well-ventilated areas and away from any potential ignition source.

(f) The area in or around the minor storage shall be kept free of combustible materials and residues.

(g) Any materials that might react dangerously if mixed shall be kept apart so that the possibility of reaction is minimized, e.g. fuel and pool chorine.

(h) Liquids should not be stored near any hot surfaces, e.g. steam pipes, furnace walls or engines, or where they might be accidentally exposed to heat, e.g. from escaping steam.

(i) Liquids should be transferred and moved in manner that reduces the likelihood of spillage, vapour escape or fire.

NOTE: Section 9 of this Standard deals with operational safety matters that may be pertinent to minor storage but which may be regarded as advisory.

2.3.3 Control of ignition sources (flammable liquids only)

Except for domestic premises, AS/NZS 2430.3.3 shall be consulted for hazardous atmosphere zoning if the volume of flammable liquids exceeds—

(a) 100 L in closed containers;

(b) 25 L for decanting purposes, e.g. petrol transfer to a motor vehicle or lawn mower;

(c) 5 L in open containers for occasional use; or

(d) 1 L in open containers for continuous use.

There shall be no ignition sources in any space in which a flammable mixture of vapour and air could be present.

WARNING: EVEN SMALL QUANTITIES OF FLAMMABLE LIQUID, IF SPILT, CAN CREATE A VAPOUR CLOUD THAT CAN TRAVEL CONSIDERABLE DISTANCES AND FLASHBACK.

2.3.4 Spillage control

All spills and leaks shall be cleaned up immediately. Any waste shall be disposed of safely and in accordance with the local regulations.

Liquids should not be allowed to reach ignition sources, stores of other chemicals, or combustible materials (e.g. timber and paper), or flow into drains or onto neighbouring land, or enter any creek, pond or waterway.

NOTES:

1 Precautions should be based at least on the loss of contents of the largest container kept.

2 A simple spillage kit may consist of—

(a) a metal bin with a tightly-fitting lid (plastics can be attacked by the liquid), partially filled with non-combustible absorbent such as vermiculite;

A2 (b) broom, shovel, face shield, chemically-resistant boots and gloves; and

(c) a suitable respirator.

3 Oils of animal or vegetable origin can oxidize, with the generation of heat and the possibility of spontaneous ignition if they are absorbed onto combustible absorbents.

2.3.5 Fire protection and warning signs

At premises other than residences or farms, in locations where more than 100 L of flammable liquids, or more than 1000 L of combustible liquids are stored, or where flammable liquids are decanted, the following requirements apply:

(a) At least one portable fire extinguisher, having a suitable rating for use with the range of materials being kept, shall be readily accessible and adjacent to the minor storage area. Where liquids are stored on open land, a fire extinguisher shall be provided if the liquids are decanted or transferred within 5 m of the storage.

(b) In areas where flammable liquids are decanted, a sign bearing the words

DANGER — FLAMMABLE LIQUIDS — NO SMOKING — KEEP FIRE AWAY

shall be displayed.

NOTE: Signs should comply with AS 1319.

For retail areas with customer access, this requirement shall apply if the liquids are decanted or transferred, or are in packages having capacities of more than 25 L.

2.4 MINOR STORAGE IN TANKS

2.4.1 Construction

Any tank that is intended for the storage of flammable or combustible liquid shall comply with AS 1692 or other appropriate specification. A Category 1 tank shall not be used for flammable liquid.

2.4.2 Installation

For underground tanks, the installation requirements of Clause 5.12 shall apply.

2.4.3 Maintenance

Tanks shall be inspected and maintained regularly.

SECTION 3 GENERAL REQUIREMENTS

3.1 SCOPE OF SECTION

This Section provides general requirements and recommendations that apply to stores of flammable or combustible liquids, in quantities greater than those classified as minor storage in Section 2.

Additional requirements that are specific to particular types of installation are given in other sections of this Standard.

NOTE: Recommendations for blending plants are given in Appendix C.

3.2 GENERAL DESIGN AND CONSTRUCTION REQUIREMENTS

3.2.1 Design safety and suitability

Any installation intended for the storage and handling of flammable or combustible liquids shall be designed and constructed so that it is safe and suitable for the conditions of use. Factors that need to be considered include the following:

(a) Working pressures and structural stresses.

(b) Heat, corrosion, or attack by the liquid being handled.

(c) Site conditions such as topography, usage of adjoining areas, or the risk of natural disasters, e.g. flood, earthquake, lightning strikes.

(d) Design of plant, equipment, and operating methods, so as to minimize fire and accident risks and the possibility of errors or misunderstanding by staff.

(e) Specific design for emergencies (see Clause 3.2.2 and Section 10), particularly firefighting facilities.

(f) The identification of the function of every valve, switch or control actuator, including any remote switches or actuators.

(g) Safe access to and egress from all working locations.

(h) Avoidance of ignition sources.

(i) Ventilation for vapour dispersal, taking into account the possible effect of nearby structures, excavations, embankments, and the like.

(j) Separation of potential hazards, including areas where activities cannot be controlled.

(k) Points of vapour relief.

(l) Spill control measures to avoid contamination of soil and water.

3.2.2 Emergency provisions

An installation shall be designed to facilitate the management of an emergency, taking into account—

(a) the nature and quantity of the liquids stored;

(b) the layout of the storage area;

(c) access through or around walls or other barriers;

(d) the type of construction of any buildings; and

(e) the type and means of operation of any fire protection system.

NOTE: See also Sections 9, 10 and 11.

3.2.3 Minimization of vapour hazards

Where a flammable liquid is being used or transferred in such a manner that vapour is released, the ventilation, extraction, or dispersal provisions shall be sufficient to maintain exposure levels below the exposure standards set out in NOHSC:1003.

3.2.4 Ignition sources

A hazardous area shall not extend beyond a boundary if it could encompass a fixed source of ignition on the adjacent property.

NOTE: Hazardous areas and zones are defined in the AS/NZS 2430.3 series of Standards.

3.2.5 Separation distances

3.2.5.1 *General*

Storages shall be separated from boundaries, ignition sources, protected places and accumulations of combustible materials by the minimum distances relevant to each type of storage as specified in Clauses 4.3 and 5.7, with the additional requirements and qualifications as set out in this Clause (3.2.5).

Where alterations to the installation or adjoining site result in a breach of the required separation distances, the installation shall be assessed and brought into compliance or decommissioned.

3.2.5.2 *Separation to property boundary*

The separation distance to any property boundary shall be at least that distance required by Table 4.2 or Table 5.3.

3.2.5.3 *Separation to protected places on adjoining properties*

The separation distance to a protected place on another property shall be at least that specified in Table 4.1. or Table 5.4, as appropriate. This distance may be measured across a boundary, provided that, if alterations on the adjacent property result in a breach of the separation distance, the installation will be modified or relocated to restore compliance or taken out of service.

Where the future installation of a protected place on the adjoining property is possible, the installation may be located in accordance with boundary separation distances, provided that the provisions stated in the above paragraph are satisfied.

NOTES:

1 The use of the protected place distance measured to the boundary of the adjacent property is recommended to eliminate future problems, although its use is a commercial decision.

2 A formal agreement or covenant may be used.

3.2.5.4 *Adjacent occupancies storing flammable and combustible liquids*

Where two adjacent premises under separate occupancies are each used for the storage and handling of flammable and combustible liquids and share a common boundary, the separation distances between tanks, package stores and other buildings may be measured as though both premises were under a single occupancy, provided that an agreement similar to that described in Note 2 to Clause 3.2.5.3, but providing for the alteration, redevelopment or change of ownership of either site is in place.

3.2.5.5 *On-site storage of other dangerous goods*

The on-site storage of other classes of dangerous goods may require differing separation distances, as specified in the relevant Australian Standards or by legislation, or both. Where no such distances are specified, the storage containing the other dangerous goods should be considered as an on-site protected place and the relevant distance specified in this Standard applied.

3.3 ELECTRICAL INSTALLATIONS AND EQUIPMENT

The following requirements shall apply to both electrical equipment and installations in areas designated as hazardous areas under AS/NZS 2430:

(a) *Electrical installations*

All electrical installations shall be installed in compliance with the provisions of AS/NZS 3000 that relate to electrical equipment in hazardous locations. The equipment shall be of a type certified to comply with the relevant Australian Standard or that has been approved for use in such locations by the relevant authority.

(b) *Portable and mobile electrical equipment*

All electrical equipment to which AS/NZS 3000 does not apply shall be of a type certified to comply with the relevant Australian Standard or that has been approved for use in such locations by the relevant authority, except where Item (c) below applies.

(c) *Electric forklift trucks*

In hazardous areas classified as Zone 2, electric forklift trucks and similar vehicles (e.g. stackers) not suitable for use in the Zone shall not be used except where Appendix D is complied with in all respects.

NOTE: Requirements for electric forklift trucks for use in hazardous zones are specified in AS 1915.

3.4 INTERNAL COMBUSTION ENGINES

Internal combustion engines may be used in hazardous areas as designated in AS/NZS 2430 under the following conditions:

(a) An engine designed and certified to AS 2359 may be used in the zones for which it is certified. In such cases, a hot work permit is not required.

(b) A spark ignition engine not complying with Item (a) may be operated in a hazardous zone if a hot work permit (see Clauses 9.8.3 and 9.8.6) has first been issued.

(c) A compression ignition engine may be operated in a Zone 2 hazardous area if—

(i) any incorporated or attached electrical equipment is suitable for use in a Zone 2 hazardous area;

(ii) the air intake is either extended to outside the hazardous zone, or is provided with a strangler valve or equivalent in the manifold, in which case the engine is attended when in use;

(iii) mechanical sparks cannot be produced in the engine compartment of the appliance during its operation; and

(iv) the exhaust has a spark arrester complying with AS 1019 or is extended to outside the hazardous zone.

Any compression ignition engine not complying with AS 2359 (see Item (a) above) shall not be operated in a Zone 0 or Zone 1 area unless a hot work permit has been issued.

Forklift trucks and similar vehicles that are not approved for use in Zone 2, or which do not comply with Items (a) to (c) above, shall not be used unless both the store and the vehicle comply with Appendix D and a work permit has been issued.

3.5 LIGHTING

Lighting shall be provided in accordance with the following requirements:

(a) During the hours of operation, lighting shall be sufficient to provide safe working conditions that include, but are not limited to, clear visibility of all markings on packages, signs, instruments and other necessary items.

NOTE: A minimum value of 50 lx is recommended.

(b) Sufficient lighting shall be available on any of the installation's internal roads when personnel at the premises might use them.

(c) Reference should be made to the appropriate part of AS/NZS 2430.3.

3.6 RESTRICTED USAGE

A storage that has a capacity greater than that given for minor storage shall only contain flammable or combustible liquids or both, unless the other products being stored will not react dangerously or be incompatible with the liquids.

If the store contains dangerous goods having a primary risk of other than Class 3, any other appropriate Australian Standards shall be consulted and the more stringent requirement shall apply.

Aerosols of Classes 2.1 and 2.2 may be stored in a store for Class 3 dangerous goods if projectile protection (e.g. cages) is provided.

NOTE: Activities within package stores are described in Clause 4.10.

3.7 FIREWALLS AND VAPOUR BARRIERS

3.7.1 Conditions of use

Separation distances may be measured in a horizontal plane around the end of any intervening vapour barrier, provided that the barrier complies with the following:

(a) For separation from protected places and on-site protected places, such a vapour barrier is also a firewall.

(b) Building walls may be treated as being firewalls or vapour barriers provided that they qualify as such.

A wall on an adjacent property shall not be used as a firewall unless an agreement similar to that described in Clause 3.2.5.4 is in place.

Firewalls and vapour barriers may be used to achieve the separation distance in Tables 4.1, 4.2, 5.3 and 5.4 to protected places, public places and security fences.

3.7.2 Construction of firewalls

A firewall shall comply with the following requirements:

(a) The fire resistance level shall be at least 240/240/240.

(b) The firewall shall be impervious to vapour apart from around fire doors or other protected openings.

(c) Any freestanding firewall shall be self-supporting and shall have adequate foundations.

(d) The height of the firewall shall be sufficient to shield a protected place from heat radiation and flame impingement in the event that a potential storage fire becomes a reality, and vice versa.

NOTE: Where an FRL is required, reference should be made to the *Building Code of Australia* (BCA) for building purposes.

3.7.3 Construction of vapour barriers

A vapour barrier shall comply with the following requirements:

(a) The material shall be impervious to vapour and deemed to be non-combustible when tested in accordance with AS 1530.1.

(b) The top of the vapour barrier shall be above the height of the hazardous area pertaining at that point as determined in the relevant part AS/NZS 2430.3.

3.8 SECURITY, SIGNS AND NOTICES

3.8.1 Control of access

All installations shall be appropriately secured against unauthorized access.

3.8.2 Signs and notices

At the entrance to any storage area greater than minor storage, the following signs shall be displayed:

(a) A DANGER—NO SMOKING, NO NAKED FLAMES sign;

(b) For flammable liquids, a Class label and Subsidiary risk label (if any).

(c) For combustible liquids, a COMBUSTIBLE LIQUID sign.

The following signs should be placed at the entrance(s) to the premises:

(i) A WARNING—RESTRICTED AREA, AUTHORIZED PERSONNEL ONLY sign.

(ii) A sign listing the emergency contact names, titles and phone numbers relevant to the installation.

(iii) The name, address and phone number of the occupier.

(iv) A layout diagram showing the location of fixed fire protection facilities (where installed), the drainage system and the 'Emergency Stop' switch.

Where two or more points of access are adjacent to each other so that a single set of signs and notices are clearly readable from each point of access, duplicate signs and notices are not required.

Signs shall comply with AS 1319. Class labels shall conform to AS 1216 and be a minimum of 250 mm square. Other signs shall have lettering at least 50 mm high.

NOTE: Composite signs or pictographs complying with the above requirements may be used.

3.9 TRANSIT STORAGE

3.9.1 General

This Clause (3.9) specifies requirements for the transit storage (as defined in Clause 1.4.70) of flammable and combustible liquids.

Sections 1, 9, 10 and 11 also apply to transit storage.

3.9.2 Delineation of transit storage areas

Areas used for transit storage of flammable and combustible liquids shall be deemed to be separate areas if apart from each other and from any other storage areas, buildings or amenities by at least 15 m.

3.9.3 Requirements for transit storage

The following requirements and recommendations apply to transit storage:

(a) The aggregate quantity of flammable and combustible liquids held in each transit storage area shall not exceed 200 t.

(b) Except where in freight containers or on board trucks, the maximum aggregate quantity of goods in each pallet bank or store in a transit storage area shall not exceed 25 t. Such pallet banks or stores shall be at least 5 m apart, or separated by a firewall having an FRL of at least 120/120/120.

(c) Dangerous goods shall be segregated in accordance with the ADG Code, as though they were to be loaded onto a vehicle.

(d) Parked road vehicles loaded with flammable liquids shall be separated from each other by at least 3 m, and from any other dangerous goods stores by at least 5 m. Vehicles shall be parked so that they can be driven out of the site without recourse to reversing.

(e) Freight containers or tank containers containing flammable or combustible liquids in a transit storage area shall—

(i) not be stacked more than two containers high and two containers deep;

(ii) where stacked two containers deep, be provided with access for inspection to both sides of each stack;

(iii) not be in the same vertical stack as any container of any other Class of dangerous goods; and

(iv) be separated from containers of incompatible goods by at least 3 m.

(f) Access and escape routes shall be clearly identified and kept clear at all times.

(g) A spillage catchment and clean-up facilities shall be provided for the site. They shall be capable of handling at least 100% of the capacity of the largest tank, freight container, IBC or tanker compartment or 10% of the total packages in the area.

NOTE: In order to facilitate the management of emergencies, it is recommended that compound capacities be about 10% greater than the minimum values specified above.

(h) The base of the transit storage area shall be sufficiently impervious to retain any spillage and to enable the recovery of any such spillage.

(i) Appropriate facilities and materials shall be provided for the collection, containment and treatment of containers that are—

(i) leaking;

(ii) damaged and likely to leak as a result of such damage; or

(iii) awaiting disposal.

NOTES:

1 A designated area may be provided for such containers.

2 Packages of liquids that are leaking, or are impaired and might spill or leak, should not be loaded onto a vehicle unless in a waste recovery container.

(j) Except in emergencies, liquids shall not be transferred between containers or decanted in a transit storage area.

(k) Where relevant, and in emergencies, appropriate protective equipment shall be provided and used.

(l) All dangerous goods and freight containers shall be marked in accordance with the ADG Code.

(m) Transit storage areas shall be kept clear of any extraneous matter.

(n) No fixed ignition sources shall be located within any hazardous zone in the transit storage area.

3.9.4 Separation distances

Areas for transit storage shall be separated from protected places, on-site protected places and public streets by the minimum distances given in Table 4.1 for the aggregate volume of liquids stored. Areas shall be separated from boundaries by the minimum distances given in Table 4.2.

Transit storage areas should be separated from any accumulation of combustible material, e.g. stacks of timber or plastic pallets, by at least 5 m.

All of the above separation distances shall be measured from the edge of the transit storage area.

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3.10 IGNITION SOURCES

A vehicle shall not be regarded as an ignition source while it is entering or leaving a hazardous zone surrounding a fuel dispenser or a bulk cargo transfer connection for the purposes of refuelling or for loading or unloading bulk liquids. However it shall be treated as a potential ignition source during the period of the bulk liquid transfer, and the procedures and precautions given in Section 7 of this Standard shall apply.

A vehicle shall not be regarded as an ignition source while it is entering or leaving the hazardous zone outside a package storage area for the purposes of loading or unloading packages, provided that the hazardous zone is not enclosed and the vehicle is not within the package storage area. During the loading and unloading, the vehicle's engine shall be switched off and shall not be started. Any vehicle shall not enter the package storage area unless—

(a) it is suitable for the applicable hazardous zone as given in AS/NZS 2430.3; or

(b) the store and vehicle comply with Appendix D and a work permit has been issued (see also Clause 3.4).

SECTION 4 PACKAGE STORAGE AND HANDLING AREAS

4.1 SCOPE OF SECTION

This Section provides requirements and recommendations for the location, design and construction of package stores for flammable and combustible liquids and for areas where such packages are filled, decanted or cleaned. It applies to quantities greater than those allowed as minor storage.

Sections 3, 9, 10 and 11 also contain requirements that apply to package stores.

NOTE: Appendix E provides further recommendations for the storage of flammable liquids in coolrooms.

4.2 TYPES OF STORES

A package store for flammable or combustible liquids may be one or more of the following:

(a) A detached store, being a store with or without a roof, or walls other than a bund (refer Figure 4.1(a)(i), (ii), (iii), (iv)).

(b) An attached fire-separated store, being a store attached to a building with outside entry and no communication to the associated building.

(c) An attached store, sharing a wall or walls with the associated building and with a communicating fire door between the store and the associated building (refer to Figure 4.1(b)(i), (ii)).

(d) An internal store, being a store wholly within a building, not sharing a common wall with the building and communicating with the associated building (refer Figure 4.1(c)(i), (ii)).

(e) Fire-separated stores, being grouped stores with no communication between adjacent storages (refer Figure 4.1(d)).

(f) A storage cabinet located within a building or located outside a building as an outdoor storage.

(g) Facilities for the holding of materials awaiting use in a process, machine or the like.

(h) A detached store, being a freight container complying with the requirements of Clause 4.8.

Variations of types (a), (b), (c) or (d) above include—

(i) stores with facilities for filling, decanting and cleaning of packages; and

(ii) stores either at ground level or on a platform (see Figure 4.1(e)); or

(iii) a combination of both.

Further examples of package stores, including those not permitted by this Standard, are given in Figure 4.2.

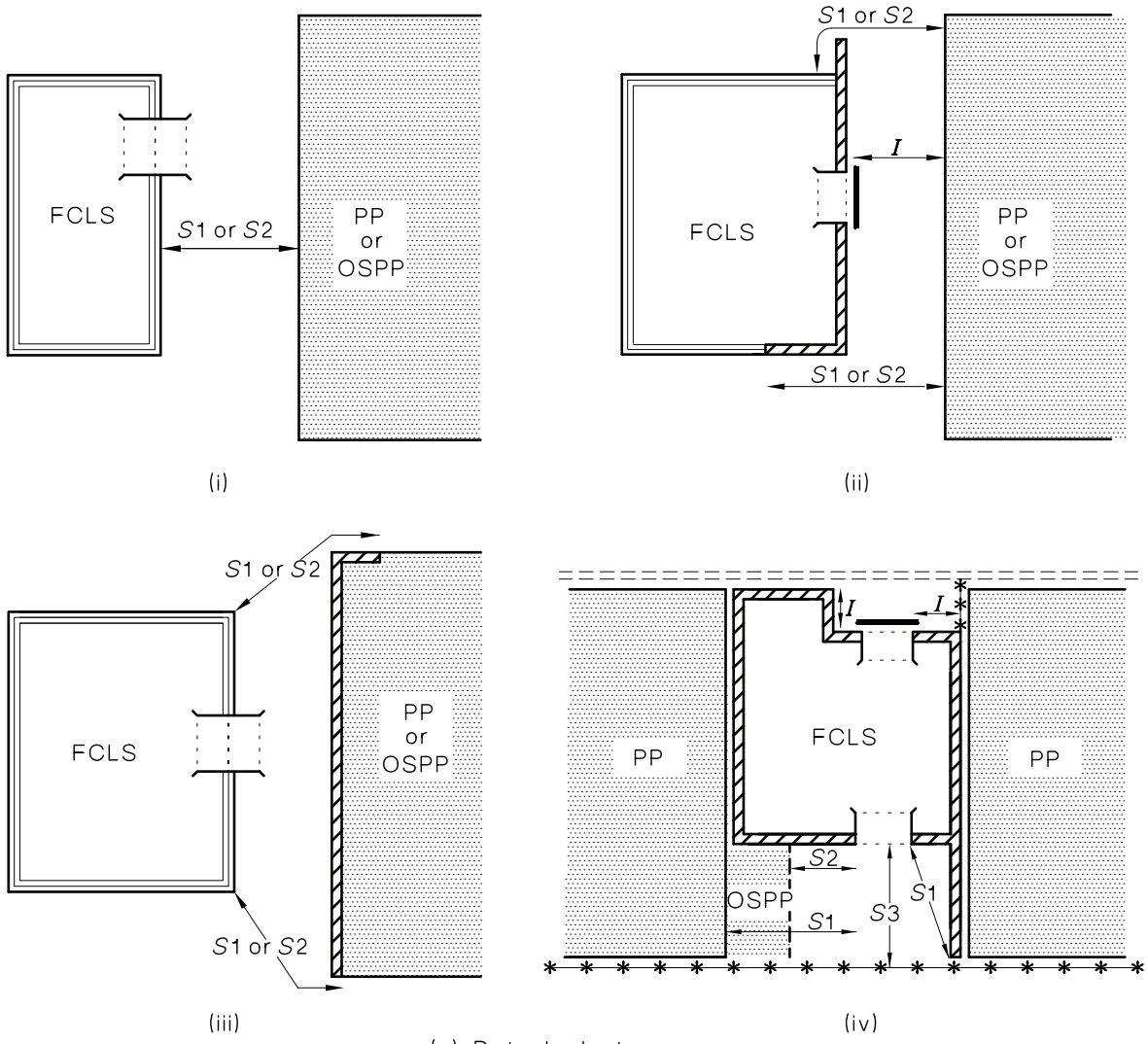
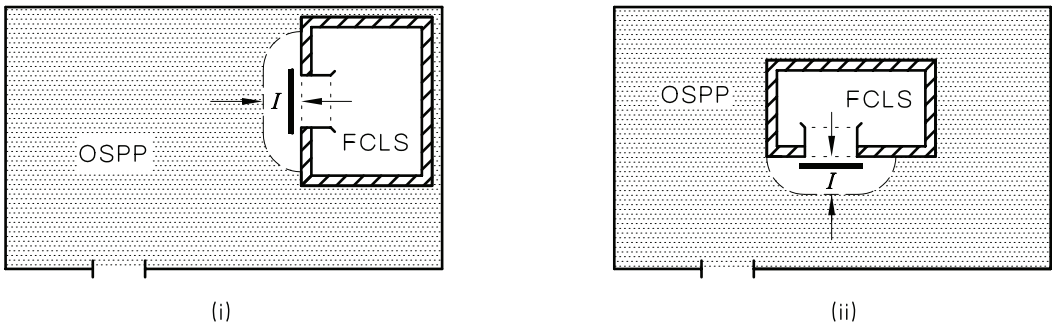
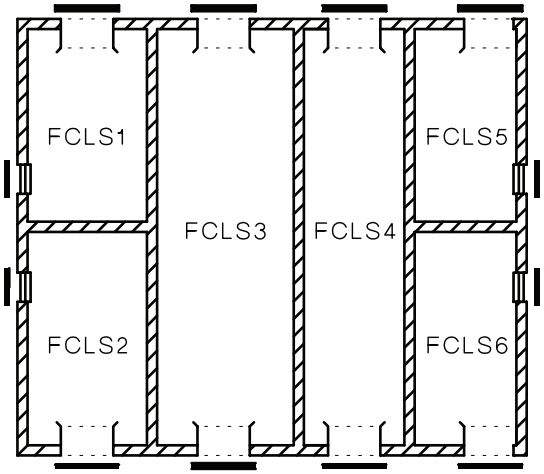


FIGURE 4.1 (in part) TYPICAL PACKAGE STORES—TYPES AND LOCATIONS

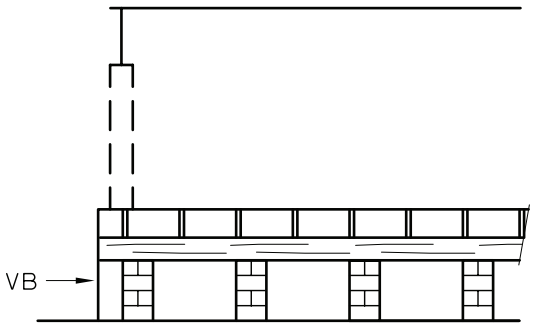


(i) (ii)

(c) Internal storage



(d) Fire separated storages



(e) Platform or dock

SEPARATION DISTANCES

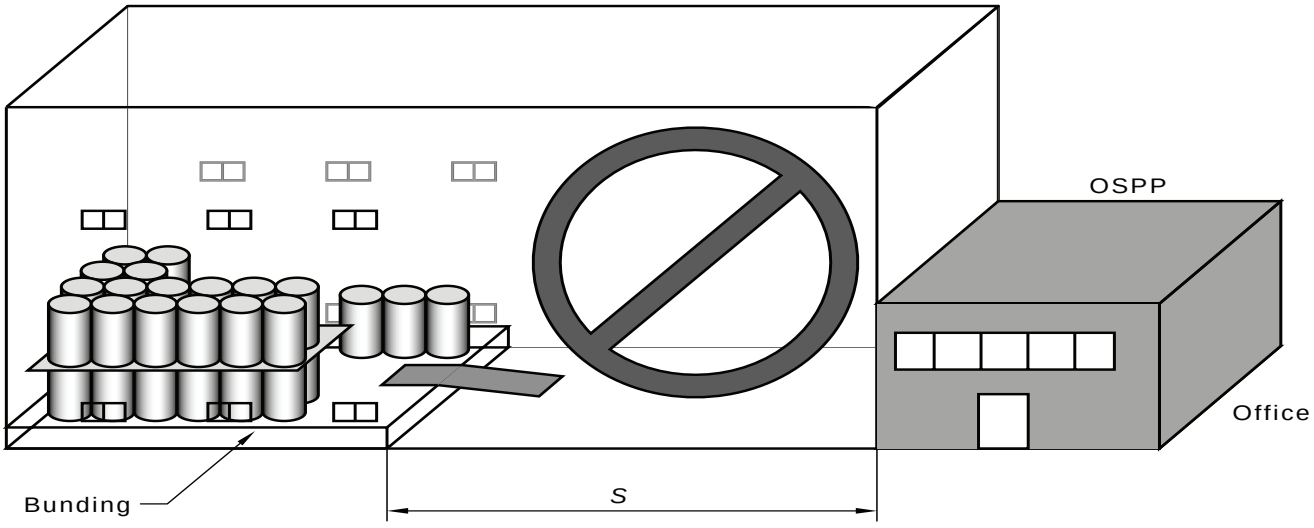
I Ignition source distance
*S*1 Protected place distance
*S*2 On-site protected place distance
*S*3 Boundary distance

LEGEND:

Fire wall
Wall, not fire-rated
Fire door
Bund wall
Boundary of facility (not fire-rated)
Ramp
Property boundary
Street boundary
Opening, no fire door
All structures are roofed

FCLS Flammable or combustible liquid store
OSPP On site protected place
PP Protected place
VB Vapour barrier

FIGURE 4.1 (in part) TYPICAL PACKAGE STORES—TYPES AND LOCATIONS



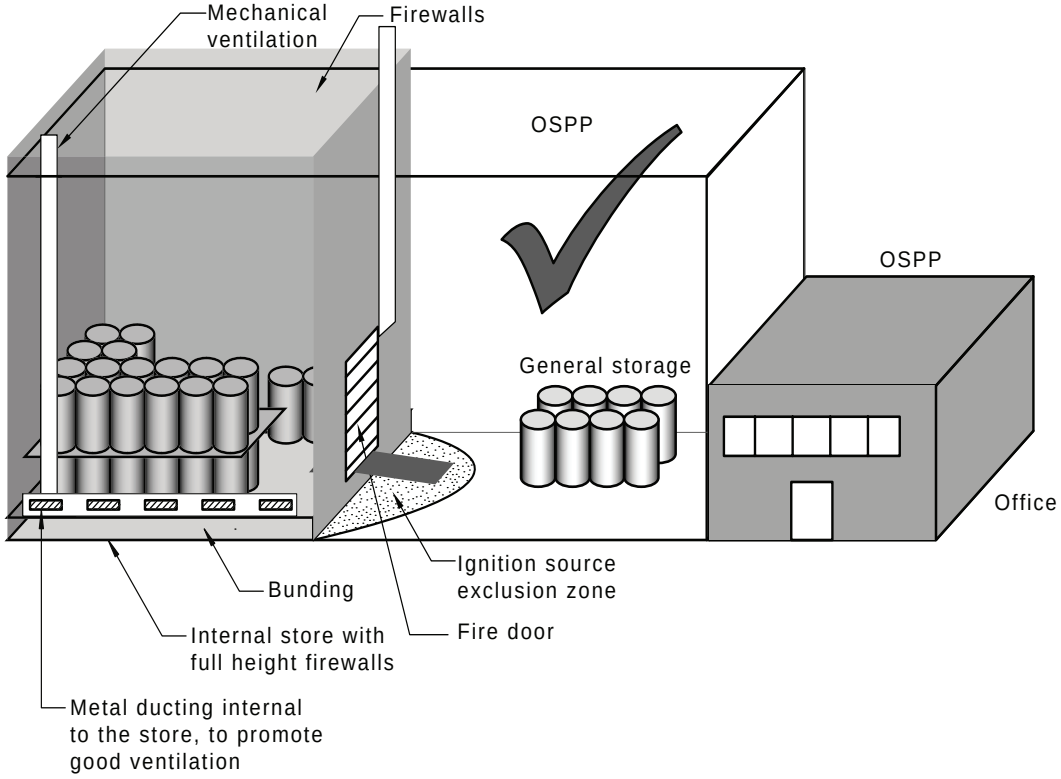
Separation distance to OSPP cannot be measured via the air space from the compound to the office, as this is an attached storage

(a) Package storage compound within a naturally ventilated building

LEGEND:

S = Separation distance
OSPP = On-site protected place

A2



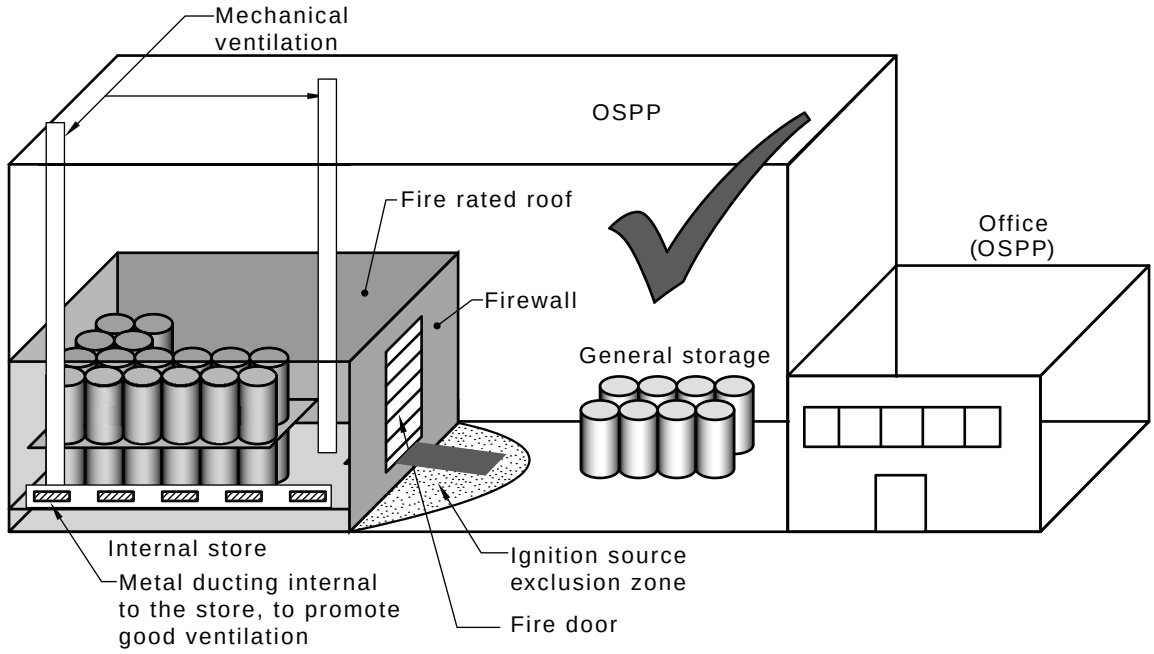
(b) Package store having mechanical ventilation and firewalls

LEGEND:

OSPP = On-site protected place

FIGURE 4.2 (in part) EXAMPLES OF PACKAGE STORES

A2



(c) Package store within a warehouse

LEGEND:

OSPP = On-site protected place

FIGURE 4.2 (in part) EXAMPLES OF PACKAGE STORES

4.3 LOCATION AND SEPARATION DISTANCES

4.3.1 Separation distances for package stores

When determining the location for a package store, factors such as infrastructure, firefighting resources, fire brigade access and automation need to be considered.

A store for packages of flammable or combustible liquids shall be located in accordance with the following requirements:

(a) The minimum separation distance to a protected place (other than an on-site protected place) shall be as given in Table 4.1.

(b) The minimum separation distance to any on-site protected place shall be as given in Table 4.1, but need not exceed—

(i) 15 m for flammable liquids; or

(ii) 7.5 m for C1 liquids; or

(iii) 3 m for C2 liquids.

Any office within or immediately adjacent to the storage area that is used solely for the direct supervision of the storage is not considered an on-site protected place (see also Clause 4.11).

(c) The minimum distance to any public place shall be as given in Table 4.2. (See also Item (a) above).

(d) The minimum distance to any tank storage shall be either—

(i) the distance specified in this Section, regarding the tank as an on-site protected place; or

(ii) the distance specified in Section 5,

whichever is the greater.

(e) Separation distances shall be measured from the internal perimeter of the bund except where Item (f) below applies.

(f) Where an indoor store has an in-built firewall or vapour barrier, separation distances shall be measured from the nearest potential point of vapour escape, e.g. the outlet of a natural vent or a door.

(g) Where a fire door connects a storage area with an associated working area, the distance from the fire door to any ignition source shall comply Table 4.2 and the relevant requirements of AS/NZS 2430.3.3.

(h) Where drainage to a separate compound, drainage tank or sump is provided (as in Clause 4.4.3), the separation distances specified in Table 4.1 shall apply, as given below:

A2 (i) The separation distance from the storage area itself shall be as required by Items (e) and (f) above.

(ii) Any remote sump, compound or open tank shall be treated as if it were a tank, of a capacity equal to that required for the compound by Clause 4.4.3.

(iii) For any open drainage channel, open tank, sump or vent, the separation distances shall be the extent of the hazardous zone as determined from the appropriate part of AS/NZS 2430.3.

(i) Where there are two or more stores on the same premises and separation distances are to be determined, they shall either be—

(i) considered separately, provided that the stores are separated by at least 5 m or the distance given in Table 4.1 for the capacity of the greater of the two; or

(ii) considered as the aggregate capacity of the two stores.

(j) Where flammable or combustible liquids of differing flash points are kept in the one store, the distances shall be those for the packing group or class with the lowest flash point present, but based on the aggregate quantity of all liquids stored.

NOTES:

A2 1 Separation distances may be measured around any intervening vapour barriers or firewalls, as described in Clause 3.7 and illustrated in Figure 4.1.

2 Adjacent stores which are separated by firewalls having FRLs of 240/240/240, fitted with doors having FRL of –/240/30, and having no access between compartments may be treated as individual stores when determining separation distances (see Figure 4.1(d)).

4.3.2 Protection of elevated protected places

Protected places located at a higher level or superimposed above a store shall be protected against potential rising flames and heat radiation from any fire in the store below.

4.3.3 Location of internal package stores

Except for cabinets, all internal package stores shall be located on a floor directly accessible from street level or site roadway in the package store.

Because an internal store is usually located within a building which is normally considered an on-site protected place, Clause 4.3.1(b) cannot validly be applied. Clause 4.3.1(a) and (c) apply from any vent outlet or doorway in the package store.

TABLE 4.1

SEPARATION DISTANCES FROM PACKAGE STORES TO PROTECTED PLACES

Maximum capacity of liquid storage, m^3 (kL)				Minimum distance
Class of liquid stored				
Flammable liquid		Combustible liquid		
PG I, PG II	PG III	C1	C2	m
0.1	0.5	2.5	5	Unrestricted
1	4	10	20	3
2	8	20	40	4
4	16	40	80	5
7	28	70	140	6
10	40	100	200	7
14	56	140	280	8
20	80	200	400	9
26	104	260	520	10
34	136	340	680	11
42	168	420	840	12
52	208	520	1040	13
64	256	640	1280	14
77	308	770	≥1540	15
170	680	1700		20
310	1240	≥3100		25
500	2000			30
750	≥3000			35
1100				40
1500				45
≥2000				50

NOTES:

1 The distances that apply to any intermediate capacity may be obtained by linear interpolation.

A2 2 Separation distances may be measured around firewalls and vapour barriers. See Clause 3.7 and Figure 4.1.

TABLE 4.2

SEPARATION DISTANCES FROM PACKAGE STORES OF FLAMMABLE LIQUIDS TO PUBLIC PLACES AND IGNITION SOURCES

Separation from public places to:	Minimum distance, m
Storage area for closed packages of flammable liquids	3
Area where packages of flammable liquids are opened (e.g. for decanting, mixing, filling)	8

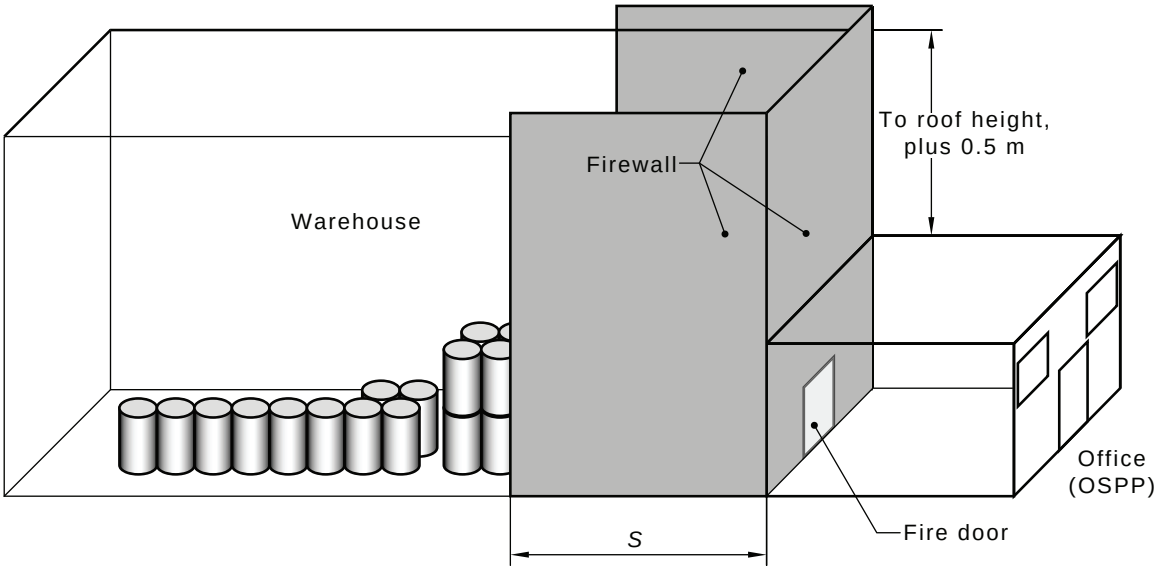
NOTES:

A2 1 Separation distances may be measured around firewalls and vapour barriers. See Clause 3.7 and Figure 4.1.

2 Where there is an ignition source on adjacent premises, reference should be made to Clause 3.2.4.

3 AS/NZS 2430.3.3 should also be consulted.

A2

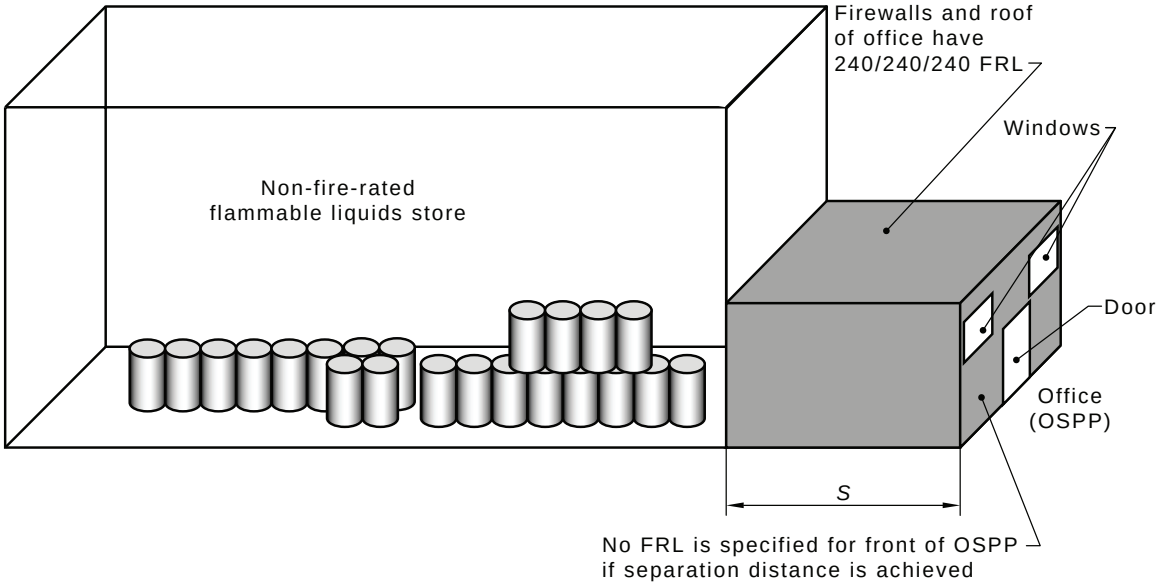


(a) Where the roof of one of the adjoining buildings is lower than the other building, the firewall extends to 0.5 m above the higher roof and has an FRL of 240/240/240.

LEGEND:

OSPP = On-site protected place
S = Separation distance

A2



(b) Where the store is not fire-rated, then the office is to be fully fire-rated (side walls, roof, front wall, door and windows) if separation distance is not achieved.

LEGEND:

OSPP = On-site protected place
S = Separation distance

FIGURE 4.3 EXAMPLES OF FIREWALL HEIGHTS

4.4 CONSTRUCTION

4.4.1 General construction

Any package store shall be designed and constructed to be adequate for the purpose in accordance with the following requirements, as appropriate:

(a) Other than where a fire-rated structure is required, any wall or roof shall be masonry, concrete, or a structure sheeted with non-combustible material, except for any skylights that might be necessary.

NOTE: Non-combustible material on timber frames complies with this requirement.

(b) Floors forming part of the spillage catchment system shall be impervious, not liable to degradation or to incendive sparking. Suitable materials are concrete and sealed masonry.

(c) Platform surfaces shall comply with Item (b). The loading face shall be a vapour barrier up to the deck height, extending the full length of the face, and returning at least 1 m along the side at each end.

4.4.2 Construction of internal or attached package stores

A package store that is inside a building, or that shares a common wall with a protected place or an on-site protected place, shall be constructed as follows:

(a) The separating walls shall be constructed of a material having an FRL of at least 240/240/240. The failure of any component with an FRL of less than 240/240/240 shall not jeopardize the stability of any firewall.

A2 (b) The floor of the store shall be of reinforced concrete having an FRL of at least 180/180/180.

(c) The roof of the store shall be of a material having an FRL of at least 180/180/180, unless the walls are taken through the main roof by at least 0.5 m, to provide fire insulation.

NOTE: This limitation is due to the potential difficulties in gaining access for firefighting in such a store.

(d) Any duct that passes through a storage area shall be constructed of or protected by material having an FRL of at least–/180/180.

(e) Any occupancy or usage above a flammable liquids store shall be separated by a barrier having an FRL of at least 180/180/180.

(f) Where the only means of access to an above-ground store of flammable liquids is through an associated working area that is an on-site protected place, the storage capacity shall be limited to 15 000 L, or 100 m^2, unless an automatic fire suppression system complying with AS 2118.1 is provided.

4.4.3 Spillage containment

Provision shall be made to contain any leaks or spillages, and to prevent them from contaminating the surrounding soil or entering any watercourse or water drainage system. The following requirements apply:

(a) A spillage containment compound shall be sufficiently impervious to retain spillage and to enable recovery of any such spillage. The compound shall be chemically resistant and fire resistant as far as is necessary to fulfil its functions.

NOTE: Portable bunding units, e.g. bunded pallets, or flexible bunding units are not suitable for permanent storage as there are no uniform performance criteria for chemical resistance or fire resistance and they can be easily moved to an unsuitable location. They may be suitable for the short-term holding of damaged packages, or where goods are in transit or in manufacturing and handling areas.

(b) Pipework that is intended to convey any spilt liquid to a remote holding tank or compound shall be resistant to fire. Flashback into the store or flashover between storage compartments shall be prevented.

(c) Construction and drainage shall comply with Clauses 5.8.3 and 5.8.6.

(d) The capacity of the spillage containment compound shall be at least 100% of the volume of the largest package plus 25% of the storage capacity up to 10 000 L, together with 10% of the storage capacity between 10 000 L and 100 000 L, and 5% above 100 000 L.

(e) If a water-based automatic or manual fire suppression system is installed, the compound capacity shall be increased by a volume equal to the output of the system over 20 min.

(f) Any drainage system shall be capable of carrying the output of the sprinkler system over the assumed area of operation at the design density of discharge (see AS 2118 series).

NOTE: The compound should be designed to provide a minimum surface area for the storage.

(g) The drainage of any rainwater or fire water to outside the compound shall either be—

(i) via a suitable interceptor or separator (e.g. a molecular sieve); or

(ii) after sampling and testing of the water.

(h) Where more than one storage is connected to a common compound, drainage tank or pit, the capacity of the compound shall be equal to the largest compound required for any one store, plus 25% of the capacity of the compounds required for the other stores connected to it.

4.4.4 Doors

4.4.4.1 *General*

Any doorway through a firewall separating a package store from an on-site protected place shall be provided with a door. Such a door shall—

(a) be a sliding or an outward-opening, automatic-closing fire door complying with AS/NZS 1905.1, and fitted with a thermal-release device; and

(b) have an FRL of at least –/120/30.

4.4.4.2 *Use of non-fire rated doors*

The entrance to a detached store with firewalls (as shown in Figure 4.1(a)) does not need to have a fire door if it is separated from any on-site protected place by either of the following:

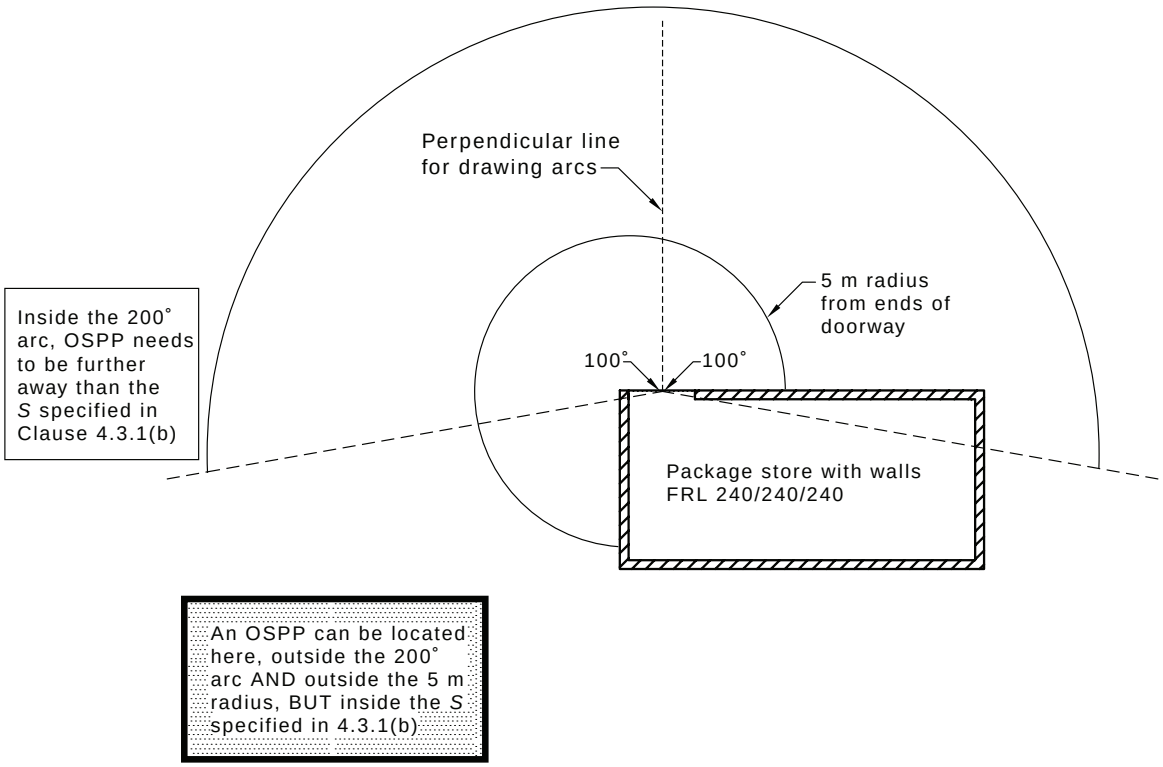
(a) The on-site protected place is separated by a distance of at least that given in Clause 4.3.1.

(b) The on-site protected place is—

(i) outside an arc of 100° in either direction of a perpendicular line drawn from the centre of the doorway of the store;

(ii) at least 5 m from the nearest point of that doorway; and

(iii) not exposed to potential heat radiation from that doorway (see Figure 4.4).



LEGEND:
OSPP = On-site protection place
S = Separation distance (see Clause 4.3.1 (b))
= Fire wall

FIGURE 4.4 USE OF NON-FIRE-RATED DOORS

4.4.5 Windows in fire-rated walls

Any window fitted shall be of the same rating as the wall.

NOTE: AS 1288 and AS/NZS 1905.1 include information on the fire resistance of glass.

Windows that are not required to be fire-rated and that face on-site protected places, protected places or public places, shall have toughened safety glass, safety wired glass or equivalent.

NOTE: The exemption for doors given in Clause 4.4.4.2 may be applied to windows if they have safety wired glass or equivalent.

4.5 VENTILATION

4.5.1 General ventilation requirements

Each package store shall be provided with adequate natural or mechanical ventilation, depending on the goods being stored. Ventilation shall be sufficient to maintain the ambient concentration of vapours in the store below the lower explosive limit (LEL).

The ventilation system shall be sufficient to ensure that any vapours and fumes generated within the store are diluted with, and removed by, air passing through the store.

NOTE: Workplace exposure standards, as given in NOHSC: 1003, also apply.

For ventilation with respect to hazardous atmosphere zoning, the relevant part of AS/NZS 2430.3 should be consulted.

Stores ventilated in accordance with the following requirements are deemed to comply with this Clause:

(a) A natural ventilation system that complies with Clause 4.5.4.

(b) A mechanical ventilation system that complies with Clause 4.5.5.

4.5.2 Additional ventilation requirements for package handling, filling and decanting areas

Where packages are opened, filled, or decanted, additional ventilation shall be provided as necessary to ensure a safe working atmosphere under normal operating conditions.

4.5.3 Vent protection

Any vent opening inside the store shall be provided with barriers in both the inside and outside of the wall where necessary so that it cannot be blocked.

Where a vent passes through a cavity wall, or where the wall is made of cavity bricks or blocks, a metal sleeve shall be provided to prevent vapour from leaking into the cavities.

4.5.4 Natural ventilation

4.5.4.1 *General*

A natural ventilation system shall comprise one of the following, as appropriate to the design of the store:

(a) At least two walls completely open to outside atmosphere (see Figure 4.5(a)).

A wall of wire mesh, or of fixed louvres, lattice or the like, having at least 50% of its area as openings, is considered completely open.

(b) One wall completely open to outside atmosphere, with no other vents, provided that the distance to, and the length of, the opposite wall do not exceed the length of the open wall (see Figure 4.5(b)).

(c) Vents in one external wall, provided that the wall is at least 6 m long and the opposite wall is not more than 5 m away from it.

(d) One wall open to atmosphere as in Item (b), and vents in one opposite or adjacent wall (see Figure 4.5(c)).

(e) Vents in two opposing walls (see Plan view in Figure 4.5(d)).

NOTES:

1 Vents should be located along the longest sides of the building and should be positioned to limit areas where there is no effective ventilation. With large stores, consideration should also be given to providing additional vents on adjacent walls and/or providing vents larger than 0.1 m^2 or 0.15 m^2.

2 Figure 4.5 provides examples of naturally ventilated stores.

4.5.4.2 *Vent size and location*

Where vents are required, they shall consist of openings immediately above the upper limit of the spillage compound, each having a net free area of at least 0.1 m^2, or 0.15 m^2 where open packages are present, with an equal area of openings above the highest package, positioned to ensure effective movement of air.

There shall be one low-level vent in each 3 m of length of wall, or in each 1.4 m of length of external wall where there is only one external wall. Where only one such vent is required, it shall be central in the length of wall.

NOTE: An equivalent open area of ventilation is acceptable, provided the required vent area per wall is maintained.

Any storage platform (except a solid-filled type) shall be provided with underdeck ventilation by means of vent openings on opposite sides having an area of at least 0.1 m^2 for each 1.2 m of length.

Figure 4.5 provides examples of naturally ventilated stores.

4.5.4.3 *Natural ventilation for package stores containing combustible liquids only*

Where the store contains packaged combustible liquids only, the upper level ventilation described above may be omitted and the surface area of the lower vents may be reduced by half.

4.5.5 Mechanical ventilation

Any mechanical ventilation system for package stores containing flammable liquids shall comply with the requirements set out below:

(a) The termination points within the room for both the fresh air supply and the draw-off ducts shall be—

(i) immediately above the upper limit of the spillage compound; and

(ii) on opposite walls.

The distance between any two inlets or any two outlets shall not exceed 5 m.

NOTES:

1 It is recommended that the outlets be located along the longest side of the building for optimum effect.

2 If a single fan system is adopted, the fan should be in the exhaust duct.

3 The air supply may be in the form of natural ventilation in an external wall at low level, as described in Clause 4.5.4.1.

(b) If the ventilation system incorporates fans on both the supply and exhaust ducts, the capacities of the fans shall be so adjusted that the room is under negative pressure.

NOTE: The capacities of the fans on the exhaust ducts should be greater than those on the supply ducts.

(c) The system shall be capable of exhausting 0.3 m^3 per square metre of floor area per minute or 5 m^3/min, whichever is the greater, and the air velocity at the air supply outlet shall exceed 300 m/min.

NOTE: Vapours from flammable liquids are heavier than air, so the ventilation system should be designed to scavenge vapours from the lower parts of the store.

(d) The system shall be provided with an airflow failure-warning device.

(e) Any intake or exhaust duct shall terminate in open air at least 2 m from any opening into a building, or 4 m from the outlet of any chimney or flue and 3 m above the ground. The external termination of any inlet duct shall be at least 5 m from the external termination of any exhaust duct.

(f) Any duct that passes through a building other than the storage area shall be constructed of or protected by material having an FRL of at least –/180/180.

NOTE: A common enclosure may be used for both intake and exhaust ducts.

(g) The system shall be designed so that it operates—

(i) continuously; or

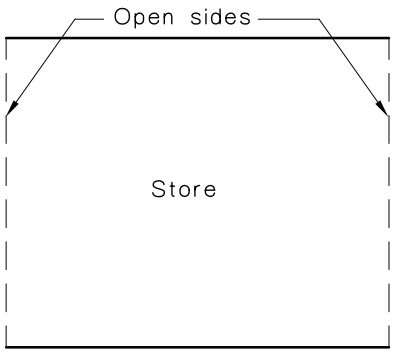
(ii) whenever work is being carried out in the store; or

(iii) whenever a person is in the store.

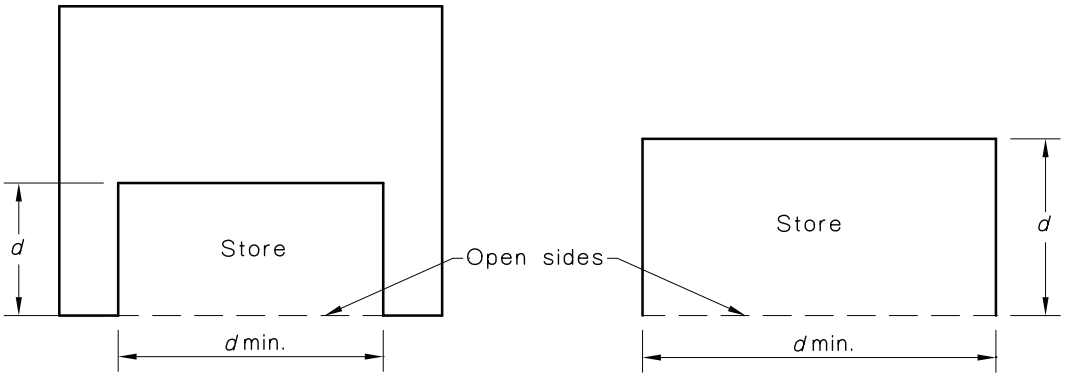
(h) Fans shall be suitable for hazardous areas. Relevant potential ignition sources, e.g. frictional sparking, static electricity and hot spots, shall be taken into account when selecting and installing fans (see also AS/NZS 2381.1, AS/NZS 1020 and AS/NZS 2430 series). Fan blades and nearby components shall be made of materials that have minimal potential for giving off sparks when struck.

NOTE: Materials known to be unsatisfactory are steel with steel, or steel with aluminium or aluminium-magnesium alloys.

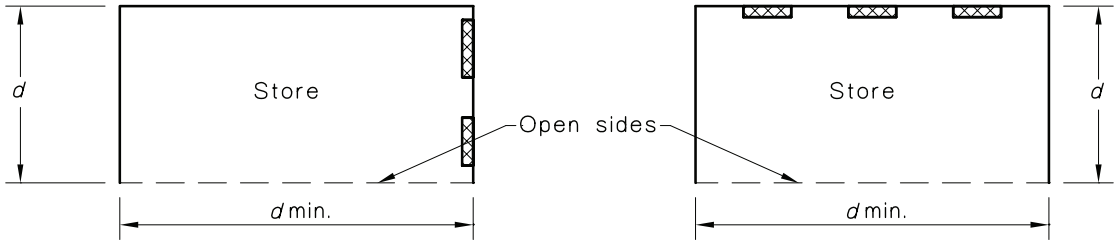
A mechanical ventilation system for package stores containing only combustible liquids shall comply with Items (a) to (g) above, except that for Item (c) the air volume may be reduced by half.



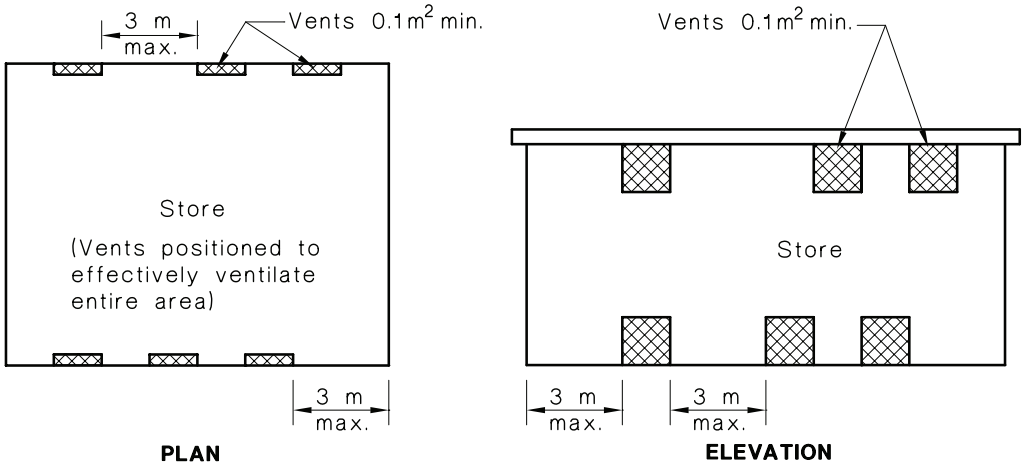
(a) Stores having opposite external sides open



(b) Stores having one external side open

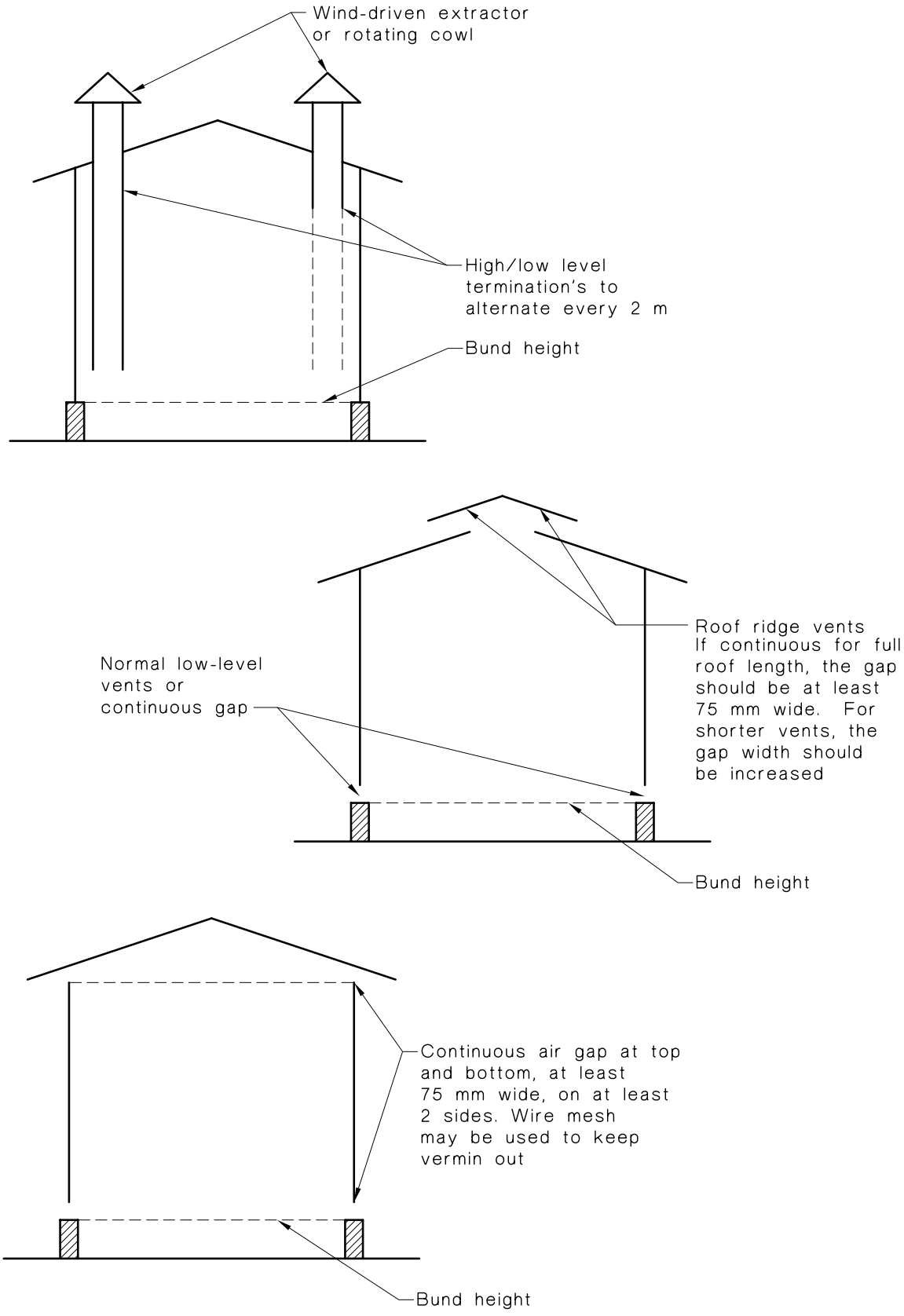


(c) Stores having one external side open and vents in adjacent or opposing external walls



(d) A store having vents in one pair of opposite external walls

FIGURE 4.5 (in part) EXAMPLES OF NATURALLY VENTILATED STORES



(e) Alternative methods of ventilation

FIGURE 4.5 (in part) EXAMPLES OF NATURALLY VENTILATED STORES

4.6 GENERAL REQUIREMENTS

Except for storage cabinets (as described in Clause 4.9), stores for packaged flammable or combustible liquids shall comply with the following requirements and recommendations, as appropriate:

(a) Packages shall be kept in such a manner that they cannot fall and cause spillage outside the compound.

NOTE: Packages of flammable liquids should be kept at least 600 mm from the inner edge of the bund wall or restraints provided to prevent falls or spills occurring outside the compound.

(b) Clear access shall be available to the store.

(c) The following items shall be provided within 10 m of, but not nearer than 2 m, to stores where packages are opened:

(i) Eye wash facilities complying with ANSI Z358.1.

(ii) Water for the washing of hands.

(d) A safety shower shall be installed where—

(i) the quantity of liquids exceeds 2000 L; or

(ii) required by risk assessment or regulation.

NOTE: Safety showers should comply with ANSI Z358.1

(e) All relevant requirements of Section 10 shall apply.

(f) Packages on pallets shall not be stacked more than three high unless purpose-built racking or a suitable restraint is provided.

4.7 STORAGE OF IBCs

Intermediate bulk containers (IBCs) of up to 1.6 m^3 capacity may be stored in a package store provided that—

(a) they are not connected to any piping or product delivery system;

(b) the ventilation and spillage control provisions are adequate to cater for the quantity of IBCs being stored;

(c) the IBCs are stored at least 1 m from the bund or edge of the store, unless splash shields or baffles constructed from compatible, non-combustible materials are used;

(d) they comply with the ADG Code; and

(e) the IBCs are not stacked more than two high unless purpose-built racking is provided.

4.8 STORAGE IN FREIGHT CONTAINERS

Except for the purposes of loading and unloading, freight containers shall not be used for the storage of flammable and combustible liquids in packages, unless they have been modified to comply with the requirements Sections 3 and 4 of this Standard with respect to separation, segregation, ventilation and spillage containment.

The following additional requirements apply to the storage of flammable and combustible liquids in such freight containers:

(a) A freight container shall not be used as both a storage and a workshop area.

(b) Before the freight container is first used as a store, the floorboards shall be inspected for any significant contamination from previous spills or leaks.

NOTE: Contaminated floorboards could react dangerously with any further spills or leaks or evolve harmful vapours in a fire.

(c) There shall be a passage at least 800 mm wide inside the freight container. Such a passage shall be clearly marked, e.g. by yellow lines painted on the floor.

(d) No electrical equipment shall be installed inside the freight container unless it is suitably flameproofed.

(e) No point within the freight container shall be more than 6 m from the freight container's exit door.

(f) Each door of the freight container shall be able to be opened from inside the freight container. Any external lock shall be deactivated.

4.9 STORAGE IN STORAGE CABINETS

4.9.1 General

This Clause (Clause 4.9) applies to the storage of flammable and combustible liquids in cabinets.

Clauses 4.9.2, 4.9.4, 4.9.5, 4.9.6, 4.9.7 and 4.9.8 provide requirements that apply to all storage cabinets. Clause 4.9.6 provides requirements for the location of cabinets depending on their capacity. Clause 4.9.3 applies to the construction of cabinets having a capacity of more than 250 L.

The maximum capacity of any cabinet shall be 850 L.

4.9.2 Cabinet construction

The following requirements and recommendations apply:

(a) The walls, floor, door and roof shall be of double-walled sheet steel construction, with a space of at least 40 mm between the walls.

NOTE: This space may be either an air space or filled with non-combustible insulation.

(b) Any gaps around the doors and into the space between the walls shall be sealed as far as is necessary to prevent the spread of flame or heat radiation.

(c) The inner base of the cabinet shall form a liquid-tight compound at least 150 mm deep, and shall be designed to prevent the compound from being used as a storage space.

(d) Any shelves shall be perforated to permit free air movement, and shall be capable of carrying the maximum possible load.

(e) All leakage shall be directed into the lower compound.

(f) All cabinet doors shall be self-closing, close-fitting and held shut automatically by catches at two or more points.

(g) Where doors are equipped with a device to hold them open when necessary, they shall be released automatically the temperature exceeds a nominal 80°C.

(h) The materials of any components that are critical to the cabinet's structural integrity shall not melt at temperatures less than 850°C. Seals or gaskets are excepted, but their use should be avoided if their failure could affect the protective function of the cabinet.

4.9.3 Additional construction requirements for cabinets exceeding 250 L capacity

Any cabinet having a capacity greater than 250 L shall be constructed in accordance with Clause 4.9.2 and the following additional requirements:

(a) The top of the cabinet shall be no more than 2 m above floor level.

(b) All external surfaces shall be constructed from sheet steel at least 1 mm thick.

(c) The cabinet's lower compound shall be capable of holding at least 25% of the design capacity of the cabinet or the volume of the largest package able to be stored in the cabinet, whichever is the greater.

4.9.4 Cabinet marking

Each cabinet shall be marked with—

(a) the name and address of the manufacturer or, for imported cabinets, the distributor within Australia;

(b) the maximum storage capacity;

(c) a Class 3 dangerous goods label with sides of at least 250 mm nominal length; and

(d) a sign bearing the words 'NO SMOKING, NO IGNITION SOURCES WITHI N 3 m' in lettering at least 50 mm high.

All signs and markings shall be clearly visible when the cabinet doors' are closed.

4.9.5 Ventilation provisions

Where ventilation is installed, it shall be designed so that vapours are prevented from escaping into any room. Any ventilation exhaust shall be to the outside atmosphere and in a location which allows the safe dispersal of vapours and is away from any ignition sources (see Clause 4.5).

4.9.6 Cabinet location

The following requirements apply to the location of cabinets for flammable and combustible liquids:

(a) Cabinets shall be located so that they do not impede escape in an emergency.

(b) Cabinets having a capacity greater than 250 L shall not be installed in residential or accommodation buildings, commercial buildings, hospitals, aged care buildings or school buildings.

(c) Cabinets having a capacity greater than 250 L shall only be installed on floors that have direct access from street or ground level.

(d) Cabinets having a capacity greater than 250 L shall not be placed nearer than 3 m to any wall that is common with another room, unless that wall is constructed of concrete or masonry to ceiling height or 3 m above the top of the cabinet (whichever is less) and 3 m to either side of the cabinet.

(e) The aggregate capacity of cabinets shall not be greater than—

A1

(i) 850 L per 250 m^2 on a ground floor area; or

(ii) 250 L per 250 m^2 on other floors.

(f) Each aggregate quantity given in Item (e) shall be separated by at least 10 m.

(g) A storage cabinet may be used for outdoor storage, provided that adequate protection against weather, corrosion and traffic damage is provided.

4.9.7 Exclusion of ignition sources

There shall be no ignition sources within the cabinet. Where flammable liquids are stored, ignition sources shall be excluded from the area outside the cabinet to a distance of 3 m measured laterally, and from floor level to a height of 1 m above any opening in the cabinet, including the door.

Where only combustible liquids are kept in the cabinet, ignition sources should be avoided within the spaces specified above.

4.9.8 Storage in storage cabinets

The following operational requirements and recommendations apply:

(a) Persons shall be prevented from entering the cabinet.

(b) Drums shall not be stacked more than two high if they are greater than 60 L capacity.

(c) Only one drum of more than 60 L capacity should be kept in a horizontal (decanting) position at any time.

(d) Only closed packages, or those fitted with a tap, should be stored in the cabinet.

4.10 ACTIVITIES WITHIN PACKAGE STORES

Activities such as mixing, blending, degreasing, tinting, package filling or co-storage with other goods shall not be carried out within the package store unless a risk assessment has been conducted and a risk management plan prepared.

The plan shall specify the conditions under which these other activities can be carried out without significantly increasing the level of risk (e.g. of ignition, fire or explosion), or creating any new hazards (e.g. vapour release).

NOTES:

1 See also Clause 4.5.2 regarding ventilation.

2 Appendix F outlines issues to be considered when doing a risk assessment.

4.11 OFFICES WITHIN PACKAGE STORES

Where an office is inside a store for flammable and combustible liquids, the following requirements shall apply:

(a) The office shall be used only for activities directly associated with the store's operation.

(b) The office shall be regarded as a restricted area.

(c) The office shall be provided with a means of escape other than through the area where the liquids are stored.

(d) All office windows facing the store shall be of shatterproof glass (e.g. toughened safety glass or safety wired glass).

(e) Personnel employed in the office shall not be exposed to any vapours from the store.

(f) Where a hazardous area (assessed in terms of AS/NZS 2430 series) extends into the office (e.g. through a door, window or other opening), the relevant requirements for ignition sources in hazardous areas shall apply.

SECTION 5 STORAGE IN TANKS

5.1 SCOPE OF SECTION

This Section sets out requirements and recommendations for the storage of flammable or combustible liquids in tanks. The provisions of this Section are additional to those given in Section 3 of this Standard.

Requirements for tank vehicle loading areas are given in Section 8. Requirements for IBCs of less than 1.6 m^3 capacity are given in Clause 4.7.

Where flammable potable spirits are stored in bulk, Appendix G provides requirements that are alternative to this Section. However, the general principles given in this Section may be applied to such storages.

Provisions for spillage containment at power stations and grid transformers are described in Appendix H.

NOTE: See Figure 5.1 for an illustration of the terms used in this Section.

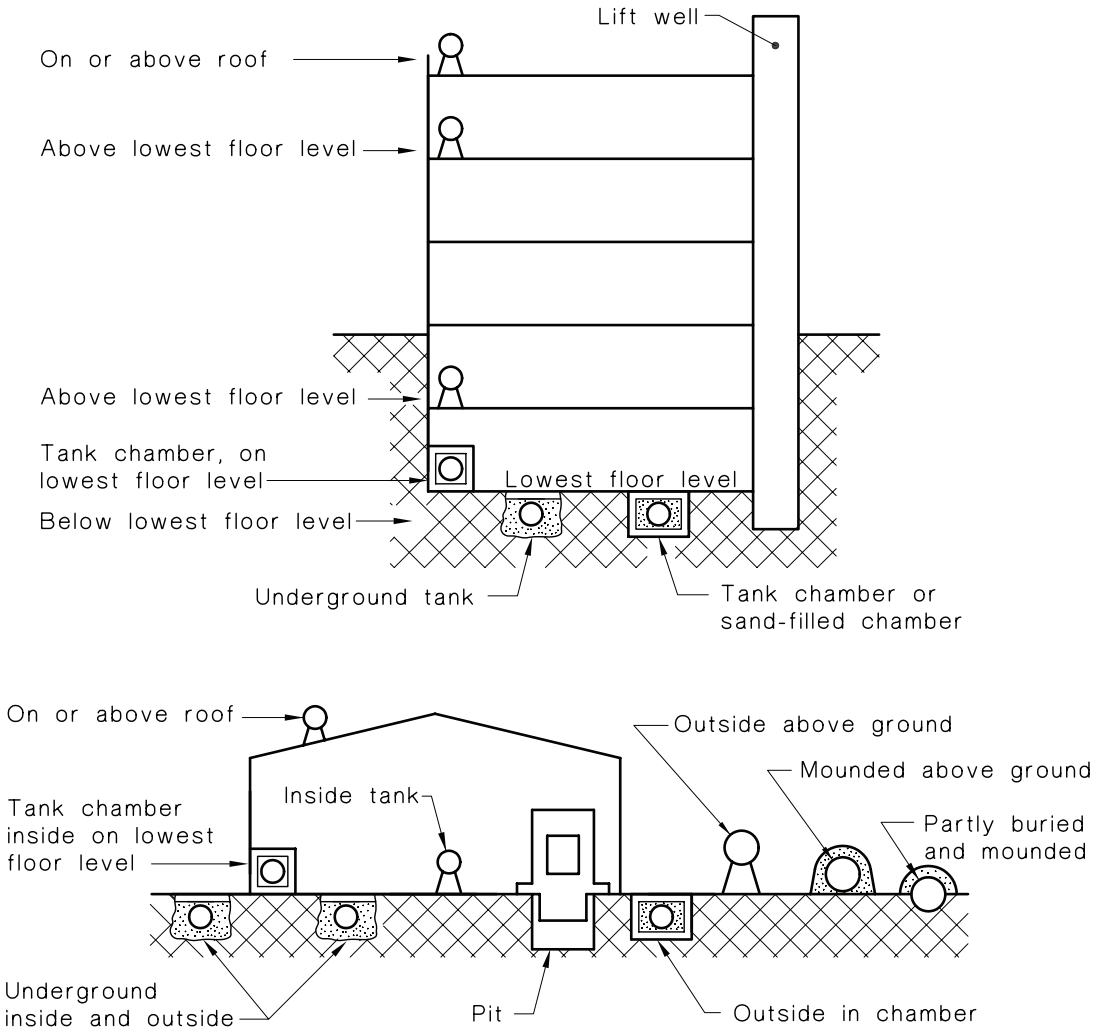


FIGURE 5.1 ILLUSTRATIONS OF TERMS RELATING TO TANK LOCATIONS

5.2 GENERAL REQUIREMENTS

5.2.1 Design and construction of static storage tanks

A static storage tank shall be designed and constructed to comply with AS 1692 or an equivalent Standard for the category of tank appropriate to the application.

NOTE: Where the filling pressure, static head or vapour pressure in the ullage space exceed 35 kPa, the tank plate thickness and end design should be stress-checked in accordance with API 620 or other recognized Standard.

A Category 1 tank shall not be used for flammable liquid.

NOTES:

1 AS 1692 requires that certain essential information be provided by the purchaser to enable the correct tank to be supplied.

2 In some circumstances it may be necessary to use a pressure vessel that complies with AS 1210.

5.2.2 Markings

Each tank in an installation shall be distinguished from any other tank by individual identification numbers or letters as part of a system for verifying the contents of each tank at any time and shall meet the following criteria:

(a) For above-ground tanks:

(i) Markings shall be displayed on the outside walls of the tanks and shall be not less than 500 mm in height for tanks having a diameter of 6 m or greater. For tanks of less than 6 m diameter the markings shall be not less than 150 mm in height.

(ii) The bottom of the markings shall be above the crest of the main bund and any plant, equipment and piping on or above the bund.

(iii) Where possible, the markings shall be clearly visible from main alternative access points likely to be used by the fire authority.

(iv) Where there is a foam pumphouse or manifold for the control of firefighting foam, one such marking shall be clearly visible from that point or its close proximity.

(v) Where there is a cluster of vertical tanks of 6 m diameter or greater or tanks are not separated as given in Table 5.3, the tanks shall have similar markings affixed to the roof with the numerals 6 and 9 underbarred.

(vi) All markings shall be of a colour contrasting with that of the tank.

(b) For underground tanks, the fill, dip and vapour recovery point for each tank shall be marked to identify it. Guidance is provided in AIP CP5.

(c) All tanks shall be marked with the appropriate warning placard as required by NOHSC:1015 or relevant regulation.

5.2.3 Change of tank contents

Where there is a change of contents of a tank, the requirements of this Standard applicable to the new contents shall apply.

5.2.4 Pipework

The following requirements apply to pipes and flexible hoses:

(a) Pipes and pipe joints shall be constructed from a material that is resistant to attack by, and is compatible with, the liquid under all service conditions. Where pressure piping is used, it shall comply with AS 4041.

(b) All pipes shall be adequately protected from physical damage. If plastics pipes cannot be adequately protected, metallic pipes shall be used. Where plastics piping is used, it may also require electrostatic protection (see AS/NZS 1020).

NOTES:

1 Plastics may be subject to environmental stress cracking, 'ageing' and UV degradation. They are more susceptible to physical damage than steel, aluminium or stainless steel. Their physical properties can be seriously affected by extremes of ambient temperature, particularly when used above ground.

2 Manufacturers' data and testing should be consulted for guidance when selecting piping for the installation conditions.

3 Such protection may require the installation of physical barriers.

(c) All above-ground pipes shall be colour-coded or labelled.

(d) Pipework shall be well-supported and protected from potential traffic damage.

(e) Flexible hoses shall not be used, except at transfer points. Where such hose is used, it shall be constructed of material that is resistant to attack by, and is compatible with, the liquid being transferred. The length of the hose shall be kept to a minimum.

NOTE: The use of bellows joints should be avoided (see also Clause 6.2.2).

5.2.5 Roofs over tanks

A2 This Clause applies to a tank or group of tanks that are located under a roof**.** It is not intended to apply to indoor tanks, which are addressed in Clause 5.6.

Where there is a roof over a tank or group of tanks, the following requirements and recommendations apply:

(a) All tanks shall be vented above roof level.

(b) Tanks shall be located and separated in accordance with Clauses 5.7 and 5.8.

(c) If, under normal operations, personnel are to work on the tank (e.g. when dipping the tank contents) a vertical clearance of at least 2.5 m shall be provided between the top of the tank or landing and the roof.

(d) Separation distances shall be based on the aggregate volume of all of the tanks under the same roof, and shall be measured from the edge of the roof.

NOTE: This requirement does not apply if the roof is designed to burn or collapse quickly in a fire.

(e) The effect of the roof upon hazardous atmosphere zoning shall be considered when designing such storage.

(f) Provision shall be made for access, egress, and the application of cooling water.

(g) Consideration should be given to—

(i) the impact that the roof might have on heat dissipation and on the dispersal of flammable vapours;

(ii) any restrictions that might be placed on firefighting as a result of the tanks being roofed; and

(iii) the mode of failure of the roof and its supporting members under fire conditions.

5.2.6 Tanks on or above a roof

Any tank that is to be installed on or above a roof shall be of double-walled construction, with the outer shell draining to a remote drainage tank, sump or compound having a capacity at least equal to the tank capacity. A tank overflow pipe shall be provided, having sufficient capacity to return the full capacity of the filling pump to the remote drainage tank, sump or compound without spillage or over-pressuring the storage tank. An overflow alarm shall be fitted, audible at the filling point.

5.3 STORAGE TANK FILL POINTS

5.3.1 Fill connection

The fill connection to a storage tank that is filled from a tank vehicle shall incorporate a liquid-tight connection unless the filling method employs a hand-held trigger nozzle with a non-latching feature. A cap or cover shall be provided for the fill point.

5.3.2 Location of fill point

The fill point for any tank intended to be filled from a tank vehicle shall comply with the following requirements:

(a) The fill point shall be readily accessible.

(b) The fill point shall be protected from accidental damage.

(c) The fill point for any tank containing a flammable liquid shall be in open air at least 2 m from any opening into a building and at least 3 m from any ignition source.

(d) Where practicable, the fill point for any tank containing a combustible liquid shall be outside. If it is inside, it shall be not more than 2 m from a building entrance useable by a tank vehicle, and shall not be in a boiler room, furnace room, or an elevated temperature area.

NOTE: Fill points located inside a building should not be operated unless the building has sufficient alternative access and egress points to ensure the safe evacuation of personnel in an emergency.

(e) The fill point for a tank shall be located so that a tank vehicle is not required to enter the tank compound to make a delivery.

(f) For any tank containing a flammable liquid, the location shall be such that the tanker can stand wholly off any public road, except where allowed under the ADG Code.

(g) Each fill point shall be clearly identified. For petroleum products, fill points shall comply with AIP CP5.

For restrictions on the loading of vehicles, see Section 8.

5.3.3 Liquid level indication

It shall be possible to monitor or gauge the amount of liquid in any tank intended to receive a delivery. This gauge or monitor shall also show the safe fill capacity of the tank.

Any tank filled by gravity shall be fitted with an automatic flow limiting device which reduces the flow rate into the tank by 98% when the safe fill level of the tank has been attained.

NOTE: Hydraulic shock can result from sudden valve closures and any static electricity that might accumulate due to a high flow rate should be dissipated.

A remote contents gauge or monitoring device together with an overfill alarm shall be provided at the fill point in the following circumstances:

(a) Where the tank is located within a building or under a building and the dip point is more than 8 m from the entrance to the building or otherwise inaccessible.

(b) Where the tank is in a tank chamber and access to the dip point is prevented.

(c) Where the tank is out of direct sight of the attendant monitoring filling flow controls.

5.3.4 Filling of elevated tanks

If the fill point is at or below the highest likely level of liquid in the tank or piping system, the fill connection shall be a dry-break type in accordance with AS 3664, incorporating a manual shut-off valve immediately upstream of the coupling. Where the fill point is beyond the security fence around the installation, a non-return valve shall be incorporated in the piping system at the security fence.

NOTE: An end-of-line assembly comprising a non-return valve, manual shut-off valve and cap with witness hole may be used in lieu of a dry-break coupling.

5.4 VENTING

5.4.1 General requirements

A tank manufacturer will not normally be able to finalize the design and size of the vent provision without consultation concerning the conditions of installation, filling, and operation, and the type of product to be stored.

Tanks, other than Categories 1 and 2, shall not be installed unless the owner holds design documentation confirming compliance with the relevant Standard, or it can be demonstrated that the tank is fit for service.

Each tank shall be fitted with a vent or vents in accordance with the following provisions:

(a) A free vent or a pressure-vacuum (PV) vent designed for the type of liquid being stored.

(b) An emergency vent when the conditions of Clause 5.5 apply.

(c) Vapours shall be safely discharged outdoors unless their recovery and treatment is otherwise required.

(d) The vents shall be separate from the filling pipe except for a Category 1 tank.

(e) API 2000 is the basis for the requirements of this Clause. Appendix I of this Standard provides a metric version of parts of API 2000, but in cases of dispute the original Standard in imperial units will be the basis for decision.

NOTES:

1 Tanks of Categories 1 and 2 are intended for specific applications; the former for oil supply to domestic heaters, the latter for minor storage in open-space locations. Neither is intended for industrial use, and their vent provision could be inadequate for the filling and draw-off rates likely to be required in such usage.

2 Classification of tanks is in accordance with AS 1692.

5.4.2 Vent capacity

The size of any free vent or pressure-vacuum vent shall be such that pressure or vacuum resulting from filling, emptying, or atmospheric temperature change will not cause the maximum allowable stress for the tank to be exceeded, nor the tank to collapse. These requirements shall be met by one of the following:

(a) For a Category 1 or 2 tank, the vent provided with the tank in accordance with AS 1692 shall be deemed to be suitable for the types of installations for which the tanks are intended (see Note 1 to Clause 5.4.1).

(b) The vent size for a Category 3, 4, 5 or 6 tank installed above-ground shall comply with the relevant requirements of API 2000.

NOTE: The vent size of a Category 4 above-ground tank may be in accordance with Table 5.1 (see also Clause 5.4.1 regarding vent size).

(c) The vent size of a Category 4 tank installed underground shall be at least that specified in Table 5.2.

TABLE 5.1

FREE VENT SIZE FOR ABOVE-GROUND CATEGORY 4 TANKS

Liquid flow rate	Minimum vent diameter, mm			
	Flammable		Combustible	
L/min	Filling	Withdrawing	Filling	Withdrawing
250	32	32	32	32
500	32	37	32	37
750	32	42	32	42
1 000	32	46	32	46
A1 1 500	32	54	32	54
2 000	34	60	32	60
2 500	38	66	32	66
3 000	41	71	32	71

NOTES:

1 The diameters specified in this Table are the minimum allowable internal diameters, as derived from API 2000, assuming a maximum tank pressure of 17.5 kPa and a vacuum 0.5 kPa below ambient pressure.

2 To use the Table, check the minimum permitted diameter for both the filling and withdrawing rates for the particular installation and use a pipe which will give at least the larger of the two resultant diameters.

TABLE 5.2

FREE VENT SIZE FOR UNDERGROUND CATEGORY 4 TANKS

Maximum filling or withdrawing flow rate	Nominal pipe size*		
	Pipe length, m		
L/min	15	30	60
750	32	32	32
1000	32	32	40
1500	32	40	50
2000	40	40	50
2250	40	50	50
2500	50	50	50
3000	50	50	80
4000	50	50	80

* Minimum nominal size in millimetres, and quoted on the basis that the actual bore will not be less than the nominal value quoted. It includes allowance for seven elbows.

NOTE: In the normal case of petrol flowing by gravity through a 100 mm hose, the flow rate will be of the order of 2000 L/min.

5.4.3 Vent piping

Any vent piping between the tank vent connection and the discharge point shall comply with the following requirements:

(a) The vent pipe shall fall consistently back to the tank at a slope of at least 1 in 100.

(b) A vent pipe shall not pass through building foundations but may be embedded in concrete that is part of other building construction. Joints in vents shall be—

(i) of such quality as to prevent vapour leaking; and

(ii) located so that any leaking that might occur, is prevented from accumulating inside or transferring into cavity walls, ceilings or enclosed spaces.

(c) An underground vent pipe shall be either embedded in a concrete slab or laid in the earth.

If the vent pipe is laid in the earth, it shall be—

(i) located at least 300 mm below ground level;

(ii) surrounded by clean washed sand;

(iii) suitably protected if the area is subject to vehicular traffic;

(iv) designed and installed to provide flexibility to accommodate settlement; and

(v) protected from corrosion.

(d) Where vent piping penetrates a fire-rated wall, it shall be installed so as to ensure that the fire resistance of the wall is maintained.

(e) The vent pipe and terminal shall be located or protected so that they are not liable to damage resulting from normal activities.

(f) Joints in vent piping shall be sealed to prevent liquid or vapour release and tested to a minimum hydrostatic pressure of 35 kPa or the operating pressure of the vent unit, whichever is the greater.

NOTE: Vent pipes may be connected together to form a common vent line, provided that the area of any common vent line is not less than the sum of the cross-sectional areas required for the individual vents connected to it, and that cross-contamination will not affect adversely the use of the contents of either tank.

(g) Where several tanks are interconnected by a common venting system and the vapours in the vapour are within the explosive range, measures shall be taken to prevent the possibility of flashback or flame propagation through the system from one tank to another, e.g. by the use of flashback arresters, barometric dampers, nitrogen inerting or ensuring that the vapour concentration is always above the explosive range.

NOTE: Additional requirements may be necessary where vapour recovery is adopted.

5.4.4 Vent outlet location

The discharge point of a vent shall comply with the following requirements:

(a) The vent discharge point shall be located laterally at least 4 m for flammable liquids and 2 m for combustible liquids from any opening into a building, e.g., window, door, ventilator, airconditioner or a mechanical vent intake to reduce the possibility of the entry of nuisance vapour. The vent shall be located such that the opening into a building shall be outside the hazardous zone specified in the relevant part of AS/NZS 2430.3.

NOTE: The vent for any above-ground tank may discharge at a point at least 150 mm above the top of the tank, provided that other requirements for tank and vent locations are met.

(b) The vent discharge point shall be located at least 4 m above ground level except for direct-vented tanks of Categories 1 or 2.

(c) Where the tank is to be filled by gravity flow from a tank vehicle, the vent discharge point for the tank shall be at least 4 m above ground level at the fill point and in all circumstances shall be higher than the tank vehicle.

(d) Where a Category 1 to 5 tank is to be filled by pumping from a tank vehicle—

(i) the vent pipe or overfill point shall terminate in view of the filling operator; or

(ii) the tank shall be fitted with a high level alarm audible to the filling operator.

Notwithstanding other requirements in this Clause, a vent provision may be connected to a vapour recovery or collection system.

NOTE: When filling rates are high, the velocity of the discharging vapour may be high enough to carry it a considerable distance. In such cases, particular attention should be paid to direction of discharge, to vapour diffusion and to potential ignition sources, especially for flammable liquid.

5.4.5 Vent terminals

The discharge end of a vent shall be protected from the ingress of foreign material by means of a protective cage or fitting. Where a tank contains flammable liquid and the vapour within the ullage space of the tank is within explosive limits, a flame arrester or similar device shall be fitted. Any such protective cage, flame arrester or other means shall not reduce the required effective vent area or create undue back-pressure within the tank.

NOTE: A flame arrester incorporating a bronze or stainless steel wire mesh having openings not greater than 600 μm is acceptable.

5.4.6 Application of pressure-vacuum vents

A pressure-vacuum vent shall not be used on any tank of Categories 1, 2 or 3, unless the tank has been specifically designed and tested as prescribed in AS 1692 for use with such a vent.

A pressure-vacuum vent shall not be fitted to any Category 4 underground tank.

5.4.7 Setting of pressure-vacuum vents

The settings of any pressure-vacuum vent shall be such that the pressure and vacuum limits, as given in the Standard to which the tank has been designed and tested, are not exceeded.

For tanks in Categories 4 or 5 designed and tested in accordance with AS 1692, the pressure setting shall be such that the test pressure of the tank is not exceeded under maximum normal venting conditions. The vacuum setting shall be such that the internal pressure does not fall below a pressure of –0.5 kPa gauge. On such tanks, the setting of the pressure-vacuum vent shall be more than 7 kPa below that of the emergency vent.

5.5 EMERGENCY VENTING

5.5.1 Application of emergency venting

Emergency venting shall be provided for any Category 4, 5 or 6 above-ground tank having a fixed roof and containing a flammable liquid or which, though it contains a combustible liquid, is in the same compound as a tank containing a flammable liquid.

Clauses 5.5.2 and 5.5.3 do not apply to:

(a) Any open-top tank with pontoon, floating or lifter roof.

(b) Any fixed-roof tank that has an internal floating pandeck and free air vents of equal or greater area than that required for emergency venting.

(c) Any fixed-roof tank having a diameter of 12 m or greater (see Clause 5.5.2).

5.5.2 Capacity and size of emergency vents

The capacity of any emergency vent shall be in accordance with API 2000 (see Appendix I of this Standard).

For a vertical tank having a diameter of 4 m or less, a weak roof-to-shell joint (a frangible roof) shall not be regarded as an acceptable alternative to an emergency vent. For vertical tanks having diameters greater than 4 m but less than 14 m, a frangible roof may not be effective and its use should be proven by calculation; alternatively, emergency venting shall be provided.

For a vertical tank having a diameter of 14 m or greater, the use of a frangible roof is acceptable.

If the emergency vent is of a simple construction such as a manhole cover with long bolts or equivalent, its size may be determined by reference to Appendix I. For more complex emergency vents, the capacity data supplied by the manufacturer shall be used in the selection of the vent.

5.5.3 Pressure setting of emergency vents

The pressure setting of any emergency vent shall be such that under maximum emergency venting conditions the pressure in the tank shall not exceed the limits given in the Standard to which the tank has been designed.

NOTE: Where both an emergency vent and a pressure-vacuum vent are required, there should be sufficient difference between the pressure settings of the two vents to ensure that the emergency vent will open only under emergency conditions when the normal venting provisions have been exceeded.

5.6 LOCATION AND CAPACITY OF INDOOR TANKS

5.6.1 General

Tanks containing flammable or combustible liquids that are an integral part of blending, mixing or processing equipment, are exempt from this Clause (5.6). However, the fire protection requirements given in Clause 11.11.1 shall apply to such tanks.

NOTE: See Figure 5.1 for illustrations of terms.

5.6.2 Flammable liquids

Any tank that is located within the confines of a building and contains quantities of flammable liquid greater than minor storage shall be either—

(a) a double-walled tank below the lowest floor level, installed in accordance with Clause 5.12; or

(b) a single-wall tank placed in a tank chamber or a sand-filled chamber, in accordance with Clause 5.13; or

(c) a tank having integral secondary containment with an FRL of 240/240/240 and complying with Clause 5.9.

Where an adjoining basement, tunnel, pit or the like extends below the level of the tank, the sand-filled chamber method should be used.

NOTES:

1 It is recognized that because of special circumstances on a particular site, other forms of installation may provide an equivalent level of safety.

2 In some areas any storage of flammable liquid within or under a building of any type may be prohibited.

3 Requirements for liquid level indication are given in Clause 5.3.3.

5.6.3 Class C1 liquids

5.6.3.1 *Tanks having a capacity of 1000 L or less*

Tanks having a capacity of 1000 L or less may be installed anywhere within the building, provided that—

(a) such tanks are not interconnected;

(b) provision is made to contain the spread of any small leak or spill; and

(c) such tanks are separated from each other, and from any other tanks, by at least 3 m.

5.6.3.2 *Tanks having a capacity greater than 1000 L*

Any tank having a capacity greater than 1000 L capacity shall be—

(i) a double-wall tank buried in accordance with Clause 5.12; or

(ii) installed on or below the lowest floor level of a building, in a tank chamber in accordance with Clause 5.13; or

(iii) a tank having integral secondary containment with an FRL of 240/240/240 and complying with Clause 5.9.

A2 Any such tank shall be installed on or below the lowest floor of the building.

5.6.4 Class C2 liquids

Any storage of Class C2 liquids in tanks within a building shall comply with the following requirements:

(a) The capacity of each tank that is located on the lowest floor level shall not exceed 60 000 L.

(b) Not more than 10 000 L shall be stored on any floor above the lowest floor level.

5.7 SEPARATION OF ABOVE-GROUND TANKS

5.7.1 Application

The tank spacing requirements of this Clause shall apply to both outdoor and indoor locations, provided that the latter are permitted by other limiting requirements.

5.7.2 Separation distance from tank to protected places, security fences or to on-site protected places

A tank or tanks shall be located so that the following minimum separation distances are maintained:

(a) To security fences and on-site protected places, Table 5.3.

(b) To a protected place beyond the site boundary, Table 5.4.

(c) Except where provided with cooling water in accordance with Appendix J, the layout of tanks storing flammable liquids (or combustible liquids within the same compound as flammable liquids) shall be such that any tank is accessible on at least two sides from an access road outside the bund.

The separation distance to a protected place on an adjacent property may be measured across the property boundary as if the boundary did not exist. Where there is no protected place on the adjoining property the installation may be located in accordance with Item (a). In all cases, should alterations on the adjacent property result in a breach of the requirements for separation distance, the installation shall be modified or relocated to restore compliance, or taken out of service.

5.7.3 Distance between vertical tanks for flammable liquids

The distance between any two adjacent vertical tanks that contain flammable liquids shall be as follows, except as otherwise provided in Clause 5.7.5.

(a) If neither tank exceeds 6 m in diameter, the distance between them shall be at least either one-third of the diameter of the larger tank or 1 m, whichever is the greater.

(b) If one of the tanks is more than 6 m but neither is more than 20 m in diameter, the distance between them shall be at least one-half of the diameter of the larger tank.

(c) If one tank is more than 20 m in diameter, the distance between it and any other tank shall be at least 15 m.

5.7.4 Distance between vertical tanks for combustible liquids

The distance between any two adjacent vertical tanks that contain combustible liquids shall be as follows:

(a) For Class C1 liquids, at least either one-sixth of the sum of their diameters or 1 m, whichever is the greater, except as otherwise provided in Clause 5.7.5.

(b) For Class C2 liquids, at least 1 m.

5.7.5 Clusters of tanks

Vertical tanks having a diameter greater than 3 m but not exceeding 10 m may be grouped in a cluster with reduced tank-to-tank spacing, provided that—

(a) the distance between any two tanks is at least 1 m;

(b) the total cross-sectional area of all tanks in the cluster does not exceed 320 m^2;

(c) the distance separating any such cluster from any other above-ground tank or cluster of tanks is at least 15 m for flammable liquids or at least 7.5 m for combustible liquids;

(d) where the total cross-sectional area of the tanks in any such cluster exceeds 30 m^2, and one or more tanks contain flammable liquid, all tanks in the cluster are provided with foam fire protection in accordance with Clause 11.13.1 and Clause 11.13.2; and

(e) when the required compound capacity and clearances from other structures is being calculated, such a cluster is regarded as being one tank of aggregated volume containing liquid of the lowest flash point present.

5.7.6 Horizontal tanks

The following requirements and recommendations apply to the storage of liquids in horizontal tanks:

(a) Horizontal tanks shall comply with AS 1692 and the requirements of this Standard.

(b) The distance between horizontal tanks shall be at least 600 mm. Where horizontal tanks are adjacent to vertical tanks, the distance requirements for vertical tanks shall apply.

(c) Tanks shall not be arranged end-to-end unless the potential for end failure and the resulting exposure hazard has been taken into account when determining the tank's location. Tanks may be arranged in parallel (side-by-side) in a row.

5.7.7 Mixed products

Where liquids of differing flash point are stored, the following requirements shall apply:

(a) Where stored within the same compound, the separation distance between tanks applicable to the liquid of the lowest flash point present shall apply to each tank within that compound.

(b) Where two compounds are separated by a bund, each tank in each compound shall be considered separately in its relationship to each tank in the adjacent compound. In each case, the separation distance shall be that applicable to the liquid of the lower flash point actually present in either of the tanks under consideration.

TABLE 5.3

SEPARATION DISTANCES FOR TANKS TO SECURITY FENCES AND ON-SITE PROTECTED PLACES

Separation required from tank to:	Minimum distance, m*		
	Flammable liquid	Combustible liquid	
		C1	C2
Fill points†, platforms or package storage	Diameter of the tank or 15 m, whichever less, but not less than 6 m	Diameter of the tank or 7.5 m, whichever is less, but at least 3 m	Unrestricted, determined by the compound
Office buildings, warehouses, manufacturing and processing areas, workshops or amenities blocks on the same premises	Distance required by Table 5.4, but need not exceed 15 m	Distance required by Table 5.4 but need not exceed 7.5 m	
Security fence‡	Diameter of the tank or 15 m, whichever is less, but not less than 6 m or the distance obtained from Table 5.4 whichever is the lesser	Diameter of the tank or 7.5 m whichever is less, but at least 3 m	

* Refer to the various rules for alternative distances when vapour barriers are used.

† Points for filling packages, drums or tank vehicles and not the fill point into the storage. Where the liquid being transferred and the liquid in the adjacent storage under consideration are of different classes, determine the separation as if both were of the lower flash point of the two.

‡ For distance to boundaries, see Clause 3.2.5.2.

TABLE 5.4

SEPARATION DISTANCES FOR TANKS TO PROTECTED PLACES

Maximum capacity of any tank, m^3 (kL)				Minimum distance
Flammable liquids		Combustible liquids		
PG I, PG II	PG III	C1	C2	m
0.25	0.5	2.5	5	Unrestricted
1	4	10	20	3
2	8	20	40	4
4	16	40	80	5
7	28	70	140	6
10	40	100	200	7
14	56	140	280	8
20	80	200	400	9
26	104	260	520	10
34	136	340	680	11
42	168	420	840	12
52	208	520	1 040	13
64	256	640	1 280	14
77	306	770	≥1 540	15
170	680	1 700		20
310	1 240	≥3 100		25
500	2 000			30
750	≥3 000			35
1 100				40
1 500				45
≥2 000				50

NOTES

1 For distances above 3 m, the distance applicable for any intermediate capacity may be obtained by linear interpolation.

2 For separation distances for a cluster of tanks, refer to Clause 5.7.5.

5.8 BUNDS AND COMPOUNDS

5.8.1 Requirements

Provision shall be made to contain any leakage or spillage from the tank storage facility and to prevent it from contaminating the surrounding soil or from entering any watercourse or water drainage system.

Any above-ground tank shall be installed within a compound, except where the quantity of liquid stored is within that allowable as minor storage in Table 2.1, or where the tank has integral secondary containment complying with Clause 5.9.

5.8.2 Capacity

The net capacity of a compound shall be at least the capacity of the largest tank. The capacity of on-site containment shall be increased to include the output of any fire water over a 20 min period. If two or more tanks are operated as a single unit, then the capacity of all such tanks shall be used when calculating the capacity of the compound.

When designing and constructing an earthen bund, account shall be taken of subsidence in the construction materials. In no case shall the bund be less than the nominated capacity. In addition, original height markers shall be installed on earthen bunds.

5.8.3 Design and construction

A compound and its associated bund shall comply with the following requirements:

(a) It shall be sufficiently impervious to retain spillage and to enable recovery of any such spillage.

NOTE: When earthen bunds are used, consideration should be given to the minimization of penetration of the bund surface, because of permeability, in the event of a spill.

(b) In a fire situation, the bund shall retain the structural integrity.

(c) Any bund or compound floor shall be designed to withstand the hydrostatic head when full.

(d) Any earthen wall 1 m or more in height shall have a flat section at the top at least 600 mm wide.

(e) The slope of any earthen wall shall be consistent with the angle of repose of the material from which the wall is constructed.

(f) A bund shall not be higher than 1.5 m above interior grade unless means for safe and rapid entry and exit are provided.

(g) Any pipe that passes through a bund shall be designed to prevent excessive stresses as a result of settlement or expansion resulting from fire exposure. The joint between the pipe and the bund shall be sealed to prevent leakage.

(h) The location of a bund relative to the closest tank shall be such that the top inside perimeter of the bund is not inside the crest locus limit specified in Figure 5.2, except where it can be demonstrated that a reduced distance would be appropriate due to viscosity or other considerations.

(i) Where flammable liquids are stored, the distance from the top inside perimeter of the bund to protected places or on-site protected places shall be at least one half of the specified separation distance given in Table 5.4 or 15 m, whichever is less.

NOTES:

1 It is preferable to have moderately high bunds, rather than shallow bunds, so as to minimize the area of fuel burning in the event of a fire.

2 Consideration should be given to access between groups of bunded areas for emergency vehicle access.

3 Alternative methods of construction may be used to ensure containment of spills and tank shell leaks.

5.8.4 Compound subdivision

Where the aggregate capacity of the tanks in any compound exceeds 10 000 m^3, intermediate bunds of at least half of the average height of the main bunds or 600 mm, whichever is the lesser, shall be provided so that any subdivision so created contains tanks having an aggregate capacity not exceeding 10 000 m^3, or a single tank if such tank exceeds that capacity.

5.8.5 Total storage per compound

Except for a single tank, the maximum total aggregate volume of flammable liquids stored within any one compound shall be 60 000 m^3 where any tank has a fixed roof, or 120 000 m^3 where only floating-roof tanks are used.

5.8.6 Compound drainage

A compound shall be drained in accordance with the following requirements:

(a) The drainage provision shall slope away from any tank to a sump which is in turn drained from the lowest level either by gravity or by pumping. In the former case, a manually controlled normally-closed valve shall be provided; in the latter case, the pump shall be manually controlled.

(b) The drain from one compound discharge shall not drain into another.

NOTE: Subdivisions within compounds may be interconnected if arranged to have individual isolating valves.

(c) Any valve controlling the drainage from a compound shall be located outside the bund except for the valves for intermediate sub-compounds. The valve shall be of a type in which the distinction between the open and shut positions is obvious, and shall incorporate a provision to be locked shut when not actually draining (see Clause 9.2.9(f)).

(d) The discharge from any sump which could contain flammable or combustible liquid shall be through an interceptor appropriate to the product, readily accessible for inspection, located outside the compound, and designed to prevent the discharge of flammable or combustible liquids to any natural watercourse, public sewer, or drain.

(e) The design capacity of any drainage system shall be at least the rate of supply of emergency water within the compound as provided in Appendix J.

NOTE: Drains should have liquid seals where appropriate to prevent the spread of fire through a drainage system.

(f) A tank or compound used for the retention of spillage, with or without water, shall be constructed and located in a similar manner to the tanks and compounds used for storage. Such a compound shall comply with Clause 5.8.3(i).

NOTE: Several compounds may be drained into a single retention compound.

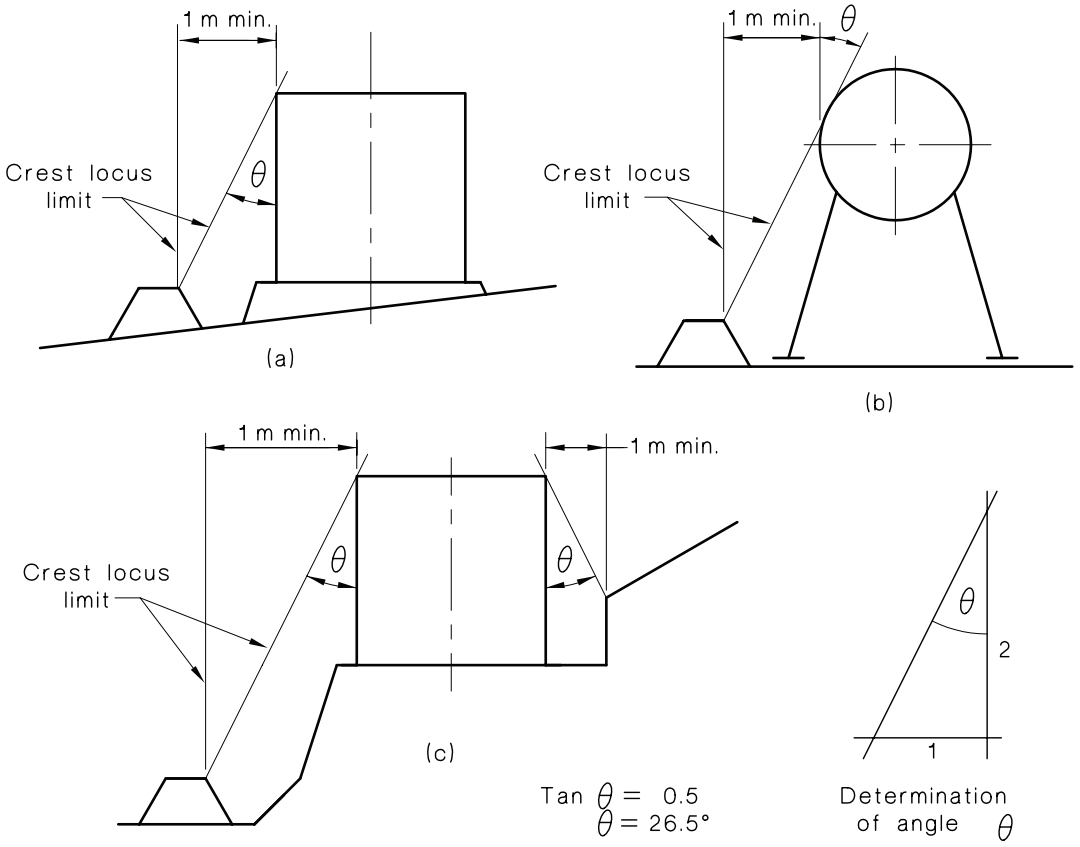


FIGURE 5.2 BUND LOCATION LIMITS

5.9 REQUIREMENTS FOR ABOVE-GROUND TANKS WITH INTEGRAL SECONDARY CONTAINMENT

5.9.1 General

A2 A tank complying with this Clause (Clause 5.9) shall be one of the following:

(a) A double-walled tank.

(b) A tank having secondary containment and an external, fire-rated covering.

(c) A tank with an attached or integrated spillage compound.

5.9.2 Requirements for all tanks having integral secondary containment

The following requirements apply to tanks with integral secondary containment:

(a) The tank shall not be used for the storage of PG I flammable liquids.

(b) The capacity of the tank shall not exceed—

(i) 55 000 L for PG II liquids;

(ii) 110 000 L for PG III liquids; or

(iii) 110 000 L for combustible liquids.

(c) The primary (inner) tank shall be constructed to AS 1692 or equivalent Standard.

(d) The secondary containment shall be adequately designed and constructed, to contain the entire contents of the primary tank.

(e) Means shall be provided to establish and monitor the integrity of the primary tank.

(f) The tank shall be installed in accordance with Clause 5.11 or 5.12.6 as appropriate.

(g) Where flammable liquid or vapour could escape from the interstitial space of a tank, the tank shall be separated by at least 3 m from any ignition source, including vehicles being refuelled.

(h) Spacing between adjacent tanks shall be at least 600 mm.

(i) The tank shall be capable of resisting damage from the impact of a motor vehicle, or suitable collision protection shall be provided.

(j) Means shall be provided to prevent release of liquid by siphon flow from the tank.

(k) The tank shall be fitted with a means of determining the level of its contents. Such means shall be available to the delivery operator.

(l) All piping connections to the tank shall be above the normal maximum fill level.

(m) Tanks shall not be manifolded unless provisions are made to prevent their being overfilled.

(n) Overfill protection shall be provided by an alarm sounding and the flow of liquid being stopped, before the tank overflows.

If the tank is designed to contain overflow, such an alarm is the minimum provision necessary to achieve this objective. If the overflow is to be discharged outside the secondary containment, an automatic shut-off shall be provided. These provisions shall not restrict or interfere with the proper functioning of the normal vent or the emergency vent.

(o) Each fill point shall be provided with spill containment having a minimum capacity of 15 L per fill point. Such a device shall be fitted to a tank in order to catch and contain any minor spill during product delivery to the tank.

(p) Where a tank having multiple compartments is installed, the separation distance to protected places shall be based on the aggregate volume of the compartments and the lowest flash point of the liquid in any tank compartment.

(q) Venting shall comply with Clause 5.4. Venting of compartments of a multiple-compartment tank shall be based on the lowest flash point product in any of the compartments.

(r) Where the interstitial space is enclosed, it shall be provided with venting in accordance with this Standard or with a UL approved method.

5.9.3 Additional requirements for double-walled tanks

A2 The following requirements and recommendations apply in addition to those in Clause 5.9.2 above:

(a) Primary and secondary containment shall be wholly constructed of steel and shall be designed in accordance with AS 1692 or equivalent Standard.

(b) Separation distances as given in Clause 5.7 shall apply.

5.9.4 Additional requirements for tanks with external fire-rated covering

NOTE: Fire rated tanks include 'vaulted' tanks which comply with UL 2085 or are approved by Underwriters Laboratories (UL) or Factory Mutual (FM) to the equivalent US fire rating.

The following requirements and recommendations apply to tanks having an external, fire-rated covering on both the tank and any supports:

(a) The secondary containment shall be of concrete or a material having an equivalent fire rating.

(b) Emergency venting for the interstitial space in this tank system may be provided by a weak seam incorporated into the tank's external cover. In such a system, this seam shall fail preferentially if the pressure within the interstitial should build up excessively, without compromising the integrity of the secondary containment.

(c) Tanks having an FRL of 240/240/240 shall be regarded as complying with the requirements for tanks in chambers (see Clauses 5.13.1 and 5.13.2).

(d) Where the tank's secondary containment has an FRL of at least 240/240/240 or complies with UL 2085, the following separation distances apply:

(i) To on-site and off-site protected places, the distances given in Clause 5.7 may be halved.

(ii) To boundaries and public places .....2 m.

(iii) To any security fence.....1 m.

(iv) To a dispenser ..... nil.

NOTE: A dispenser may be mounted on a tank, provided it is suitable for use in the hazardous area around the tank.

5.9.5 Additional requirements for tanks with integrated spillage compounds

A2 The following requirements apply in addition to those in Clause 5.9.2:

(a) The design of the external secondary containment shall comply with Clause 5.8.3 except that the 1 m separation distance given in Figure 5.2 does not apply. However, provision shall be made for inspection of the tank's outer surface.

(b) The separation distances given in Clause 5.7 shall apply.

5.10 REQUIREMENTS FOR TANK CONTAINERS (ISO TANKS, PORTABLE TANKS) WHEN USED AS STATIC STORAGE TANKS

Tank containers complying with the ADG Code may be used as static storage tanks. As such they are exempt from the provisions of Clause 5.2.1.

NOTE: The UN *Model Regulations* refer to these tanks as 'portable tanks'.

Where flammable or combustible liquids are to be stored in tank containers, other than when such containers are used as delivery tanks or in transit storage, the following requirements apply:

(a) All of the requirements of this Section (Section 5) shall apply with the exception of Clause 5.2.1.

(b) Tank containers shall not be stacked.

(c) Storage configurations shall be maintained to ensure venting from relief vents is to free space.

NOTE: This safety control is to guard against the potential for flame impingement and jet fire on the ISO tank or any other ISO tank through the ignition of vapours.

(d) Tank containers shall be separated from each other so as not to impede or obstruct any necessary firefighting operations.

5.11 INSTALLATION METHODS FOR ABOVE-GROUND TANKS

5.11.1 Foundations

An above-ground storage tank shall rest on a foundation which is adequate to support, without unacceptable or uneven settling, the following loads and forces:

(a) The direct load imposed by the tank when full of either water or product, whichever is the more dense.

(b) Any possible overturning forces, and in particular those due to wind when the tank is empty.

(c) Any uplift or other distorting forces such as may occur in a tank under pressure.

Any attachment between the tank and its supporting structure or foundation shall be adequate to withstand any such forces.

NOTE: Because of the wide variety of surface, subsurface, and climatic conditions, it is obviously not possible to establish design data to cover all such situations. The allowable soil loading requires a decision for each individual case, having regard to the permissible settlement (see AS 1726).

5.11.2 Supporting structures

Any supporting structure between the foundation and the tank shall comply with the following requirements:

(a) Any supporting structure, or ancillary structure used to provide rigidity, shall be made wholly of non-combustible material.

(b) Any metallic support that is more than 1 m high and supports a tank having a capacity greater than 2500 L of PG I and PG II liquids, or 5000 L of PG III liquid, or 10 000 L of combustible liquid, shall be protected by material having an FRL of at least 120/120/120.

(c) The structure shall be designed according to the requirements of the Australian Standard applicable to the particular construction (see AS 4100 for steel and AS 3600 for concrete).

(d) The design shall take account of the total mass of the tank when full of either water or product, whichever is the greater, any wind loading, any possible uplift loading on restraining connections, and any likely seismic loading (see AS 1170.4).

Any such anchorage shall be designed to overcome the maximum anticipated buoyancy force.

5.11.3 Tank bearing area

The method of support of a tank shall avoid excessive concentration of loads on the supporting portion of the tank shell. Legs, cradles or similar methods of support shall be attached in a manner that will prevent possible trapping of moisture and corrosion of the tank shell.

5.11.4 Tanks in areas subject to flooding

A tank located in a flood-prone area shall be anchored to prevent floating.

5.12 INSTALLATION METHODS FOR UNDERGROUND TANKS

5.12.1 Method of installation

Any tank with more than 50% of its height buried below the surrounding ground gradient and mounded without any surrounding pit or chamber shall be considered an underground tank and shall be installed in accordance with AIP CP4 and the following requirements:

(a) The tank shall be set on and be surrounded with at least 150 mm of non-corrosive inert material such as clean sand well-tamped into place.

(b) The tank shall be covered with sand or earth to a depth of at least 600 mm or, alternatively, the cover shall consist of 300 mm of sand superimposed with reinforced concrete at least 150 mm thick. Any covering shall provide adequate support.

(c) The tank shall be securely anchored where necessary to prevent floating. Any such anchorage shall be designed to overcome the maximum anticipated buoyancy force.

(d) A tank within a building shall be wholly below the lowest floor level of the building, and shall have a concrete covering.

(e) Glass reinforced plastic tanks shall be installed in accordance with the manufacturer's instructions.

NOTES:

1 Tanks that are installed with part of the shell above ground gradient and with the shell exposed to atmosphere, are deprecated because of corrosion control problems.

2 PICA RP001 provides recommended practices for the installation of underground petroleum storage systems.

5.12.2 Access pits

Where a pit is provided for access to fittings or entry/exit points, it shall be lined to restrain the surrounding earth fill, the lid shall be of adequate strength for any normal traffic load, and the closure shall be designed to minimize ingress of rain-water.

5.12.3 Separation between tanks

The distance between any two underground tanks shall be at least 150 mm.

5.12.4 Proximity to property boundaries

An underground tank shall be protected from potential damage arising from adjacent properties by at least 2 m of boundary separation.

5.12.5 Proximity to foundations

An underground tank shall be located, with respect to existing building foundations and supports, so that the building loads cannot be transmitted to the tank.

5.12.6 Secondary containment

Where there is risk of leakage into a building, a tank should be a double-walled tank buried in sand, or a single-wall tank installed in a chamber complying with the appropriate requirements of Clause 5.13 or other means of providing equivalent integrity.

5.12.7 Corrosion protection

Any buried tank, its anchorage and associated piping shall be protected from corrosion by one or more of the following methods:

(a) Protective coatings or wrappings.

(b) Cathodic protection (see AS 2832.1 and AS 2832.2).

(c) Corrosion-resistant construction materials, e.g. FRP.

Consideration shall be given to the corrosion history of the area in the selection of the type of protection to be employed.

5.13 INSTALLATION METHODS FOR TANKS IN TANK CHAMBERS

5.13.1 Above-ground tank chambers

Any tank chamber that is on or partly below the lowest floor level shall be constructed in accordance with the following requirements:

(a) The walls shall have an FRL of 240/240/240.

(b) The roof shall be of reinforced concrete at least 150 mm thick.

NOTE: The roof may have a removable section or sections for access or maintenance.

(c) Where a tank chamber is subject to superimposed loads, the thickness of the roof or walls, or both, shall be increased appropriately.

(d) The floor shall be of masonry or reinforced concrete, or of material of equivalent strength, excluding earth and asphalt.

(e) There shall be a clear space of at least 450 mm between any tank and any wall or roof of the chamber, or any other tank in the chamber.

(f) Any doorway or other access opening in any wall shall be protected by a fire door or cover having an FRL of at least –/120/30. Such a door or cover shall be designed to normally be closed.

(g) The sill of any doorway shall be raised to provide a liquid-tight compound capable of sustaining the hydrostatic load and having a net capacity at least that of the largest tank.

(h) The tank chamber shall not have an automatic pump-out system.

NOTE: If spills could accumulate in the tank chamber, a manually operated low-point sump or pump-away facility should be installed.

5.13.2 Underground tank chambers

Any tank chamber that is wholly underground shall be constructed in accordance with the following requirements:

(a) The walls and floor of the chamber shall be of reinforced concrete at least 150 mm thick and of such quality as to prevent any leakage out of or into the chamber.

(b) The roof or lid shall be of reinforced concrete of the thickness necessary to support itself and any superimposed loads, but at least 150 mm.

(c) Access shall be provided by means of a removable roof or lid, hatch, or access pit. Any cover shall have an FRL of at least 120/120/120.

(d) There shall be a clear space of at least 450 mm between any tank and any wall or roof of the chamber, or any other tank in the chamber.

5.13.3 Backfilled chambers

Any backfilled chamber shall comply with the relevant requirements of Clause 5.13.1 or Clause 5.13.2, with the following exceptions or additions:

(a) The distance from any tank to a side or top of the chamber shall be at least 150 mm or 300 mm respectively.

(b) The distance between any two tanks in the one tank chamber shall be at least 150 mm.

(c) A steel tank shall be set on a bed of sand at least 150 mm thick and, subject to Clause 5.11.2, all other spaces shall be filled with sand well-tamped into place.

(d) Filling sand shall be water-washed and free from soil, rocks, gravel or ashes and other harmful matter, and shall have a minimum resistivity of 100 Ω.m.

(e) Any access pit shall comply with Clause 5.11.2.

5.14 SERVICE TANKS

5.14.1 Use of service tanks

A service tank shall be interposed between a storage tank and a burner, engine, or other fuel-consuming equipment in the following circumstances:

(a) When the storage tank is higher than the consuming equipment.

(b) When the supply pressure that the consuming equipment can tolerate might otherwise be exceeded.

(c) When for any other reason it is necessary to provide a limited storage or pressure-controlling facility close to the consuming equipment.

The service tank shall be located close to the consuming device.

5.14.2 Service tank higher than storage tank

Where liquid is pumped from a storage tank to a service tank at a higher level (irrespective of any level control device which is fitted) an overflow pipe shall be provided. The overflow pipe shall have sufficient capacity to return the full capacity of the pump to the storage tank without spillage.

5.14.3 Storage tank higher than appliance

Where fuel is supplied from a storage tank to a burner, engine, or other consuming equipment that is lower than the tank, the service tank shall be—

(a) close to the consuming device;

(b) located outdoors if filled by gravity;

(c) provided with at least two independent overfill shut-off devices arranged so that each will continue to function to prevent overfilling in the event of failure of the other; and

(d) provided with a means of handling liquid overflow and tank over-pressure in the event that the shut-off provisions fail to operate.

5.14.4 Return systems

Where a return system is installed, the following requirements shall apply as appropriate:

(a) Gravity return systems shall incorporate at least one overfill shut-off device to prevent the overfilling of the service tank.

(b) Other return systems shall incorporate at least two independent overfill shut-off devices, arranged such that each will continue to function to prevent an overfill in the event of failure of the other device.

5.14.5 Service tanks indoors

Any service tank located indoors shall be installed in accordance with Clause 5.6 in addition to the requirements of this Clause (Clause 5.14).

SECTION 6 SYSTEMS FOR PIPING, VALVES PUMPS AND TANK HEATING

6.1 GENERAL DESIGN AND CONSTRUCTION

6.1.1 Design suitability

The design, fabrication, assembly, testing and inspection of piping that is to contain flammable or combustible liquids shall be suitable for the expected working pressures, temperatures, and structural stresses. AS 4041 should also be consulted.

AIP CP4 should be consulted when designing, installing and operating underground petroleum storage systems.

6.1.2 Material suitability

Any material used in the construction or installation of piping shall be suitable for the conditions of use (see also Clause 5.2.4). The following requirements apply:

(a) The material shall be compatible with the particular liquid or any other component with which it may be in contact.

(b) The material shall be resistant to any heat to which it may normally be exposed.

(c) Where exposed to corrosion, from within or without, the material shall be sufficiently resistant to ensure a life span at least equal to other parts of the installation or to achieve its design life.

NOTE: Copper is not a preferred material for product lines and its use is to be discouraged for the following reasons:

(a) It is mechanically weaker, and has a lower melting point than other materials (e.g. steel).

(b) The jointing methods used for copper pipe are less robust than other systems (e.g. flanges, welds).

(c) Given the wide range of flammable and combustible liquids, chemical reaction between the liquid and the copper pipe may be more likely.

(d) Vibration could cause copper to harden over time.

(e) Copper could catalyse the decomposition of some fuels.

6.2 PIPING

6.2.1 Design and construction

The following general design considerations shall be taken into account when designing or installing any piping:

(a) Access for operating, testing, maintenance, replacement or drainage.

(b) Support and fixing.

(c) Exposure to mechanical damage.

(d) Protection against corrosion wherever necessary, particularly for piping that is outdoors, or underground, or underwater, or which passes through or is embedded in any material likely to induce corrosion.

(e) Suitability for the liquids to be piped, and possible change of such liquids.

(f) Integration with any cathodic protection system.

(g) Any need to relieve excess pressure between valved-off sections of pipe in liquid service.

(h) Expansion or contraction of the piping.

(i) Drainage for any trench in which pipes are laid.

(j) Protection for any buried piping from superimposed loads or ground settlement.

(k) Electrical bonding and earthing (see AS/NZS 1020).

(l) Where piping is encased in concrete, the need to guard against corrosion and to provide for expansion.

(m) Painting or marking of piping, to permit ready identification of its contents (see AS 1345).

(n) Access to, and operation of, valves and other control devices, including ergonomic considerations.

(o) Fire resistance, where piping could be exposed to fire.

6.2.2 Joints

Joints in piping shall be suitable for the operating pressures, temperatures, materials, and other conditions of use. Particular attention should be paid to the joint's vulnerability to failure in the event of fire and susceptibility to corrosion, particularly if it is buried or submerged.

Joint types that are suitable are—

(a) threaded joints conforming with AS 1722; and

(b) flanged joints conforming with AS 2129.

NOTES:

1 Mechanical grooved couplings tested to API 607 should only be used to accommodate misalignment or movement.

2 AS 4041 provides requirements for joints in pressure piping.

Any joint in copper pipework shall be made only with a flare compression fitting, or with a capillary fitting using a brazing metal with a melting point of at least 540°C, or by a spigotted joint formed from the pipe itself, and brazed as above. Flare fittings having mismatching cone angles shall not be used.

6.2.3 Flexible tubing

This Clause (6.2.3) applies to the connection of the fuel dispenser to the supply piping, but does not apply to the internal piping of the fuel dispenser.

Flexible tubing, piping or hose may be used, provided that the principles of Clauses 6.1 and 6.2.1 are met. Such tubing shall meet any necessary requirements with regard to compression, elongation, and angles of horizontal and vertical displacement.

A hose assembly shall be designed or shall have been tested to withstand at least 1.5 times the maximum allowable operating pressure, regardless of whether it is under pump pressure or at zero flow, and including dead-heading and system back-pressure.

6.2.4 Transfer hose

A hose and hose assembly for petroleum products shall comply with AS 2683 and hose couplings with AS 3664.

NOTE: Products other than petroleum may require specific hose materials or couplings, because of compatibility of materials, additional hazards or the like.

6.2.5 Vapour recovery piping

Any vapour recovery piping system for tank vehicle filling installations shall be designed so that when all pump-supplied tank vehicle filling provisions served by that vapour recovery system are in use simultaneously, the back-pressure on each tank vehicle does not exceed its normal operating pressure.

6.3 VALVES

6.3.1 System requirements

Sufficient valves shall be provided to permit proper operation of the system and to protect the installation. The following requirements apply:

(a) A manually-operated tank or liquid outlet valve shall be located as close as possible to the shell of an above-ground tank.

(b) A non-return valve shall be located in each tank-filling pipe close to the filling connection unless the levels of the filling connection, the downstream filling pipe, and the tank are such that backflow cannot occur when the filling hose has been disconnected. Where an anti-siphon opening is made in the filling pipe above the maximum liquid level in the tank, a non-return valve is not required.

6.3.2 Emergency shut-off provisions

Provision shall be made to shut off the flow of liquid quickly in an emergency—

(a) from the storage tank to a consuming device; and

(b) to a tank vehicle fill point.

Any manually operated valve or the actuating device for a remotely operated valve shall be located in a convenient and safe location and conspicuously marked with the words EMERGENCY LIQUID SHUT-OFF or EMERGENCY STOP.

6.3.3 Valve selection

Any valve used for a flammable or combustible liquid shall comply with the following requirements:

(a) For any valve that can be operated or closed by manual action, the distinction between the open and shut positions shall be obvious.

(b) Any hand-operated valve having a handwheel, cross, tee or similar symmetrical handle, shall close by clockwise rotation, when viewed from the end of the spindle of the actuating device. A hand-lever operated valve shall be installed so that the lever is at right angles to the pipe when closed, and so that gravitational forces on the handle will not act in the direction of opening except where the valve is designed to fail-safe. The direction of closing shall be clearly marked.

(c) The use of detachable handles for valves shall be avoided unless essential for security, for procedures, or for sequences. Any such handle shall not be removable unless the valve is at a safe setting and so indicated.

(d) It is preferable that the valve type permits gland repacking to be achieved without having to remove the valve from its installed position.

(e) Any valve whose failure in the event of fire could create a hazard shall be of either steel or a suitable grade of spheroidal graphite iron. The valve handle shall be of metal not inferior to the valve body in fire resistance.

(f) Cast steel fire-safe valves shall be provided —

(i) where any tank valve is below the liquid level of a tank of Categories 4, 5 or 6 containing flammable or combustible liquid; or

(ii) where located in the transfer piping between marine tanker berths and storage tanks.

6.4 PUMPS

6.4.1 Pressure and temperature control

Where the discharge pipe of a pump can be shut off, provision shall be made to prevent the build-up of pressure or temperature in excess of the design capability of the pump and piping. The design of the system shall take into account the following:

(a) A hydraulic relief valve shall not normally be provided with an isolating valve.

Any such isolation valves, if installed, shall be arranged to be secured in the open position.

NOTES:

1 Pump bypasses may be installed to prevent local overheating. Isolation valves to serve hydraulic relief valves or pump bypasses are not recommended.

2 Discharge from a hydraulic relief valve should be returned to the supplying storage tank or returned to the pump inlet provided that the heat generated by such recirculation is within design limits.

(b) The range of adjustment of any hydraulic relief valve shall be restricted to prevent excess pressure, or an excess-pressure relief valve shall be fitted.

6.4.2 Emergency shut-off

An emergency shut-off device shall be provided on each pump. The shut-off device shall be readily accessible and its purpose clearly identified.

6.4.3 Pump drive

Clauses 3.3 and 3.4 shall apply to motors and engines for driving pumps.

6.5 HEATING OF LIQUIDS

6.5.1 Access for service

Critical components of the control system shall be removable without the need to drain any tank. The design, fixing and sealing of any insulation or lagging on pipes and tanks shall be such as to avoid the retention of moisture and to allow the removal of the insulation for inspection and maintenance purposes.

6.5.2 Condensate

Condensate from a steam heater that might be contaminated with flammable or combustible liquid should not be returned to a boiler feed without treatment to ensure that it is suitable as feed water.

6.5.3 Resistance heating of pipes

Where heating is provided by means of heat-tracing or passing an electric current through the pipe wall, the supply shall be thermostatically controlled and shall comply with AS/NZS 3000.

6.5.4 Heater controls

Where heating elements could become exposed above the liquid level because of normal operating level fluctuations, and the temperature of the heating medium is within 6°C below the flash point of the liquid (see Clause 6.5.5), sufficient valves or control systems shall be provided to isolate such exposed heating elements.

6.5.5 Temperature limits

The maximum temperature to which any portion of the liquid may be heated shall be below the temperature at which cracking, decomposition, or ignition could occur.

NOTES:

1 Where water could be present, the heating should be controlled to prevent sudden eruptive boiling.

2 Refer to Appendix K for combustion characteristics of various flammable liquids.

6.5.6 Temperature monitoring

The energy input shall be controlled to prevent boiling, steam eruption or deterioration of the liquid. An excess temperature control and alarm shall be fitted.

Where the temperature rise is slow and not liable to cause deterioration of the liquid, a management system may be used for monitoring if a satisfactory, documented risk assessment has been conducted.

SECTION 7 FUEL DISPENSING

7.1 SCOPE OF SECTION

This Section applies to sites at which flammable or combustible liquids are dispensed into the fuel tanks of vehicles, boats or other containers. It covers both private and retail installations, but does not apply to the bunkering of large vessels or the refuelling of aircraft.

NOTE: The principles given in this Section may be applied to the refuelling of light aircraft.

7.2 GENERAL REQUIREMENTS

7.2.1 Storage method

Any flammable or combustible liquid in quantities exceeding those dealt with in Section 2 shall be kept in package stores or tanks in accordance with Sections 3, 4 and 5 as appropriate.

7.2.2 High-level tanks

Any tank which is so situated as to produce a gravity head at the dispenser shall be equipped with a fail-safe solenoid valve or other equally effective device which shuts off the supply at the tank outlet except when the dispenser is in use. Where the tank is either Category 1 or 2 and there is no metering dispenser, a manual shut-off valve shall be provided at the tank.

7.2.3 Gaseous fuels

Where gaseous fuels for vehicles are stored, handled and dispensed on the premises, the following provisions shall be observed:

(a) AS/NZS 1596 for LP Gas.

(b) AS 3961 for LNG.

(c) AG 901 for CNG.

7.2.4 Emergency power cut-off

A clearly identified switch or circuit-breaker which will enable the power to be shut off to all dispensing units shall be provided at a location remote from any dispensing unit and easily accessible in an emergency.

NOTE: Consideration should be given to incorporating a single emergency stop that would shut off all fuel dispensing.

7.2.5 Signs

A prominent sign on or near the dispenser shall be marked in letters at least 50 mm high as follows:

STOP ENGINE—NO SMOKING

The international symbol for ‘smoking prohibited’ may be used in lieu of the words ‘no smoking’. The words ‘no flames, pilot lights or mobile phones’ may also be added.

7.2.6 Hazardous zones

The hazardous zones for dispensers as defined in the AS/NZS 2430.3 series differentiate between petrol and LP Gas so care should be taken to consider the interrelation of the two zones where both fuels are being dispensed.

7.3 DISPENSERS

7.3.1 Location

A dispenser shall be located in accordance with the following requirements:

(a) The location or protection shall be such as to minimize the possibility of damage from vehicles, boats or the like.

(b) Any dispenser serving road vehicles with flammable liquids shall be so located that any vehicle is entirely on the premises while being fuelled, and no part of the dispenser housing is less than 4 m from the boundary. The location shall permit free air movement for the dispersal of vapours from refuelling.

NOTE: This distance may be measured around a vapour barrier.

(c) Any dispenser for flammable liquid shall be located to comply with the following minimum separation distances:

(i) From any above-ground flammable liquid storage or handling facility other than a dispenser—8 m.

(ii) From any point where the bulk tank of a road tank vehicle or rail tank vehicle is being filled—15 m.

(d) Notwithstanding Clause 7.3.1(b), where a dispenser is located inside a building, it shall comply with the following:

(i) The dispenser shall be located within 1.5 metres of the vehicle entrance.

(ii) The dispenser shall be used only for the supply of vehicle fuel to a vehicle or into a container that is located on the carriageway used by vehicles entering the building by that entrance.

(iii) The nozzle shall comply with Clause 7.4.

(iv) The carriageway and area within 1.5 m of the dispenser shall be graded so that any fuel spilled during any dispensing will flow directly out from and clear of the building. The spill shall be contained on the premises.

(e) Any fixed, portable or mobile ignition source shall not be present within a hazardous zone for a dispenser as defined in AS/NZS 2430.3.3, except for a vehicle entering or leaving the dispensing area and personal equipment (e.g. hearing aids, key-ring torches, watches and pagers).

7.3.2 Drainage

Any area on which a vehicle can stand while being fuelled shall be so graded that spilled liquid will flow away from any building, and will not flow off the site. Any interceptor shall be readily accessible for inspection.

7.3.3 Dispenser bypass

Where a dispenser is provided with a bypass return pipe, it shall be arranged to return the liquid to the tank from which it is being drawn.

7.3.4 Remote pumping systems

Where a flammable liquid is supplied to a dispensing installation by means of a pump that is not located at the dispenser, the following requirements shall apply:

(a) Unless the pump is submerged in a tank, it shall be located above ground in the open, suitably weather-protected, and not less than 2 m from any boundary of the premises or on-site protected place.

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(b) The pump control system shall permit the dispenser to operate only when a dispensing nozzle has been removed from its hanging bracket, and shall stop the pump after all of the nozzles supplied from that pump have been returned to their normal non-dispensing positions.

(c) A valve incorporating a pipe-shear provision and automatic flow shut-off shall be installed at each pressurized dispenser inlet. This valve shall be securely attached to the ground. The shear provision shall be below or as near as possible to ground level.

(d) All pipelines subject to pump pressure shall be hydrostatically tested to not less than twice the maximum shut off pressure of the pump unit prior to commissioning.

Pipeline integrity and leakage shall be monitored by—

(i) hydrostatic testing at intervals of not more than 2 years; or

(ii) leak detection equipment and inventory control; or

(iii) other systems giving equivalent results.

NOTE: AIP CP4 provides guidelines.

(e) Any leak in a pressurized piping system shall be able to be readily detected.

7.3.5 Unsupervised self-service systems

Any dispenser that is operated by a customer by means of currency or other means of payment, e.g. credit card, shall comply with the requirements of this Clause (7.3.5) as appropriate, and the following:

(a) The dispenser hose shall be shorter than the distance from the dispenser to the nearest building or to the nearest boundary of an adjacent property.

(b) The area around the dispenser and the payment unit shall be lit in accordance with Clause 3.5 at all times during which the unit is available for service.

(c) The installation shall include an emergency shut-down device having the following functions or features:

(i) When activated, the emergency device shall shut off the dispenser pump and transmit an alarm to a person or organization capable of responding.

NOTE: It may also be used to release the access to the fire extinguishers (see Clause 11.9).

(ii) It shall be readily accessible, and shall be integral with or adjacent to the currency or card receptor.

(iii) It shall be protected from vandalism or unwarranted operation by a break-glass screen or equivalent.

(iv) A notice shall be displayed, giving instructions on how to operate the device in the event of a major spill or fire.

7.3.6 Supervised self-service systems

Any installation where a dispenser is operated by a customer under the observation of a central supervisor or attendant shall incorporate the following features:

(a) A control station or console, which shall be located within 40 m of each of the units, so that each unit's operation is visible to the attendant by direct vision or by means of mirrors, or other suitable means.

(b) A control console switch that can cut off the operation of all dispensers.

(c) A telephone adjacent to the control console. A list of emergency telephone numbers, including the fire brigade, ambulance services and other emergency responders shall be prominently displayed near the telephone.

Dispensers shall not be operable unless an attendant is on duty at the control console, or the installation has been switched over to operate as an unsupervised self-service system. In the latter case Clause 7.3.5 shall apply.

7.4 DELIVERY HOSES AND NOZZLES

7.4.1 Nozzle design

Where fuel to the dispenser's delivery nozzle is supplied by a pumping system, the following features shall be incorporated:

(a) The nozzle shall incorporate a device which automatically shuts off fuel flow to that nozzle when the level of the liquid in the receiving vessel reaches the end of the nozzle.

(b) The nozzle shall be designed so that fuel flow to that nozzle is shut off, and remains shut off if the nozzle is dropped onto a non-resilient surface from a height of 250 mm or greater.

(c) The nozzle shall incorporate a safety device (safety cut-out attitude valve) so designed that the fuel flow to that nozzle is shut off and remains shut off if the nozzle spout is tilted above horizontal from its normal operating position.

(d) The nozzle on any dispenser which has a value or quantity preset facility incorporated into its operation shall not be provided with a latching device.

7.4.2 Customer-operated nozzles

The delivery nozzle for flammable liquids dispenser that is intended to be operated by a customer shall not have a latching device. No item, e.g. fuel cap, keys or any other device, shall be used to hold open a customer-operated nozzle.

7.4.3 Conductivity

The delivery hose and nozzle assembly shall be capable of dissipating any static electricity charge generated during filling.

7.5 MARINE DISPENSERS

7.5.1 Application

Installations for refuelling boats shall comply with the requirements of this Section (7) where relevant, unless varied by the following Clauses.

7.5.2 Pipework

Pipework supplying an off-shore marine dispenser shall be provided with a readily-accessible emergency isolation valve at or near the shoreline. It shall be clearly marked

EMERGENCY STOP VALVE

Pipework shall have secondary containment in the form of double-walled piping with an interstitial space. All piping shall be pressure tested annually to 1.5 times the maximum working pressure. The integrity of the secondary containment shall be checked and maintained.

7.5.3 Location

Any dispenser serving boats shall be located so as not to impede entry to or exit from the boat being fuelled.

7.5.4 Nozzle

A2 Any hand-held dispensing nozzle shall comply with Clause 7.4.1 and shall not be provided with a latching device.

7.5.5 Instructions

The instructions listed in Table 7.1 shall be displayed in a prominent location where flammable liquid is dispensed.

TABLE 7.1

MARINE REFUELLING INSTRUCTIONS

Before refuelling	During refuelling	After refuelling
Check that dispensing point is equipped with fire appliances Put all passengers ashore and clear of refuelling stations Take any portable tank to be filled to a place safely clear of the boat Prohibit smoking and striking of any sparks in the area Turn off pilot lights to gas refrigerators Cut off electric power at main switch Close all hatches and the like to prevent fumes entering the hull and lying in the bilges	Maintain contact between the hose nozzle and fixed pipe to prevent static sparks Avoid any spillage, either into the boat or onto water Carefully monitor filling rate to avoid overfilling	Thoroughly clean up all spillages Open all hatches and ventilate the boat If fuel has spilt, pump out bilges (manually) and leave boat wide open for at least 30 minutes. Do not pump any spilt fuel overboard When completely satisfied that the boat is free of fumes, start the engine before allowing passengers aboard

7.6 OPERATIONS

7.6.1 Records

Inventory records of liquids received, stored and dispensed, shall be maintained and reconciled. Where any discrepancy in records indicates possible leakage, the installation shall be checked and any leaks found shall be rectified.

7.6.2 Procedures

Operating procedures shall take into account the following:

(a) The prevention of smoking or any other ignition sources within 3 m of any point where flammable liquid might be exposed, particularly when receiving or dispensing.

(b) The need to switch off a vehicle's engine while refuelling.

(c) Any possibility that vapour from a flammable liquid fill or vent pipe could reach an internal pilot flame on a campervan or caravan if the appliance vent has been badly located in relation to the filler (in such cases it is necessary to turn off the pilot before filling).

(d) The prevention of overfilling and spillage when storage tanks are being replenished.

(e) The maintenance of fill and dip caps in a liquid-tight condition.

(f) The suitability of containers being filled at dispensers for use, i.e. container condition and material, the presence of an effective cap, correct labelling. Containers shall not be filled when inside a vehicle compartment (see also Clause 7.6.3).

(g) Specific instructions that do not allow the filling of plastic containers that do not comply with AS/NZS 2906 or equivalent Standard.

(h) Risks when cleaning parts with flammable liquid.

(i) Procedures to be followed in the event of spillage, and particularly the spillage of flammable liquid on clothing.

(j) Risks when draining fuel tanks, particularly over inspection pits.

(k) Precautions for hot work on vehicle fuel tanks.

(l) Safety of electrical equipment used in pits.

(m) Floors shall not be washed with flammable liquid.

(n) Emergency clean-up equipment shall be available in case of spillage.

(o) Persons under the age of 15 years shall be prevented from operating fuel dispensers.

(p) Precautions for working in confined spaces.

(q) Training in the use of emergency equipment and maintenance of appropriate records.

7.6.3 Filling of containers at dispensers

Flammable liquids shall not be filled from a service station's fuel dispenser into a container unless—

(a) the capacity of the container is not greater than 25 L; and

A2 (b) the container complies with AS/NZS 2906 or equivalent Standard, or is substantially leakproof, metal, and has a tight-fitting closure; or

(c) the container is an approved portable fuel tank for a boat.

A2 Any container shall be on the ground whilst being filled, and not in a car boot or the back of a utility vehicle.

NOTE: Approved portable fuel tanks for boats may be filled in situ.

SECTION 8 TANK VEHICLE LOADING FACILITIES

8.1 SCOPE OF SECTION

This Section provides general requirements for installations where tank vehicles are filled, as well as, specific filling instructions. The requirements of this Section are additional to those of the ADG Code.

8.2 GENERAL REQUIREMENTS

8.2.1 Transfers

Transfers to a tank vehicle shall not be achieved by pressurization unless the entire system has been designed for the pressure and a suitable gas is used.

8.2.2 Location of fill point

8.2.2.1 *Separation from above-ground tanks*

The point of connection to the tank vehicle shall be separated from any on-site above-ground tank by the minimum distances given in Table 5.3.

8.2.2.2 *Separation from protected places*

The following distances shall apply:

(a) Where flammable liquids are loaded, a minimum separation distance of 15 m from the connection point.

(b) Where flammable and combustible liquids are loaded, a minimum separation distance of 15 m from the connection point.

(c) Where only combustible liquids are loaded, a minimum separation distance of 3 m from the connection point.

8.2.2.3 *Separation from package stores*

The following distances shall apply:

(a) Where flammable liquids are loaded, a minimum separation distance of 8 m from the connection point.

(b) Where flammable and combustible liquids are loaded, a minimum separation distance of 8 m from the connection point.

(c) Where only combustible liquids are loaded, a minimum separation distance of 3 m from the connection point.

8.2.2.4 *Separation from on-site protected places, ignition sources and security fences*

The separation distance shall be that given in the appropriate part of the AS/NZS 2430 series for hazardous zones.

At multi-tanker loading bays, vehicles other than those to be loaded shall not drive through a Zone 1 area.

8.2.3 Building requirements

Where the fill point is within a building, the building shall be open on at least three sides where flammable liquids are stored, or on two sides where C1 liquids are stored. The building shall be used solely for tanker loading.

NOTE: Any side of a building where the wall sheeting does not extend to within 2 m of the ground may be considered open for the purpose of this Clause.

8.2.4 Collision protection

A tank vehicle filling facility shall be protected against damage from vehicles and forklift trucks by a guard rail, traffic bollards or other physical barriers.

8.2.5 Vehicle access

The direction of entry of vehicles into a tank vehicle filling area shall be clearly marked.

The design of a tank vehicle loading facility shall be such that vehicles are positioned so that in an emergency, they can be driven or towed out without recourse to reversing (see also Clause 9.18.4).

8.2.6 Spillage control

8.2.6.1 *General requirements*

The tank vehicle filling area shall have a system for collecting any spilt liquid and draining it to a containment tank or compound. The following requirements apply:

(a) The vehicle standing area shall be graded so that any spillage will drain away to dedicated tank or compound and not spread to other loading areas.

(b) The surfaces of the system shall be impervious to any liquid that might be spilt.

NOTE: Concrete is a suitable material.

(c) The tank or compound in which spillage is retained shall be constructed and located in a similar manner as that described in Clause 5.8.

Alternatively, a system based on a documented risk assessment and providing an equivalent level of protection may be used.

8.2.6.2 *Capacity of spillage control system*

The capacity of the spillage control system shall be the greater of—

(a) the capacity of the largest compartment of any tank vehicle using the facility or 9000 L, whichever is less; or

(b) the maximum volume of liquid that can be discharged from the two filling points having the greatest flow over 2 min.

The capacity shall be increased where necessary to provide for rain, clean-up or output from fire protection systems.

8.2.6.3 *Drainage*

Drainage of spilt liquid from the tank vehicle filling area shall be provided. One of the following methods shall be used:

(a) Use of an isolating valve.

The isolating valve shall be kept closed at all times except when liquid is being drained.

NOTE: Drainage should be through a separator pit under controlled conditions, unless the system is designed to operate with the valve continuously open.

(b) Drainage directly to a separator pit.

The pit shall be designed for the expected flow.

(c) Drainage directly to a remote compound, tank or pump-out pit.

NOTE: Subsequent treatment should be through a separator pit.

(d) A combination of the above.

Where an isolating valve is used, it shall be clearly marked with the words:

TANK VEHICLE FILLING AREA DRAIN VALVE—NORMALLY CLOSED

and shall be marked to indicate the open and closed positions.

Separator pits shall be capable of dealing with the flow rate from the drainage system, in accordance with regulatory requirements.

8.2.7 Flow rates

The flow velocity into the compartment of a tank vehicle shall be controlled to less than 1 m per second until a minimum level of 150 mm has been reached. Maximum flow velocity thereafter shall not exceed 7 m per second until filling is nearly completed, when the flow velocity shall again be reduced to minimize hydraulic shock when filling stops.

8.2.8 Emergency shut-down

Any transfer pump shall be provided with an emergency shut-down device located in a prominent position at least 10 m but not more than 30 m from any tank vehicle filling point. It shall be clearly marked EMERGENCY PUMP STOP.

8.2.9 Earthing and bonding

Static electricity shall be dissipated during tank vehicle filling, in accordance with AS/NZS 1020.

8.2.10 Bond wire connection

The bond between the vehicle tank being filled and the filling facility shall be made with a flexible sheathed cable being at least 10 mm^2 (322/0.2) in cross section or equivalent. It shall be securely attached to the filling facility at one end and provided with a robust spring clip, G clamp, plug and socket or equivalent at the other end.

NOTES:

1 The size of the flexible sheathed cable above is unrelated to its resistance but is necessary to provide a robust flexible connection suitable for field use.

2 A flexible cable used in a system to prevent overfilling of the tank vehicle and containing a dedicated bond wire connected by a special plug and socket is an acceptable alternative.

3 The sheathing on a bond cable should be resistant to the product.

8.3 TOP-FILLING INSTALLATIONS

8.3.1 Access to vehicle tank

A platform with an anti-slip surface and an elevated grating or walkway shall be provided for each tank vehicle position and shall be provided with fall protection. Any platform over 6 m long shall have a means of egress at each end.

If handrails are suspended from the roof structure, they shall be provided on the opposite side of the vehicle tank to the access platform.

NOTE: AS 1657 provides requirements and guidance on the design, construction and installation of platforms, walkways, stairways and ladders.

8.3.2 Open-hatch filling

An open-hatch filling facility shall comply with the following:

(a) Flammable liquid transfer shall be through rigid piping extending to and in contact with the bottom of the vehicle tank compartment during the entire transfer operation. A hose shall not be used inside a vehicle compartment.

(b) Where the liquid transfer operation is controlled by a pre-set measuring device, an overriding ‘stop’ mechanism shall be provided.

(c) Where a liquid transfer operation involving flammable or C1 liquids is controlled manually, it shall incorporate a valve which is manually held open, closes upon release and cannot be locked or fixed open. Where such a valve is not of fire-safe construction and is used for loading flammable liquids, a fire-safe isolation valve should be installed within 15 m of the fill point.

NOTES:

1 Where the products being transferred are viscous, e.g. bitumen, and there are operational problems in complying with Clause 8.3.2 Item (a), the requirements of this Clause (Clause 8.3.2) need not apply. In such situations, operational safety should not be compromised.

2 A procedural alternative to Items (b) and (c), such as two-person filling, where one person controls the flow whilst the other is dedicated to fill monitoring, and both can intervene to stop the flow if necessary, may be used, but a physical means of control is preferred.

8.3.3 Tight-connection filling

Liquid transfer into a tank vehicle employing a fixed internal filling tube with leak-proof connections within the coaming area of the vehicle tank shall comply with the following:

(a) Final connection of pipework to the vehicle tank shall be rigid metal piping or a flexible hose complying with AS 2683.

(b) The requirements of Clause 8.3.2 Items (b) and (c) shall apply.

8.4 BOTTOM-LOADING FACILITIES

8.4.1 System design

A bottom-loading facility shall incorporate the following:

(a) A preset meter incorporating automatic slow-start and slow-finish controls.

NOTE: Aviation refuellers are excluded from this requirement.

(b) A dry-break coupling between the loading arm or hose and the vehicle tank.

(c) Automatic overfill protection for each vehicle tank compartment.

(d) An integrated bond cable between the pipework in the filling facility and the vehicle tank.

(e) Provision for vapour relief, accessible from ground level, which includes a means of safely discharging the vapours to atmosphere or to a vapour recovery system.

(f) Interlocks to—

(i) prevent the tank vehicle from moving whilst hoses are connected;

(ii) prevent liquid transfer if the bond wire and vapour collecting hose are not properly connected; and

(iii) prevent the liquid transfer if any one of the overfill protection devices has been tripped.

NOTE: The above Clause is not intended to apply to bottom loading of bitumen, as the nature of the product makes such loading impractical. AIP CP20 provides guidance on the loading of bitumen.

8.4.2 Compliance with AIP Code

Where appropriate, a bottom-loading facility shall comply with AIP CP6 where not otherwise dealt with in this Standard.

8.4.3 Design pressure

All components which are subject to pump shut-off pressure shall be designed to withstand a pressure not less than 1.5 times the maximum shut-off pressure of the transfer pump.

8.4.4 Flow rates

A2 The liquid transfer into the vehicle tank shall be controlled within the limits specified in Clause 8.2.7, and shall reduce the flow rate towards the end of filling to minimize hydraulic shock.

8.4.5 Overfill protection

Means shall be provided to ensure the overfill protection devices are active and to prevent liquid transfer into any compartment under fault conditions. Any faults shall be indicated by a clear visible signal.

8.4.6 Internal valve and vent control

A pneumatic system for opening and closing the internal valves and vents of each compartment shall be interconnected with the tank vehicle braking system. This is to prevent the tank vehicle being driven or moved while the internal valves and vents are open, or while any liquid transfer hose is connected to the tank vehicle.

8.4.7 Data collection

A data collection device, which incorporates some or all of the control devices required by this Section, may be provided within the bottom-loading facility provided it complies with all relevant Standards.

8.4.8 Atmospheric venting

Where vapours are discharged to atmosphere during transfer, the discharge shall be in a vertical direction from a point at least 2 m above the highest point of the roof of the filling facility or, if not roofed, 8 m above the floor of the filling facility. The separation distances given in Clause 8.2.2.2 Items (b) and (c) shall apply to the vent outlet. The vent shall be provided with flashback protection at its outer extremity.

SECTION 9 OPERATIONAL AND PERSONNEL SAFETY

9.1 SCOPE OF SECTION

This Section sets out requirements and recommendations on matters relating to operational and personnel safety. It applies to all storage other than minor storage, but the principles stated may be applied to achieve a greater measure of safety in such storage.

NOTE: Section 10 should also be consulted.

9.2 GENERAL PRECAUTIONS

9.2.1 Control of entry

In order to prevent unauthorized personnel from gaining access to the installation, a member of the occupier's staff should accompany those visitors, contractors' personnel and other persons whose duties require their entry into a restricted area. Where this cannot be done, such persons shall, before their entry into the restricted area, be given a written list of the hazards present and the appropriate precautions to be taken or undergo induction training. Any contractors working on-site shall be suitably trained (see Clause 9.10.3).

It is recognized that compliance with the above requirement is not possible where emergency services personnel have to enter unattended premises to attend an emergency. A safety information board is sufficient for such purposes.

Any restricted area shall be locked whenever it is unattended.

9.2.2 Clear access

The means of entry into and access from any area, room or building, in which flammable or combustible liquids are stored or handled shall be kept clear at all times.

At all times, access shall be available to—

(a) firefighting equipment;

(b) personal protective equipment;

(c) clean-up materials and equipment; and

(d) the place where the manifest is kept.

9.2.3 Vehicular access in restricted areas

The following requirements apply:

(a) Vehicular access to, and movement within, a restricted area shall be controlled.

(b) Vehicles shall be confined to a designated safe area unless they are suitable for use in hazardous zones.

(c) Speed limits shall be imposed where appropriate, and shall be indicated by signs.

(d) Vehicles shall be parked in designated parking places and comply with any operating and emergency procedures.

9.2.4 Vehicular access into a compound

Any vehicular access over a bund and into a tank's compound shall be kept barricaded and locked when not in use.

A2 A notice bearing the words NO VEHICLE ACCESS WITHOUT WRITTEN PERMIT, in clearly legible red lettering, 100 mm high on a white background, shall be displayed at the access point.

9.2.5 Access by locomotives

A work permit shall be issued to control the entry of any locomotives into a hazardous area.

9.2.6 Lighting

Lighting shall be provided in accordance with the following requirements and recommendations:

(a) During the hours of operation, sufficient lighting shall be provided in work areas so as to enable a person to easily read all markings on packages, signs, instruments and other necessary items. Interior lighting should be of at least the luminance specified in AS 1680.1.

(b) Sufficient lighting shall be available on any of the installation's internal roads when personnel on the premises might use them.

(c) Reference should be made to the appropriate part of AS/NZS 2430.

9.2.7 Control of ignition sources

9.2.7.1 *Introduction of ignition sources*

A work permit shall be obtained before introducing any active or potential ignition source into a restricted area.

Conditions for work permits are given in Clause 9.8.3.

9.2.7.2 *Portable electrical equipment*

Portable electrical devices shall not be taken into a hazardous area unless certified for use in such a zone or authorized by a work permit.

This is to control ignition sources such as torches, rechargeable power tools, pagers, phones and cameras, but not low-energy devices such as hearing aids or completely enclosed objects such as battery-powered watches.

9.2.7.3 *Smoking*

Smoking or the carrying of matches or cigarette lighters shall be prohibited in any hazardous area as defined by AS/NZS 2430 and within any restricted area.

Within a restricted area, any specifically designated place where smoking is permitted shall be clearly identified by SMOKING PERMITTED signs.

9.2.7.4 *Earthing and bonding*

Static electricity shall be controlled in accordance with AS/NZS 1020. Lightning protection shall comply with the requirements of AS 1768. Earthing shall comply with AS/NZS 3000.

NOTE: Bonding and earthing are often confused with each other.

Bonding connects all items where static electricity might build up. For example, a tank, pump, filling nozzle and receiving container could be connected with each other through pipes with bridged flanges, conducting transfer hoses and bonding wires and clips.

Earthing discharges dangerous currents into the ground. It is not intended to provide the continuous circuit required for bonding and should not be used to control static electricity.

9.2.8 Heated storage

Any combustible liquid that is heated and kept above its flash point shall be stored and handled in the same manner as a PG III flammable liquid.

If liquids are to be heated, controls shall be provided to prevent their heating to a temperature that could jeopardize the safety of the container or its contents.

Where liquids are heated during storage, operating procedures shall take account of the following:

(a) Where the temperature of the liquid could approach that at which cracking, decomposition, polymerization or ignition could occur, the vapour space in the container could be within flammability limits.

(b) Any water present in the container could flash to steam and cause a boilover as the boiling point is approached. Any procedures for water removal shall be followed closely.

(c) Sufficient ullage shall be allowed for thermal expansion.

(d) Vapours shall be controlled to ensure that they do not create a hazard.

NOTE: Appendix K provides a table of characteristics of common flammable liquids.

9.2.9 Site upkeep

The area within any compound or in and around any store shall be maintained in a safe condition. The following requirements apply:

(a) The area shall be kept clear of all extraneous materials.

(b) Specified clearance distances shall be maintained at all times.

(c) Packages shall not be placed where they could jeopardize entry and exit.

(d) Vegetation that could become a fire hazard shall be kept short.

(e) Any weed killer that is known to be a potential source of fire danger shall be used only with due care and precautions.

(f) Any compound drain valve shall be kept closed and locked except during supervised drainage. A notice with the words

BUND DRAIN VALVE—TO BE KEPT CLOSED AND LOCKED

shall be displayed.

(g) The walkway of any tanker loading gantry shall be kept clear of extraneous materials.

(h) Spills shall be cleaned up as soon as possible (see also Section 11).

9.2.10 Bunds and compounds

Bunds shall be maintained so as to retain their designated capacity and in a condition which will prevent the escape of liquid from the compound.

All bunds shall be kept free from extraneous combustible material, e.g. packagings, pallets, tree branches, leaves.

For earthen bunds, original height markers shall be checked regularly and the bund height maintained to those levels.

9.2.11 Doors and doorways

The following requirements apply:

(a) Any self-closing door to a store or cabinet shall not be propped open.

(b) Doorways shall be kept clear so as not to impede the closing of fire doors in an emergency.

(c) The area to be kept clear around a fire door shall be clearly marked.

9.2.12 Commissioning of new, modified or repaired equipment

No equipment or installation shall be put into service unless a hazard identification and risk assessment has been undertaken to ensure that appropriate controls are in place. In addition, appropriate operating and emergency procedures shall be available and personnel shall have been trained in the operation of the equipment, recognition of fault conditions and actions to be taken if fault conditions occur.

9.2.13 Safety information

Material safety data sheets (MSDSs), describing the properties of the liquids being kept or handled in the installation and the appropriate first aid measures for them, shall be readily accessible.

9.3 OPERATING PROCEDURES

9.3.1 General requirements

Safe systems of work, including procedures commensurate with the quantity and nature of the liquids being kept, shall be developed, documented and implemented.

Written procedures shall be appropriate to the installation and shall include the following:

(a) A site plan (or plans) indicating tanks, plant, main pipework, switchboards or substations, emergency stop valves or actuating devices, fire protection systems and drainage.

(b) Operating procedures, covering all aspects of the day-to-day operation of the installation.

(c) Maintenance procedures, covering regular testing, inspection and monitoring of the equipment.

(d) Emergency procedures, covering actions to be taken in the event of fire, spillage, accident, equipment failure or other abnormalities or emergencies (see also Section 10).

(e) Construction and maintenance procedures, covering new facilities and repairs to and modification of existing plant.

NOTE: Many states have occupational health and safety legislation that provides for consultative mechanisms at workplaces, enabling management and workers to be jointly involved in the development of procedures and work practices.

Procedures shall be documented in notices, manuals or other recorded instructions as appropriate to the particular installation. They shall be either on view or readily available on site.

All personnel shall be trained in appropriate procedures (see also Clause 9.10).

All personnel shall comply with the procedures established for the installation. An audit system should be established to ensure compliance.

Procedures shall be regularly reviewed and modified as necessary, particularly following any equipment or organizational changes.

9.3.2 Operating procedures

Operating procedures shall include, but not be limited to, the following as appropriate:

(a) Initial commissioning procedures.

(b) Normal handling procedures.

(c) Liquid transfer procedures.

(d) Monitoring of essential functions and components.

(e) Control of hazards, including ignition sources.

(f) Manufacturer's operating instructions for equipment.

(g) Earthing and bonding.

(h) Fault conditions.

(i) Housekeeping and site upkeep.

(j) Isolation, deactivation and identification of equipment not in use.

(k) Maintenance of clear spaces for access.

(l) Management of leakage, spillage and clean-up.

(m) Personnel safety and protective equipment.

(n) Environmental monitoring.

(o) Operation of utilities.

(p) Fire protection systems.

(q) Control of access, movement and activities.

9.3.3 Construction and maintenance procedures

These procedures shall include the following, as appropriate:

(a) Work authorization, including the issuing of work permits.

(b) Work in confined spaces.

(c) Testing of instrumentation, protective devices, alarms and monitors.

(d) Isolation and tagging of equipment.

(e) Control of contractors.

(f) Firefighting equipment.

(g) Pipework.

(h) Storage tanks.

(i) Drainage systems and any separators.

(j) Bunds.

(k) Electrical equipment.

(l) Ventilation systems.

(m) Fences and security.

(n) Lighting.

(o) Signs and notices.

(p) Plant components, e.g. pumps, fans, package filling equipment.

9.3.4 Emergency procedures

Documented emergency procedures and first aid procedures shall be prepared in accordance with Section 10 and Clause 9.13.

9.4 MANAGEMENT OF LEAKS AND SPILLS

9.4.1 General

Every endeavour shall be made to prevent leaks or spills, and to control them if they do occur. Clean-up action shall be initiated immediately. Leaked or spilled liquids shall be kept and disposed of in accordance with Section 12.

9.4.2 Clean-up materials and equipment

In order to deal with leaks and spills, clean-up equipment, chemicals for neutralizing or decontaminating spills, and absorbent materials shall be kept at premises on which flammable or combustible liquids are kept or handled. Sufficient neutralizer should be available to treat the contents of the largest container kept.

The following is a typical list of such materials and equipment:

(a) Adequate quantities of absorbent material, e.g. sand, fuller's earth or suitable proprietary substances.

(b) Calcium hydroxide (hydrated lime), sodium carbonate (soda ash) or crushed calcium carbonate (limestone), for use on acidic spills.

(c) Sodium bisulfate, for use on alkaline spills.

(d) A sufficient number of resealable waste-recovery containers, e.g. drums, made of materials compatible with the substances being kept and appropriately marked as being for emergency use only.

(e) Portable pumps and decanting equipment.

NOTE: Petrol-powered or non-flame proofed electric pumps are unsuitable for use with flammable liquids.

(f) Shovels.

(g) Yard brooms.

(h) Booms (on-ground and floating).

(i) Drain covers and drain plugs.

Any absorbent material containing flammable liquids or products from any neutralizing reaction are normally regarded as wastes but might still be classified as dangerous goods. In such cases they shall be disposed of in accordance with Section 11 of this Standard and in compliance with local and State or Territory law.

NOTE: It is unlikely that such wastes could be disposed of with general garbage destined for landfills.

9.4.3 Actions for dealing with leaks and spills

At every occurrence of a leak or spill, the emergency plan should be implemented and consideration should be given to notifying the emergency services.

Emergency services should be notified when—

(a) the liquids have spread, or have the potential to spread, beyond the boundary of the installation;

(b) it is beyond the resources of the of the occupiers to clean up the spill or leak effectively and safely;

(c) the protective equipment is inadequate for dealing with the situation;

(d) staff are not experienced in dealing with the situation; or

(e) staff and the public are, or could potentially be, placed at risk.

Leaking packages should be positioned in such a manner as to stop or minimize the leak and, if necessary, should be moved to a safe location. The package should either be placed in a suitable container, e.g. an oversize drum, or its contents should be transferred to a clean packaging. The exterior of such a clean packaging should be clearly labelled.

Small spills on the floor, or on the walls or structures of a building, should be collected, absorbed, or diluted. as appropriate. Where spills are absorbed, the used absorbent should be placed in a suitable waste container for disposal in accordance with Section 12.

9.5 PLACARDING

9.5.1 Placarding of stores

Every installation in which flammable liquids are kept shall be placarded in accordance with NOHSC:1015. Signs and placards shall comply with Clause 3.8.2 and shall be maintained so as to be legible.

Placarding shall reflect the actual storage situation at any given time and shall be amended without delay.

These additional signs shall have lettering that contrasts with the background and be clearly legible from any access point. Unless otherwise required, signs shall comply with AS 1216 and AS 1319. Composite signs or graphic symbols complying with these requirements may be used.

9.5.2 Safety information

Safety information, intended principally for emergency services, shall be provided. The following information should be included:

(a) The location of the emergency plan.

(b) The location of the manifest.

(c) The location of personal protective equipment and clean-up equipment.

(d) The location of essential services and of the controls for their distribution.

Such information shall be available at the site's main entrance and at least one other entrance if there is more than one access point.

NOTE: This information may be provided on a safety information board. A pictorial layout of the site may also be required.

9.6 LIQUID TRANSFER

Quantities of flammable liquid exceeding 5 L should not be transferred from storage to point of use in open containers. Transfer should be made in closed containers or in purpose-made containers that are suitable for the liquid.

9.7 EFFLUENT CONTROL

Effluent control shall be provided in accordance with regulatory requirements.

9.8 CONSTRUCTION AND MAINTENANCE WORK

9.8.1 General

Construction or maintenance work shall not be carried out in any store or cabinet in which flammable or combustible liquids are kept, except with written authorization from a person designated for the purpose by the occupier of the premises.

When contemplating such work, the effect of carrying it out shall be evaluated. Where there is any doubt about the safety of the intended procedures, the flammable or combustible liquids shall be moved to another location before the work is commenced.

When maintenance work is to be carried out on equipment from an area where liquids are kept, such equipment shall be checked to ensure that no flammable or hazardous vapours or residues remain, prior to the maintenance work being carried out.

9.8.2 Routine work

Any routine, non-hazardous work shall be supervised in such a manner so as to ensure its safe conduct.

9.8.3 Work permit

Except for routine, non-hazardous work, any work within the restricted area shall be authorized by means of a work permit.

A work permit shall include statements of the following:

(a) The nature and extent of the work.

(b) Any conditions to be observed.

(c) Any personal protective equipment to be used.

(d) The period for which the permit is valid.

(e) Any necessary regular checking to ensure that the safety requirements and conditions remain in force, e.g. atmospheric monitoring.

(f) Any necessary procedures and precautions in returning the area to normal service.

(g) Any firefighting equipment required to be at hand.

A work permit may identify, within the restricted area, an open area in which major maintenance or construction work can be performed without further permission. Such an area shall be determined in relation to any storages and plant so that the unrestricted use of ignition sources does not create a hazard. The physical limits of such an area shall be clearly marked.

Considerable care is still required in a safe area, as some articles might contain residues or might be hazardous in themselves, regardless of their location. Examples of such articles are used tanks, pipes and containers.

9.8.4 Preparation of work site

The relevant site area and plant shall be prepared in a way that reduces the potential for fire, explosion, or exposure of persons to a hazardous substance.

Precautionary measures shall include the following, as appropriate:

(a) Identification of both the equipment to be worked on and other affected equipment.

(b) Depressurization and disconnection of such equipment.

(c) Isolation and locking-off of the equipment from other equipment.

(d) Purging of the equipment.

(e) Where the work to be carried out may impact upon hazardous substances, the removal of those substances from the immediate vicinity.

(f) Sealing-off of sewers.

(g) Provision of appropriate fire-protection equipment.

(h) Testing of the work environment for flammable or hazardous vapours and oxygen content.

9.8.5 Completion of work and commissioning

When the work is complete, and before the plant is returned to service, a check shall be made to ensure that—

(a) the work has, in fact, been completed;

(b) any temporary arrangements (e.g. bypass lines, blank flanges) have been removed;

(c) all personnel and equipment are accounted for;

(d) the work permit has been cancelled or signed-off as being completed; and

(e) all related equipment and facilities, including bunds, scrubbing systems (where relevant) and fire systems are operational and have been inspected and tested appropriately.

9.8.6 Hot work

9.8.6.1 *General*

Any work involving cutting or welding by gas or electric arc or any non-welding work of equivalent risk (e.g. grinding, drilling, the use of percussion tools) shall not be undertaken within a restricted area unless—

(a) a work permit has first been obtained; and

(b) any flammable or hazardous residues or vapours have been removed.

The requirements of the AS 1674 series shall be observed in relation to any hot work undertaken.

9.8.6.2 *Hot tapping*

When a connection is to be welded to a tank or pipe containing flammable or combustible liquid and the tank or pipe cannot be isolated or gas-freed, hot-tapping procedures shall be carried out in accordance with a documented procedure authorized by a person experienced in the design of hot taps. Hot tap operators shall be trained in their use.

NOTES:

1 Hot taps on tanks can carry particular risks and need to be carried out in accordance with API 653.

2 When combustible-gas detectors are used for gas-free testing, the presence of toxic residues may not be indicated.

A1 3 Where hot work is involved, particular attention should be paid to scale, rusts, coatings or deposits that could decompose or generate volatile products upon heating. The use of combustible gas detectors for gas-free testing will not indicate the presence of such deposits.

9.8.7 Work inside a confined space

The requirements of AS/NZS 2865, including the issuing of a work permit, shall apply whenever a person is to enter or work in a confined space.

9.8.8 Grass cutting

Any use of a grass cutter in a restricted or hazardous area shall be covered by a work permit and shall be subject to the following conditions being observed:

(a) No flammable or combustible liquids shall be transferred while the grass is being cut.

(b) There shall be no leaks, spills or pools of liquid on or near the area to be mowed. Any such occurrences shall be cleaned up prior to mowing (see also Clause 9.4).

(c) Grass cutting shall not be carried out within 3 m of any open-topped separator pit.

(d) Tank valves shall remain closed.

(e) Grass shall not be cut in still weather conditions.

NOTE: Air movement will assist vapour dispersal.

(f) The lawn shall be thoroughly inspected and any foreign objects that could contact the cutting blades shall be removed prior to mowing.

(g) The grass cutter shall be checked prior to use to ensure it is in good condition.

NOTE: The check should ensure that—

(a) the blades are securely attached;

(b) the spark plug lead is securely fastened and fully insulated; and

(c) the muffler is in good condition and generally free from rust particles.

9.9 GAS-FREEING OF TANKS AND PACKAGES

9.9.1 General precautions

The general safety measures set out below shall be observed when gas-freeing tanks, irrespective of the method employed. These procedures shall be applied where appropriate to the gas-freeing of packages.

(a) The tank shall be emptied and cleaned as far as is possible before gas-freeing is commenced.

(b) No ignition source shall be permitted in the hazardous zone (as defined in AS/NZS 2430) while the tank is being gas-freed.

(c) Any electrical equipment shall be of a type certified for use in a hazardous location.

(d) The danger of ignition of any pyrophoric materials when air is admitted to the tank shall be taken into account.

Precautions to be observed when gas-freeing with air, water, steam and inert gas are given in Appendix L.

9.9.2 Effective completion

Any technique used to gas-free a space or container shall be sufficiently effective and shall continue for sufficient time, to ensure that the concentration of flammable vapour is nominally nil, but does not exceed levels for the work or tasks to be completed safely. For confined space entry, the levels specified in AS/NZS 2865 shall apply.

Additionally, if any person is required to enter the space, the concentration of any vapour shall be below workplace exposure levels unless appropriate personal protective equipment (PPE) is provided.

9.10 PERSONNEL TRAINING

9.10.1 Job knowledge

All personnel handling flammable or combustible liquids on the premises shall be made fully conversant with —

(a) the means of identifying the liquids and the properties of the specific substance handled, by reference to the relevant material safety data sheet (MSDS); and

(b) applicable safety regulations and safe-handling procedures.

9.10.2 Training

Personnel employed on the premises shall be trained as appropriate, in —

(a) the nature of the work and safe methods of operation;

(b) the properties and hazards of the substances handled;

(c) the location of first aid equipment, and first aid measures to be taken;

(d) the correct use of personal protective equipment, its care and maintenance;

(e) actions (including evacuation procedures) to be taken in various emergencies, including spills, gas escape, fire and explosion;

(f) control measures in place at the facility; and

(g) the content and operation of the safety management system.

Simulated emergency exercises shall comprise part of the training (see also Section 10).

9.10.3 Contractors

Contractors and their staff shall be trained in the following, as appropriate to the specific task to be performed:

(a) The safety rules of the installation, including any restrictions on movement, access, activities and use of personal protective equipment.

(b) Conditions and obligations associated with work permits and confined space entry permits.

(c) Hazards likely to be encountered, including any materials stored or handled on the site.

(d) Procedures to be followed in the event of any incident, e.g. spillage, accident or fire.

9.10.4 Refresher training

Training procedures shall include provision for refresher training at sufficient intervals to ensure that capability is maintained.

9.10.5 Hygiene

All persons whose work involves handling flammable or combustible liquids shall comply with the following directions:

(a) Do not introduce, keep, prepare or consume any food or drink, or use tobacco, in any area where the liquids are kept or handled.

(b) After handling any liquids, always wash your hands before eating, drinking, smoking or using the toilet, and after work.

(c) Immediately attend to injuries caused by contact, or suspected contact, with the liquids.

The above directions, or wording to the same effect, shall be prominently displayed in the work area.

9.11 RECORDS

Records shall be kept of the following:

(a) Training and retraining (permanent record).

(b) Equipment tests required by this Standard and its referenced documents.

(c) In-service inspections (life of installation).

(d) Drills (six years).

(e) Maintenance and repairs (life of installation).

(f) Fires, significant spillage, accident, injury, dangerous occurrence or other incident (life of installation).

NOTES:

1 The suggested periods for the retention of records are given in parentheses.

2 Regulations may require differing periods for the retention of such records.

9.12 PERSONAL PROTECTIVE EQUIPMENT

9.12.1 General

Where flammable or combustible liquids are kept or handled—

(a) all persons on the premises shall be provided with appropriate personal protective equipment;

(b) personal protective equipment shall be kept in designated, well-identified locations and ready for use; and

(c) all personal protective equipment shall be maintained in good condition.

9.12.2 Type of personal protective equipment

The following personal protective equipment shall be provided, as appropriate to the operational requirements of the site:

(a) Protective clothing complying with AS 2919, AS 3765.1 or AS 3765.2, and suitable for use with the specific liquids being handled.

(b) Eye protection, selected in accordance with AS/NZS 1337.

(c) Protective gloves complying with the relevant parts of the AS/NZS 2161 series of Standards.

(d) Safety helmets complying with AS/NZS 1801 and selected in accordance with AS/NZS 1800.

(e) Safety footwear complying with AS/NZS 2210 (series).

(f) Respirators having appropriate filters, and self-contained breathing apparatus (SCBA) complying with AS/NZS 1716 and selected, used and maintained in accordance with AS/NZS 1715.

NOTE: MSDS may provide further information on suitable personal protective equipment.

9.12.3 Care and maintenance of personal protective equipment

Personal protective equipment shall be kept separate from normal clothing. Maintenance of personal protective equipment and clothing shall be as follows:

(a) After use, all personal protective equipment shall be maintained, cleaned and kept in accordance with the manufacturer's instructions, and as appropriate to the materials to which it has been exposed.

(b) Safety helmets shall be maintained in accordance with AS/NZS 1800.

(c) Respirators and self-contained breathing apparatus shall be maintained in accordance with AS/NZS 1715.

9.13 FIRST AID

A first aid station shall be provided in a clean area. It shall comprise, as a minimum, an appropriate first aid kit and first aid instructions, e.g. MSDS, for the liquids being kept or handled on the premises.

It is recommended that—

(a) at least one person on the premises is trained in first aid; and

(b) a list of persons trained in and responsible for administering first aid should be kept at the first aid station and displayed on notice boards throughout the premises.

NOTE: Occupational health and safety regulations also apply.

9.14 ADDITIONAL REQUIREMENTS FOR THE STORAGE AND HANDLING OF PACKAGES

9.14.1 Suitability of packagings

9.14.1.1 *Flammable liquids*

Where packaged flammable liquids are to be transported, their packaging shall comply with regulatory requirements.

Where the packaging is only for use at the premises at which it is filled, it shall be—

(a) constructed with sufficient strength and durability for such service;

(b) constructed such that all components of the packaging that could come into direct contact with the liquid are compatible with the liquid; and

(c) marked in accordance with OHS regulatory requirements.

9.14.1.2 *Combustible liquids*

Packages for combustible liquids shall be constructed with sufficient strength and durability for their intended service and of material that is compatible with the liquid to be contained.

9.14.2 Marking of packagings

Packages containing flammable or combustible liquids shall be marked in accordance with the relevant Australian State or Territory legislation.

NOTE: Labelling in compliance with the ADG Code, NOHSC:2012 and the SUSDP may be required under such legislation.

9.14.3 Stacking of packages

For safe stacking, block stacks shall be restricted in height, having regard to the load bearing ability, design and quality of the package, e.g. sole or combination packaging. Other considerations include—

(a) the method of stacking;

(b) the design of the stacking; and

(c) the safe working load of the pallets.

If it is possible for packages to fall outside the compound, restraints shall be provided.

9.14.4 Housekeeping

The following housekeeping procedures shall be established and maintained:

(a) The aisles of the store shall be kept clear.

(b) In order to prevent the accumulation of old stock that could deteriorate and become a hazard, stock integrity shall be monitored.

(c) All packages shall be handled with care so that the possibility of leaks is minimized.

(d) Packages shall be regularly inspected and when any signs of spill, leak or deterioration are observed, the suspect package shall be examined and rendered safe.

(e) Minor spills or leaks shall be dealt with in accordance with Clause 9.4.

(f) Labels shall be retained on emptied packages until the packages have been gas-freed or decontaminated, at which time the labels shall be removed or obscured.

9.14.5 Used packagings

9.14.5.1 *General*

Packages that have been partly or completely emptied of liquid shall be re-closed unless they have been decontaminated or gas-freed.

Partially empty packages (not including those that are nominally empty) shall be stored and treated as though they were full.

9.14.5.2 *Nominally empty packagings*

Packagings that are nominally empty (i.e. they might contain vapour or small amounts of liquid) shall be stored in compliance with the following requirements:

(a) The location of the stored packages in relation to any boundary or structure shall provide for clear access not less than 1 m wide all around for site upkeep.

(b) Storage areas for empty containers shall be identified.

(c) Packages that are exposed to the weather shall be monitored for corrosion. Severely corroded packages shall be disposed of safely.

(d) Spillage containment shall be provided for environmental reasons. Bunding is not necessary.

9.14.6 Process feedstocks and finished products

The storage of flammable liquids within a process area shall be limited to—

(a) no more than two pallet loads or an aggregate quantity of 3200 L (i.e. two IBCs of up to 1.6 m^3 capacity each) adjacent to the process; or

(b) not more than 12 h supply, whichever is the greater, except where the flammable liquids are stored in a separate area that complies with this Standard.

Finished packages shall be cleared regularly throughout the shift. Any accumulated finished packages shall not exceed the output of one working shift.

NOTE: Appendix M provides additional recommendations for batch blending.

9.14.7 Handling precautions

The following precautions shall be observed when handling packaged liquids:

(a) Packages shall be handled in a manner that will reduce the likelihood of spills and leaks.

(b) Appropriate personal protective equipment (PPE), as specified in the appropriate material safety data sheet (MSDS), shall be available for use.

(c) Where packages or IBCs are to be palletized, they shall be protected from the possibility of punctures or tears caused by splinters or nails in the pallets.

(d) All movement of packages shall be subject to manual handling risk controls for the packages concerned.

(e) Packages shall not be pressurized in order to transfer their contents.

9.14.8 Opening of packages

Sole or inner packagings shall not be opened inside a package store unless for the purposes of sampling, tinting, testing or inspection. Any package that has been opened shall not be returned to the storage area unless it has been securely closed.

9.14.9 Mechanical ventilation

Where mechanical ventilation is installed, the following procedures shall be established:

(a) The times for starting, stopping and operating the system.

(b) Procedures to be followed if the ventilation fails or needs to be shut down.

(c) Any restrictions on activities adjacent to the ventilated areas, particularly when the ventilation is not working.

9.15 ADDITIONAL REQUIREMENTS FOR PIPING AND VALVE SYSTEMS

The following procedures shall be established:

(a) Procedures for safe operation of piping, taking into account the nature of the liquid being handled.

(b) Avoidance of the possibility of liquid being locked-off in a section of piping that does not have pressure relief, unless thermal expansion is unlikely.

NOTE: Non-return valves, blinds, spades and positive displacement pumps can have the effect of closed valves.

(c) Any valve that is intended to isolate a hydrostatic relief valve shall be secured in the open position while the hydrostatic relief valve is in service.

9.16 ADDITIONAL REQUIREMENTS FOR PIPEWORK

Procedures for the installation and maintenance of any pipework within an installation shall be established. They should take into account—

(a) the nature, pressure and temperature of the liquids;

(b) inspection and testing;

(c) flow rates;

(d) pressure relief;

(e) draining and recommissioning;

(f) earthing and bonding;

(g) supports;

(h) blanking off and isolation;

(i) freedom from leakage, undue movement, vibration and corrosion; and

(j) correct and legible identification.

9.17 ADDITIONAL REQUIREMENTS FOR TANKS

9.17.1 Inspection and maintenance of tanks, tank vents and fittings

Tank vents and fittings shall be inspected regularly, to ensure that pressure/vacuum (P/V) and emergency vent passages are clear and any relief valves are operating correctly. Such inspections shall be carried out at least annually or as necessary.

Where long bolt manhole covers or flanges are used, consideration should be given to the prevention of water ingress to the tank and corrosion between the flange faces. Measures shall be taken to ensure that the long bolts cannot be tightened down at a later date.

For tanks with integral secondary containment, procedures shall be in place to maintain the primary tank. These should include regular inspection of the tank and its fittings, and the checking for and removal of water from the primary tank.

Tank containers shall be regularly checked to ensure their integrity.

Valves shall be overhauled completely at periods not exceeding 10 years. Valves for Category 6 tanks shall be overhauled at least at each floor inspection. Table 9.1 provides inspection frequencies for tanks, valves and fittings for tanks of Categories 5 and 6.

Maintenance inspections may be varied (i.e. more or less frequent) if a proven maintenance management system is in place and operating. The frequency of inspections may be varied if the following prerequisites are in place:

(a) An auditable maintenance management system has been in place and operating effectively at the installation for at least 5 years. Records are available for this time.

(b) Plant safeguard systems and critical alarms are listed and managed as part of the system.

(c) A system for monitoring, review and improvement is in place.

(d) For internal tank inspections, at least two floor inspections have been conducted, approximately 10 years apart, or over a period of time as varied as given below, without alteration to the tank floor. If floor plates have been replaced, then the previous inspection data shall not be used and data collection recommenced.

The interval between such inspections may be increased to a maximum of 20 years between internal floor scans if—

(i) the last of the internal scans and inspections has shown that the calculated corrosion rate will satisfy the requirements of API 653 with regard to the thickness of the floor plate at the end of the inspection period;

(ii) there has been no change to product allocation or specification that could alter the corrosion rate; and

(iii) there has been no change to operating conditions.

NOTES:

1 Magnetic flux leakage floor scanning is the preferred method of floor inspection.

2 A properly engineered tank inspection and maintenance program should take into account—

(a) the tank design and its liquid contents;

(b) inspection and maintenance history;

(c) soil conditions and foundation or berm construction;

(d) site experience with underfloor corrosion;

(e) the application and monitoring of cathodic protection;

(f) stray currents (which can protect tank floors, giving a false idea of underfloor corrosion potential);

(g) surface coatings;

(h) temperature;

(i) methods of heating;

(j) the presence and type of insulation;

(k) tank settlement history

(l) other safeguards, e.g. ground water monitoring, location of facility, bunding; and

(m) the inspection methods used.

3 Table 9.1 provides inspection frequencies for Categories 5 and 6 tanks and their components. This does not form a complete specification for tank inspection, and sites without the necessary experienced engineering back-up will need to seek advice on the implementation of an inspection and maintenance program. New inspection technology may be used, provided it is properly evaluated and its limitations understood and taken into account when evaluating the results obtained.

TABLE 9.1

TANK INSPECTION SCHEDULE FOR CATEGORIES 5 AND 6 TANKS

Part of tank	Minimum inspection type	Standards	Purpose	Tank category	Maximum interval between inspection
Tank shell	Non-destructive testing	AS 2452.3	To prove continued structural integrity of the tank and ensure minimum plate thickness (see also Clause 9.17.1)	6	10 years
Other structural members					
Floor plates					
Roof plates					
Whole tank, including floating roof seals	Visual	API 653	To check for shell deformation, tilting and floating roof operation	5 and 6	Monthly
Valves and vents	Visual	AS 1940 (this Standard	To ensure that fittings are operating correctly	5 and 6	Monthly
	Remove and test	AS 1692 API 2000			10 Years
Other fittings and appurtenances	Visual	AS 1940 (this Standard)	To ensure that fittings are sound and operating correctly	6	Quarterly
External foundations and tank supports	Visual	API 653	To check for erosion, settlement and structural deterioration	5 and 6	Yearly
Internal and external floating roof seals	Physical	API 653	To ensure that seal performance is within acceptable limits	6	10 years
Cathodic protection	Physical	AS 2832	To ensure that cathodic protection, if provided, is effective	6	10 years
Level controls	Physical	AS 1940 (this Standard)	To ensure that all alarms and shutdown mechanisms, if fitted, are operating correctly	6	6-monthly

NOTES:

1 Ultrasonic testing of tanks for structural integrity and thickness should be in accordance with AS 2452.3.

2 Visual inspection refers to an visual examination of the tank parts while physical inspection refers to visual inspection and appropriate tests to confirm the function and condition of the parts and identify any weakness, deterioration or faults.

3 Reference should be made to API 653 and API 2000.

4 Where tank integrity can be demonstrated by a documented risk-based approach, these periods may be extended.

5 Further guidance may be found in AIP CP16.

9.17.2 Inspection and maintenance of Categories 5 and 6 tanks

9.17.2.1 *General*

Any Category 5 or 6 storage tank, its foundations and fittings, shall be kept in a serviceable condition while the tank is in use. A permanent record of inspection and testing shall be kept. Table 9.1 specifies inspection and testing frequencies for Category 5 and 6 tanks.

NOTE: AIP CP6 should be consulted.

9.17.2.2 *Repair of defects*

Where defects create local stresses that exceed the allowable limits, the tank shall not be operated unless either—

(a) the tank is repaired; or

(b) the filling level is limited to ensure that stresses are not exceeded and controls are in place to ensure that the tank is not filled past its revised filling level.

9.17.2.3 *Limited filling height*

Where a tank can only be operated with a limited filling height as determined under Clause 9.17.2.2 (b), the following provisions shall apply:

(a) The structural strength of the tank has been evaluated by a suitably qualified engineer.

(b) The limited filling height does not stress the weakest part of the tank beyond allowable design limit.

(c) Any testing or inspection is carried out by non-destructive examination of the shell plates and welds, taking into account any pitting, grooving or other imperfections.

(d) Sufficient measurements of metal thickness have been taken and the minimum effective thickness of each strake has been determined.

(e) Records of measurements and engineering details in Items (a) to (d) above are maintained in accordance with regulatory requirements.

9.17.2.4 *Repairs*

Any repairs shall restore the tank to a design standard for its proposed service.

9.17.2.5 *Hydrostatic testing*

After any structural repairs and prior to its return to service, the tank shall be hydrostatically tested in accordance with AS 1692. Hydrostatic testing is not required following minor repairs or repairs to fittings.

9.17.2.6 *Floor plates*

For Category 6 carbon steel tanks built to AS 1692 sufficient measurements of floor plate thickness shall be taken to ensure that the minimum thickness has been determined. Where the effective thickness at any point is less than 4 mm, the floor plate shall be repaired to a condition fit for service.

For tanks constructed from other materials, a design safety review shall be carried out.

9.17.3 Inspection and maintenance of Categories 1 to 4 tanks and tank containers (ISO tanks) used as static storage

Procedures shall be established for the inspection and maintenance of tanks of Categories 1 to 4, taking into consideration—

(a) the condition of foundations and supports;

(b) the integrity of the tank shell and tank floor;

(c) serviceability of fittings, valves, vents and lines;

(d) condition of welds, paintwork and surface condition; and

(e) integrity of cathodic protection, if fitted.

For underground tanks, Items (a) to (d) do not apply.

Underground systems shall be maintained in accordance with AIP CP4.

9.17.4 Emptying tanks

Where a portable pump is used to empty a tank for cleaning, repair or other purposes (e.g. taking the tank out of service for a short time), the following conditions shall apply:

(a) The procedure is temporary and is covered by a work permit.

(b) Where the pump is in a hazardous zone or is pumping flammable liquid, the pump shall be suitable for use in the hazardous zone, e.g. powered by air or steam, or manually or hydraulically driven.

Where electric motors or diesel engines are used, they and their associated cabling, control gear and equipment shall be suitable for use in hazardous zones.

(c) Portable pumps and hoses shall be earthed and bonded to dissipate static electricity.

The danger of ignition of any pyrophoric residues shall be taken into account when emptying a tank. The possibility of spontaneous ignition should not be overlooked; it might occur hours or even days after the materials have dried out.

9.17.5 Isolation of a tank

Any tank that is to be cleaned or repaired shall be isolated physically from any other tank or pipeline by—

(a) removing a section of pipeline and blanking off the upstream connection; or

(b) inserting a blank flange, as close as possible to the tank.

The tank shall also be isolated from any common vapour recovery system to which it is connected.

Closing a valve is not in itself an acceptable method of isolation. The isolation of a tank shall be covered by a work permit.

9.17.6 Disused tanks

An underground tank that has been taken out of service shall be either—

(a) removed; or

(b) completely filled with an inert solid material (e.g. sand, concrete).

All pipes shall be disconnected and removed from the tank, drained and the open ends sealed off.

NOTES:

1 AIP CP22 provides further information regarding taking tanks out of service.

2 Additional EPA requirements may apply. The appropriate authority should be consulted.

9.18 BULK TRANSFER

9.18.1 General requirements

Safe filling and emptying procedures for tanks and tankers shall be established on the basis of the following requirements:

(a) A safe filling level that allows for thermal expansion shall be established, and shall not be exceeded.

(b) Filling and emptying flow-rates for which the tank vents were designed shall not be exceeded.

(c) Filling shall be monitored and controlled so as to prevent the occurrence of overflow, spillage, or excessive pressure in the tank.

(d) The recommendations of AS/NZS 1020, and the requirements of the ADG Code shall be observed wherever applicable.

9.18.2 Control of static electricity

The requirements of AS/NZS 1020 and AIP CP8, as appropriate, shall be observed when transferring flammable or combustible liquids into any container or tank to control and safely dissipate any static electricity generated during the operation.

9.18.3 Continuity testing

Tests shall be carried out at intervals of not more than six months to ensure that earthing and bonding is effective and that the resistance between a vehicle tank and earth is not greater than 1 MΩ.

9.18.4 Restrictions on vehicles in tank vehicle filling facilities

The following restrictions apply to vehicles in filling facilities handling flammable liquids:

(a) A tank vehicle shall be positioned at all times so that in an emergency it can be driven or towed straight out without recourse to reversing.

(b) The tank vehicle should be driven forward into the tank vehicle filling area rather than being backed in. Where the layout makes this impossible, so that reversing is unavoidable, a person shall be stationed to guide the driver while reversing.

(c) No vehicle, including tank vehicles, shall be maintained or serviced whilst in the tank vehicle filling facility except for the refuelling of the vehicle running tank.

(d) No vehicle, other than a tank vehicle, a vehicle associated with maintenance of the filling facility or an emergency services vehicle, shall be permitted to pass through or stand in a dedicated vehicle filling facility, consisting of two or more filling positions.

(e) A tanker containing product shall not park or stand in or under a filling facility other than when filling or draining.

(f) Where a flammable liquid spill occurs at the filling facility while a tank vehicle is standing therein, the vehicle engine shall not be started until the spill has been satisfactorily cleaned up, except in the case of an emergency.

The requirements of Items (c) and (d) may be varied by the use of a work permit.

Where a filling facility has been constructed for combustible liquids only and it is separated from a flammable liquid filling facility by more than 15 m, the requirements of Items (d), (e) and (f) shall not apply.

9.18.5 Bottom loading

A tank vehicle shall not be used for bottom loading unless it is constructed specifically for that purpose and complies with AS 2809.2 and AIP CP6 as appropriate.

When an overfill protection system either fails to operate or senses an overfill condition during a bottom loading operation, the overriding or bypassing of the system shall be authorized and supervised by a supervisor and then only to permit the compartments being loaded to be shut down and the tank vehicle removed. The bottom loading facility shall not be reactivated until any fault condition in the system or on board the tanker has been rectified.

9.18.6 Top filling

9.18.6.1 *General*

The following requirements shall apply when a tank vehicle is being top-filled through either a fixed internal filling tube or an open hatch:

(a) Where a compartment is being filled without the use of a preset stop meter, a person shall only control the filling of a single compartment.

NOTE: A hatch or other opening to the compartment being filled may be left open during the liquid transfer operations to ensure the compartment is not filled beyond its safe filling level after allowing for drainage of the filling hose or piping.

(b) No hatch or opening to any other compartment of the tank vehicle shall be open during the liquid transfer operation other than those compartments being filled.

(c) All openings to a compartment just filled shall be closed before opening any other compartment of the same tank vehicle.

(d) Any pipework or flexible hose shall be drained into the compartment just filled prior to disconnecting from the vehicle tank unless fitted with a dry-break coupling.

9.18.6.2 *Filling through an open hatch*

The following requirements relate specifically to filling through an open hatch:

(a) Any rigid filling tube shall be kept in physical contact with the side of the hatch opening at all times during the liquid transfer operation and touch the bottom of the compartment. A hose shall not be used inside a compartment for filling.

(b) On completion of the filling of a compartment a minimum time of two minutes shall elapse, then the rigid tube shall be carefully removed to permit complete draining and the avoidance of any spillage outside the hatch opening unless the tube is permanently fitted. (Refer to AIP CP8.)

9.18.7 Switch-loading

When a flammable or combustible liquid is to be filled into a vehicle tank compartment which had previously contained a liquid having a lower flash point, the precautions outlined in AIP CP8 shall be followed.

SECTION 10 EMERGENCY MANAGEMENT

10.1 SCOPE OF SECTION

This Section sets out requirements and recommendations on planning for emergencies. It applies to stores where the volumes of liquid stored are greater than minor storage, or as given in NOHSC:1015. However, this Section may be regarded as advisory for minor storage or those storages having volumes less than those given in NOHSC:1015.

NOTE: The fire authority and other emergency service agencies should also be consulted.

10.2 PLANNING FOR EMERGENCIES

10.2.1 Considerations in designing premises

The likelihood of an incident occurring in an area used for storage and handling of dangerous goods can be minimized by good design and layout, sound engineering, good operating practices, and proper instruction and training of personnel in the performance of their duties.

The design and layout of the facility should consider the following provisions:

(a) Sufficient space between bund walls, storage areas and other structures as will allow access for maintenance and during emergencies.

(b) A means for reducing emission of vapours to the outside atmosphere.

(c) Alarms connected directly to the fire brigade or 24 h monitoring services.

(d) Water supplies.

(e) Fire protection equipment.

(f) A means of evacuation and assembly points.

(g) Protection of personnel responding to an emergency.

(h) Access routes for fire brigade appliances.

(i) Containment of leaks, spills and run-off of firefighting water (see Clause 5.8 and Section 11).

(j) The location of the emergency plan and safety information (see Clause 9.5.2).

NOTE: The emergency plan is described below in Clause 10.2.2. Appendix N provides guidance on the location and contents of the emergency plan.

Where so required by the relevant regulatory authority, the fire authority and other emergency service agencies should be consulted with respect to the above matters.

10.2.2 Emergency plan

10.2.2.1 *General*

A detailed plan for combating emergencies that could occur on-site shall be prepared. Such a plan should be developed in consultation with the emergency services and relevant regulatory authorities.

The emergency plan shall—

(a) take into account any potential for the occurrence of fire, explosion, natural disaster, reaction or release of dangerous goods;

(b) be appropriate to the size and complexity of the installation, its resources and personnel; and

(c) be regularly reviewed and updated as necessary.

Plant personnel shall be familiar with the contents of the emergency plan.

NOTES:

1 Guidelines for emergency plans are given in Appendix N.

2 The emergency services may require a copy of the plan to be kept at the site entrance.

10.2.2.2 *Review of emergency plan*

The emergency plan shall be kept up-to-date and reviewed and revised where necessary. For example, a review should be undertaken whenever—

(a) a new type of liquid is introduced to the premises;

(b) the quantity of liquids being kept is changed;

(c) a change is made in the way the liquids are stored or handled;

(d) a change is made in a process or procedure, which might result in a change of risk;

(e) new information regarding the hazardous properties of a substance is established; or

(f) problems are encountered during training or after an incident.

10.3 MANIFEST

A manifest shall be provided and maintained in accordance with NOHSC:3010.

10.4 PLACARDING

Stores shall be placarded in accordance with Clause 9.5.1.

SECTION 11 FIRE PROTECTION

11.1 SCOPE OF SECTION

This Section sets out requirements and recommendations relating to the protection of storages of flammable and combustible liquids from fire, and for the fighting of any fire in such storages.

NOTES:

1 This Section does not provide for fire protection facilities at marine tanker loading and unloading berths, which are dealt with in AS 3846.

2 It is essential that the requirements of all regulatory authorities, including the fire authority, be observed.

The protection of an installation from fire is achieved primarily by good facility design and operational practices which ensure that the possibility of the outbreak of fire is minimized.

NOTE: Good facility design and operational practices will permit firefighting equipment to be restricted to that necessary for the rapid extinguishment of a fire in its initial stages.

11.2 APPLICATION OF SECTION

Any building or site where flammable or combustible liquids are stored or handled, in quantities exceeding minor storage (see Section 2), shall be provided with fire protection in accordance with this Section. Each installation shall comply with the general requirements of Clause 11.3 and the specific requirements of such other Clauses as are appropriate to the particular situation.

The following exceptions and provisos apply:

(a) Individual storages within the boundaries of a single property may be treated as separate storages for the purpose of determining total fire protection requirements, provided that one or more elements of the total storage are physically separated from each other by at least the distances given in Table 5.4.

(b) Where risk assessment indicates that a destructive fire will not endanger persons on or off the site, will not endanger any property under other ownership, or will not have the potential to cause serious environmental damage, fixed fire protection is not required. In such a situation, the separation distance to any protected place should be at least five times that normally applicable to the installation unless the risk assessment indicates otherwise.

(c) The separation distances given in Table 5.4 may be measured across boundaries (as described in Clause 3.2.5) provided that a formal agreement is in place to ensure that all land within the required separation distances is maintained in such a state that the spread of fire to or from the installation is minimized.

When the flash point or quantity of liquid stored is changed, the fire protection shall be upgraded to satisfy the requirements of this Section as appropriate.

11.3 GENERAL REQUIREMENTS FOR FIRE PROTECTION EQUIPMENT

11.3.1 General

Fire protection systems shall be appropriate to the hazard and include consideration of adjoining activities and materials, so as not only to deal with incidents within the storage but also to reduce the potential for the liquids to become involved through the escalation of another incident.

11.3.2 Equipment compatibility

In designing a fire protection system, equipment needs to be optimized and adaptable, so that it can be used effectively in a variety of likely events.

Materials used in a fire protection system shall be suitable for the conditions of use and compatible with the liquids being stored. All firefighting media, appliances, equipment, components, hoses, connectors, booster connections, and the like shall be compatible with that of the local fire authority at all essential interfaces. Particular attention should be paid to provisions and procedures to cater for possible variations in the type of foam concentrate, mixing ratios, application methods and application rates.

11.3.3 Location of firefighting equipment

Any firefighting equipment shall be located so as to be reasonably adjacent to the risk being protected and accessible without undue danger in an emergency.

11.3.4 System integration

The fire protection facilities specified in this Section shall be either an independent system or integrated with other fire protection systems covering this or adjoining installations, to achieve the same result (mutual aid).

11.3.5 Weather protection

Any firefighting equipment that is susceptible to corrosion or degradation by weather, the environment, ultraviolet light, fumes and the like, shall be protected by a sheltered location or a protective enclosure, with the contents suitably labelled.

11.3.6 Labelling of firefighting equipment

All firefighting equipment shall be marked or labelled in accordance with the relevant Australian Standard. Other firefighting resources, such as water storage tanks, should be clearly identified.

NOTE: Advice may be sought from the fire authority.

11.3.7 System drawing illustrations

A layout plan showing the locations of all tanks, shut-off valves, pipelines, hydrants, and firefighting systems shall be provided and kept available for ready reference. Adequate wall-charts should be displayed in strategic control locations.

11.3.8 Equipment and piping identification

Firefighting equipment and piping shall be provided with the following means of visual identification:

(a) Water piping and valves within the foam pumphouse: R13—Signal Red.

(b) Pumps, above-ground piping, and valves containing foam concentrate: B15—Mid Blue.

(c) Above-ground foam solution lines and valves within the pumphouse: B25—Aqua.

(d) Outside hydrants and firefighting equipment: colours as in Item (a) or (c) and the word WATER or FOAM, as appropriate.

(e) Cabinets containing firefighting equipment: painted in accordance with Items (a), (b) or (c), as appropriate.

(f) Control points for water or foam: the word WATER or FOAM, as appropriate.

NOTE: The colours specified are taken from AS 2700.

11.3.9 Impact protection

All equipment, piping and valves shall be adequately supported and protected, taking into consideration the potential for traffic damage and projectile impact during a fire.

11.3.10 Maintenance of fire protection equipment

Fire protection systems and equipment shall be maintained in accordance with the relevant part of AS 1851.

In addition the following requirements shall apply to the maintenance of foam systems:

(a) At least annually, all foam systems shall be thoroughly inspected and checked for proper operation. The inspection shall include the quality of the foam concentrate or premix solution quality or both. Test results that deviate more than 10% from those recorded in acceptance testing shall be discussed immediately with the manufacturer.

(b) The inspection report, with recommendations, shall be filed with the owner. The requirements for performance evaluation of foam concentrate or premix solution shall be in accordance with the maintenance requirements of NFPA 11.

NOTES:

1 The purpose of this inspection and testing is to ensure that the system is in full operating condition and that it remains in that condition until the next inspection.

2 Fixed discharge outlets equipped with frangible seals should be provided with suitable inspection means to permit proper maintenance and for inspection and replacement of vapor seals.

11.4 PORTABLE FIRE EXTINGUISHERS

11.4.1 General

Fire extinguishers shall be provided in accordance with this Section as appropriate to the particular type of installation.

Any fire extinguisher shall comply with the appropriate Standard listed in Table 11.1, and shall be located and mounted in accordance with AS 2444.

TABLE 11.1

STANDARDS FOR PORTABLE FIRE EXTINGUISHERS

Type of portable fire extinguisher	Standard
Foam type	AS/NZS 1841.4
Powder type	AS/NZS 1841.5
Carbon dioxide type	AS/NZS 1841.6
Wheeled fire extinguishers	AS 4265
Selection and location	AS 2444
Classification of extinguisher	AS/NZS 1850

11.4.2 Type and rating

The type and rating of any extinguisher required by this Standard shall be as follows:

(a) Where the term ‘powder-type extinguisher’ is used it shall mean a portable powder-type fire extinguisher having a rating of at least 2A 60B(E).

A capacity of 9 kg is recommended.

(b) Where the term 'foam extinguisher' is used it shall mean a portable foam fire extinguisher having a rating of at least 2A 20B.

NOTES:

1 Fewer extinguishers may be provided in a specific area in order to reduce the total number of extinguishers nominated, provided that the overall rating is equivalent.

2 Although it is recognized that foam extinguishers cannot achieve a performance rating as high as is possible with other agents, foam is specified in certain applications where its characteristics are advantageous, e.g. ability to blanket spills, and to flow into corners otherwise difficult to reach. Nevertheless, substitution is permissible for rationalization, in which case the opportunity should be taken to raise the level of protection. Thus a 20B foam type could be replaced by a unit having a considerably more effective rating, e.g. 2A 60B.

11.4.3 Limitations

Extinguishers shall be selected with the following criteria in mind:

(a) Their suitability for use with the type of liquid on which it is intended to be used.

(b) Alcohol-compatible foam shall be used for alcohol or other polar liquids.

(c) Where powder-type and foam extinguishers are liable to be used together in an emergency, they shall be compatible.

NOTES:

1 Powder-type extinguishers have little cooling or quenching ability, so personnel should be aware of the potential for flashback or re-ignition.

2 Carbon dioxide can be adversely affected by wind, and so is more suitable for indoor and similar protected positions. Care needs to be taken in confined spaces.

11.5 FIXED FIRE PROTECTION AND DETECTION SYSTEMS

11.5.1 General

Any fixed fire protection or detection system shall be designed and installed in accordance with the appropriate Standard as listed in Table 11.2. Where any requirement in this Standard is more onerous than the requirements of the appropriate Standard then the requirement of this Standard shall take precedence.

NOTE: Some Standards are not written for the prime purpose of protecting storages of flammable and combustible liquids, and the need to vary the requirements of such Standards is recognized. When consulting other Standards, care should be taken when selecting the appropriate portions of those Standards to be applied to the storage.

Detailed requirements and recommendations for foam systems and cooling water are provided in Clauses 11.14, 11.15 and 11.16.

11.5.2 Fire alarm systems

Any fire alarm system shall comply with AS 1670 and AS 1603.5, together with the following requirements:

(a) Any automatic system shall be capable of being manually activated at clearly identified positions.

(b) The warning signal of the alarm system shall be sufficiently distinguishable from other signals to permit ready recognition, and shall be clearly audible throughout the whole installation, unless it can be demonstrated that audibility over a limited area is justified.

NOTE: In addition, a visual alarm system should be considered in areas of excessive noise.

(c) The power supply for any alarm system shall be independent of the main electricity isolating switch for the area.

(d) Any mandatory fire alarm system shall be connected to a fire station nominated by the relevant fire authority or 24 h monitoring service. The latter shall immediately notify the nominated fire station in the event of the fire alarm being activated.

(e) Manual actuation points shall be located at convenient and safe locations near work stations.

11.5.3 Fire hose reels

Where hose reels are required, they shall comply with AS/NZS 1221 and AS 2441. Foam hose reels shall be fitted with a foam-making branchpipe with pick-up tube capable of producing 27 L/min of foam solution at a minimum of 220 kPa for 30 min.

11.5.4 Fire hydrants

Where fire hydrants are installed, they shall comply with AS 2419.1. Fire hydrant outlets shall be fully equipped when required by Clauses 11.12 and 11.13.

NOTE: The fire authority may need to be consulted regarding their use of such equipment.

Further requirements for fire hydrants are given in later clauses specific to the type and volume of storage.

TABLE 11.2

STANDARDS FOR FIXED FIRE PROTECTION SYSTEMS

System	Standard
Fire hydrant installations	AS 2419 series
Fire hose reels	AS/NZS 1221
Fire hose reel installations	AS 2441
Manual alarm call points	AS 1603.5
Pumpsets	AS 2941
Gaseous extinguishing systems	AS 4214
Automatic fire detection and alarm systems	AS 1670 series
Automatic sprinkler systems—Wetpipe	AS 2118.1
Automatic sprinkler systems—Deluge	AS 2118.3
Low-, medium- and high-expansion foam systems	NFPA 11
Water spray fixed systems	NFPA 15
Foam-water sprinkler and foam-water spray systems	NFPA 16

11.5.5 Monitors

Where monitors are installed, they shall comply with the manufacturer's specifications. The following requirements and recommendations also apply:

(a) Monitors shall be capable of applying the required water density and quantity to the storage under adverse wind conditions.

(b) Fixed monitors shall be provided with adjustable, constant flow, fog to straight stream nozzles so that the facility is suitably protected, but not damaged by solid stream at shorter ranges.

(c) Monitors should be located so that the facility is adequately protected. If such a location could endanger the operator, radiant heat protection or remote operation should be considered. In any case, the operator shall not be exposed to radiant heat flux of greater than 4.7 kW/m^2.

NOTE: In still air and at a nozzle pressure of approx. 690 kPa, the maximum horizontal straight stream range of a 1900 L/min monitor is about 45 m and the horizontal reach to the centre of the pattern is approximately 36 m.

11.6 FIRE PROTECTION REQUIREMENTS FOR PRODUCT PUMPS, MANIFOLDS AND HOSE CONNECTION POINTS

11.6.1 Product pumps

A pump installation for handling flammable or combustible liquids shall be provided with at least one powder-type extinguisher not less than 3 m nor more than 10 m from each risk being protected.

11.6.2 Manifolds and hose connection points

Except as otherwise required by this Section, a powder-type extinguisher shall be provided within 10 m of a hose connection point or a manifold.

11.7 FIRE PROTECTION REQUIREMENTS FOR TANK VEHICLE TRANSFER AREAS

11.7.1 Location of extinguishers

The positions of extinguishers shall be chosen to optimize access in an emergency. The following considerations should be taken into account:

(a) At least one powder-type extinguisher should be at ground level at each loading position. For a top-loading installation at least one additional powder-type extinguisher should be at the loading platform.

(b) All foam type extinguishers should be at ground level within 10 m of the loading point.

(c) Locations should be on approach or exit paths.

(d) Access to any extinguisher should not be vulnerable to blockage by a fire.

11.7.2 Road tank vehicle loading areas

An installation for filling road tank vehicles with flammable liquid shall be provided with the following minimum fire protection:

(a) For top loading, one powder-type extinguisher per vehicle loading position located on the platform plus one powder-type extinguisher for each set of access stairs.

(b) For bottom loading, one powder-type extinguisher for each vehicle loading position.

(c) In addition to Items (a) and (b), one foam extinguisher for every two vehicle loading positions or part thereof.

(d) Where the associated storage incorporates a hydrant system and trained personnel are available, hoses complying with Clause 11.13.4.3 shall also be provided.

(e) Where a road tank vehicle consists of more than one tank unit (e.g. a B-Double or road train), Clause 11.7.3 shall apply.

11.7.3 Rail tank vehicle loading areas

An installation for filling rail tank vehicles with flammable liquid shall be provided with the following protection:

(a) When filling a single tank vehicle, or two tank vehicles on parallel sidings from a common elevated platform, Clause 11.7.2 Items (a) and (c) shall apply.

(b) When filling two or more tank vehicles in line from a common platform, the following shall be provided:

  (i) At least one powder-type extinguisher for every 15 m or part thereof of platform length.

(ii) One powder-type extinguisher and one foam extinguisher at the foot of each set of access steps to the platform.

(c) Where bottom loading takes place, at least one powder-type extinguisher shall be provided for each loading point or group of loading points, plus one foam extinguisher for each two loading points or for each two groups of loading points.

(d) Where the associated storage incorporates a hydrant system and trained personnel are available, hoses complying with Clause 11.12.1 (c)(iii) shall also be provided.

11.7.4 Tank vehicle delivery locations

Any location at which a tank vehicle will unload flammable liquid shall be provided with at least one powder-type extinguisher per unloading point or grouped set of unloading points with a minimum of two powder-type extinguishers for the installation.

NOTE: Where the location of the unloading area in relation to the storage renders it inadvisable to locate the extinguishers permanently at the tank vehicle standing area, they may be taken to that area for the unloading period.

For rail tank vehicle unloading, a minimum of one powder-type and one foam type extinguisher shall be provided for every two rail tank vehicle unloading positions.

11.8 FIRE PROTECTION REQUIREMENTS FOR PACKAGE STORAGE AND HANDLING AREAS

11.8.1 Application

This Clause (Clause 11.8) provides fire protection requirements for package storage and handling areas, as described in Section 4 of this Standard.

11.8.2 Package storage areas

Unless exempted by the provisions of Clause 11.2, a package store of greater aggregate volume than minor storage, or of any type other than an indoor storage cabinet shall be provided with fire protection in accordance with Table 11.3.

NOTE: Specific advice on automatic systems for indoor stores of packages and IBCs may be found in Clause 4.8 of NFPA 30, which addresses package size and materials, stack heights and spacing.

11.8.3 Indoor storage cabinets

Each indoor storage cabinet having a capacity of 250 L or less, at least one powder-type extinguisher shall be provided. For indoor storage cabinets of more than 250 L capacity, an extra extinguisher or foam hose reel shall be provided. All extinguishers shall be located not less than 3 m nor more than 10 m from the cabinet.

11.8.4 Package filling areas

In areas where packages are filled, with or without an associated storage, extinguishers shall be provided as follows:

(a) For every filling point for flammable liquids, or for any two such filling points that can be circumscribed by a 5 m diameter circle, one powder-type extinguisher plus one foam extinguisher shall be provided. A foam-equipped hose reel may be substituted for any foam extinguisher within reach of the hose.

(b) For every filling point for combustible liquids or group of filling points within a 5 m diameter circle, one powder-type extinguisher within 10 m of the filling point.

11.8.5 Storage of IBCs

Where IBCs are kept in a package store (as described in Clause 4.7), then fire protection for the appropriate type and size of package store shall apply, as listed in Table 11.3. Where IBCs are not stored in accordance with Clause 4.7, then fire protection shall comply with the relevant Clauses regarding tank storage, dependent on the total volume of liquid stored.

11.8.6 Transit storage

For transit storage (as defined in Clause 1.4.70 and described in Clause 3.9), the requirements of Table 11.3 shall apply.

11.9 FIRE PROTECTION REQUIREMENTS FOR FUEL DISPENSING INSTALLATIONS

11.9.1 Vehicle refuelling stations

Fuel-dispensing installations for vehicles shall be provided with at least two powder-type extinguishers. For a private installation containing a single dispenser, one such powder-type extinguisher shall suffice where flammable liquid is dispensed. Extinguishers may be omitted where only combustible liquid is dispensed.

11.9.2 Refuelling berths for small craft

An installation for refuelling boats with flammable liquid shall be provided with the following fire protection equipment:

(a) One powder-type extinguisher and one foam extinguisher per dispenser or group of dispensers and located no more than 10 m from a dispenser.

(b) One hose reel complying with Clause 11.5.3, the nozzle of which is capable of reaching the nozzle of each dispenser on the same jetty or wharf, when the dispenser hose is fully extended for normal refuelling. The reel shall be at least 3 m from any dispenser.

The fire protection equipment specified in Items (a) and (b) shall be located between the shore access and the dispenser.

11.9.3 Refuelling installations for light aircraft

An installation for the refuelling of light aircraft (up to 15-seater planes) shall be provided with one powder-type extinguisher per dispenser or group of dispensers. Such an extinguisher shall be located within 10 m of the dispenser.

11.9.4 Extinguisher access and security

At installations dispensing to the public, the extinguishers shall be accessible to the persons refuelling. Such extinguishers may be protected from vandalism or unauthorized access by a break-glass screen or an equivalent, such as a hatch that is opened by an emergency alarm or shut-off actuator.

The break-glass screen or similar device shall be prominently marked with instructions for gaining access to the extinguisher.

11.9.5 Specific dispenser extinguishers

The extinguishers specified for fuel dispensers shall be additional to any extinguishers provided elsewhere on the site.

11.10 FIRE PROTECTION REQUIREMENTS FOR ABOVE-GROUND FIRE-RATED TANKS, TANKS UNDERGROUND OR IN CHAMBERS

Any tank that is fire-rated (see Clause 5.9.3), or installed underground or in a tank chamber may be operated without fire protection additional to that otherwise required for the site.

TABLE 11.3

FIRE PROTECTION FOR PACKAGE STORES

Type of storage	Quantity, m^3	Flammable liquid	Combustible liquid
Unroofed	≤2	1 × Unit 1 or 1 × Unit 4	1 × Unit 1
	>2 to ≤10	1 × Unit 1 1 × Unit 4	1 × Unit 1
	>10 to ≤100	4 × Unit 1 2 × Unit 4 Unit 5	1 × Unit 1 2 × Unit 4
	>100 to ≤200	4 × Unit 1 2 × Unit 4 Unit 5 Unit 7	4 × Unit 1 2 × Unit 4 Unit 5
	>200	4 × Unit 1 2 × Unit 4 Unit 5 Unit 7	4 × Unit 1 2 × Unit 4 Unit 5 Unit 7
Roofed	≤2	1 × Unit 1 1 × Unit 4	1 × Unit 1
	≥2 to ≤10	2 × Unit 1 Unit 2 2 × Unit 4	2 × Unit 1 Unit 2 2 × Unit 4
	>10 to ≤100	Unit 2 Unit 3 Unit 5	2 × Unit 1 Unit 2 2 × Unit 4
	>100 to ≤600	Unit 2 Unit 3 Unit 5 Unit 7	1 × Unit 2 Unit 3 Unit 5
	>600 to ≤1 000	Unit 2 Unit 3 Unit 6 Unit 7	Unit 2 Unit 3 Unit 5 Unit 7
	>1 000	Fire safety study	Fire safety study

NOTES:

1 Table 11.3 relates to stores containing unopened packages or where single packages are opened momentarily for testing or sampling.

2 Table 11.3 seeks to provide for the capability of handling a fire wherever it may occur within a storage. Some modification may be required to suit particular storage arrangements.

3 Where flammable and combustible liquids are stored together, the requirements listed in the flammable liquid column of Table 11.3 apply for the aggregate quantity.

4 Refer to Clause 11.4.3 for special limitations and requirements for extinguishers.

5 References to a particular type of fire protection 'Unit' in Table 11.3 have the following meanings:

Unit 1: One powder-type extinguisher.

Unit 2: One powder-type extinguisher located at each doorway to the storage area.

Extinguishers may be located immediately inside external doors if access or security risks exist, subject to the provision of prominent signs detailing their location.

Unit 3: Powder-type extinguishers internally positioned to achieve a 15 m maximum travel distance.

Unit 4: One foam-type extinguisher.

Unit 5: Hose reel(s) with foam capabilities (see Clause 11.5.3), able to reach all parts of the storage (a hydrant with 38 mm hoses and equivalent foam-making facilities is an acceptable alternative for a hose reel provided personnel are trained in their use).

Unit 6: Automatic foam-water sprinklers in accordance with NFPA 16, protecting the whole storage area (see Clause 11.5.1 and Table 11.2).

Unit 7: Unequipped hydrant(s) external to the storage provided in accordance with AS 2419.1.

11.11 FIRE PROTECTION REQUIREMENTS FOR ABOVE-GROUND TANK STORAGE OF AGGREGATE CAPACITY LESS THAN 60 m^3

11.11.1 Tanks within buildings

Where a tank containing flammable or C1 liquid is located within a building, but is not in a tank chamber, it shall be provided with at least one powder-type extinguisher, located within 10 m of the tank.

11.11.2 Tanks that form part of a blending plant, or contain potable spirits

If tanks containing flammable liquids are part of a blending plant, or contain potable spirits, they shall be provided with—

(a) at least one powder-type extinguisher, located within 10 m of the tank; and

(b) a hose reel equipped with foam induction facilities as described in Clause 11.5.3.

Where only C2 liquid is stored, the normal building fire protection provisions shall suffice.

11.11.3 Outdoor tanks

Any outdoor tank storage shall be provided with fire protection in accordance with the following requirements:

(a) Where flammable liquid is stored with or without combustible liquid, fire protection facilities shall be provided in accordance with Table 11.4.

(b) Where Class C1 liquid is stored without flammable liquid, but with or without Class C2 liquid, at least one powder-type extinguisher shall be provided if a single-tank installation, otherwise two powder-type extinguishers shall be provided.

(c) Where only Class C2 liquid is stored, no specific fire protection provisions are required for the storage other than those required for the building or site.

11.11.4 Location

Unless otherwise specified, extinguishers shall be located within 10 m of the tank and shall be positioned outside of any bund.

TABLE 11.4

FIRE PROTECTION FOR OUTDOOR TANKS OF CAPACITY <60 m^3 STORING FLAMMABLE LIQUID

Individual tank capacity m^3	Aggregate capacity, m^3	Fire protection per installation
<30	≤30	At least two extinguishers, one of which may be foam and the remainder powder
	>30 but <60	At least one powder-type extinguisher plus a hose reel with foam
Any tank ≥30 but <60	<60	At least one powder-type extinguisher plus a hose reel with foam

NOTES:

1 Reference to a hose reel with foam means a hose reel to AS/NZS 1221 with foam-making branchpipe and pickup tube (see Clause 11.5.3).

2 This Table should be applied to tanks separated as required by Clause 5.7. Where tanks are separated as described in Clause 11.2(b), each tank or group of tanks should be treated individually for the purpose of using the Table.

11.12 FIRE PROTECTION REQUIREMENTS FOR ABOVE-GROUND TANK STORAGE OF AGGREGATE CAPACITY 60 m^3 TO 2000 m^3

11.12.1 Flammable liquids

Where flammable liquid is stored with or without combustible liquid, the following requirements shall be provided, in addition to the provisions for any other storage or building on the site, unless exempted or varied by Clause 11.2 Items (a), (b) and (c):

(a) For clusters of tanks, Clauses 11.13.2 and 11.16 shall apply.

(b) At least one powder-type extinguisher and hose reel with foam.

(c) Fire hydrants complying with AS 2419.1 and the following:

(i) A fog nozzle and foam-making branchpipe with pick-up tube. The foam branchpipe shall be capable of producing 240 L/min (4 L/s) of foam solution at a minimum pressure of 400 kPa.

(ii) Sufficient foam concentrate in containers to provide 20 minutes operation of the foam branchpipe in addition to any concentrate required for other purposes.

(iii) Sufficient length of hose of at least 38 mm size, to reach the compound and any road or rail tanker loading point, from a hydrant from either of two directions at least 90° apart shall be available. Where hoses have to be joined, not more than one length shall be 38 mm size. Additional lengths shall be at least 65 mm size, but there shall be no more than two lengths of hose per hydrant outlet. Hydrants shall be not more than 60 m from the tank.

NOTES:

1 The essential requirement is that satisfactory foam be generated, with an expansion ratio of at least 8:1. Some types of equipment may require pressures and flow rates higher than those specified above.

2 A foam-making branchpipe producing 240 L/min (4 L/s) of foam solution for 10 min will provide a 50 mm deep foam blanket to an area of 360 m^2 when generating foam at an expansion ratio of 8 to 1. The 20 minute foam requirement provides for a second application of the foam blanket to maintain effective suppression of vapours for a period in excess of 30 min. A bund of 360 m^2 is an average area for 500 m^3 of storage.

(d) Sufficient hydrants shall be provided in accordance with Clause 11.13.4.1(a).

(e) The location of hydrants on the site shall be chosen on the basis of providing effective cover for each compound and any road or rail tank loading point with the hoses available on site, under any foreseeable conditions of fire and wind.

11.12.2 Flammable liquids associated with blending plants

Where flammable liquids are kept as part of a blending plant, all of the requirements of Clause 11.11.1 shall apply. In addition, either a hydrant system complying with AS 2419.1 shall be provided, or a fire safety study shall be undertaken and implemented.

11.12.3 Potable spirits

Where potable spirits are kept, fire protection complying with Clause 11.12.1 Items (a) and (b) shall be provided.

11.12.4 Class C1 liquid

Where Class C1 liquid is stored without flammable liquid but with or without Class C2 liquid, the installation shall be provided with—

(a) a hose reel and foam-making equipment complying with Clause 11.5.3, for use where the water supply is adequate; or

(b) two powder-type fire extinguishers.

11.12.5 Class C2 liquid

Where only Class C2 liquid is stored, the normal fire protection provisions of the building or site shall be sufficient.

11.12.6 Cooling water

Where any individual tank exceeds 500 m^3 capacity, cooling water shall be provided where relevant. See Clause 11.15.

11.13 FIRE PROTECTION REQUIREMENTS FOR ABOVE-GROUND TANK STORAGE OF AGGREGATE CAPACITY 2000 m^3 AND GREATER

11.13.1 Foam systems for tanks

Every vertical fixed-roof tank over 6 m diameter that contains flammable liquid shall be provided with a fixed foam system in accordance with Clause 11.16, irrespective of whether an internal or external roof is provided for the tank, unless the use of foam is inappropriate (see Note 3). Foam shall be applied as directly as possible to the liquid surface.

NOTES:

1 Some authorities require that open-top floating roof tanks be provided with fixed foam systems, others do not, so it is necessary to determine the requirements for the locality. Where a fixed foam system is required, foam dams are necessary and reference should be made to NFPA 11. Where a fixed system is not required, it is usual to rely on portable manual foam facilities.

2 For top application, Type II discharge outlets are preferred over those of Type I, due to their simplicity of operation and lesser maintenance requirements.

3 It is recognized that there may be special cases in which the use of foam is not advisable or is unnecessary, e.g. where the stored liquid is incompatible with foam or water, or where air is excluded by inert gas, or where a volatile liquid is stored in a pressure tank. Special consultation with the fire authority is necessary in any such cases.

4 The term ‘fixed’ in the context of this Clause means both fixed and semi-fixed, as defined in NFPA 11. On large or segregated sites, it may not be practical to have multiple proportioning and storage facilities. In such cases, it is acceptable to provide fixed foam piping to storage tanks from connection points outside the compound, to which mobile facilities can be attached. Consideration should be given to availability and access for such mobile facilities.

11.13.2 Foam protection for tank clusters

Where a tank cluster (see Clause 5.7.5) requires foam protection, but one or more tanks, because of the contents or the diameter, would not otherwise be required to be provided with a fixed foam system on the tank, provision shall be made to apply foam over the area of the compound, by means of monitors or hydrant systems. Where the cluster is located in a sub-compound within a larger compound, the foam requirements may be calculated on the basis of the area of the sub-compound, provided that the bund is at least 500 mm high and complies with Clause 5.8.3(h).

11.13.3 Cooling water

Clause 11.15 shall apply where relevant (see also Appendix J).

11.13.4 Hydrant system

11.13.4.1 *General*

A hydrant system shall be provided, which shall comply with Clause 11.14 where relevant, AS 2419.1 and the following requirements unless only combustible liquids are stored:

(a) Fire hydrants shall be located such that water can reach—

  (i) every part of any tank requiring cooling water; and

(ii) other storages, building, pumps, valves and other components of the installation.

Fixed or portable monitors, or a line of hose not more than 60 m long (which may be made up from the lengths available on site) shall be used to achieve Items (i) and (ii) above.

(b) Where any part of a pipe for water supply to a hydrant system lies within 150 m of any part of the storage as listed in Item (a), fire hydrants shall be placed not more than 60 m apart along that part of the pipe.

(c) No fire hydrant shall be located within a compound unless the pipe to that hydrant can be isolated from the rest of the hydrant system by a valve outside the compound.

(d) There shall be at least three hydrants per storage.

(e) When planning the location of hydrants, the following points shall be taken into account:

(i) The possible need to apply further hydrants for auxiliary tank cooling, using either uncommitted reserve water or spare water (see Clause 11.15 and Appendix J).

(ii) The use of ring mains valve to retain 75% of the operational availability of the fire main at all times.

(f) Non-fire-rated groove couplings shall not be used within a compound.

NOTE: The use of threaded sockets and fittings is not recommended, but where it is impractical to do otherwise, pipework should be back-welded for strength.

11.13.4.2 *Simultaneous operation of water-based systems*

When the cooling and foam systems with the largest demands are operating, the three adjacent fire hydrants that are not being used for cooling or foam and are the most hydraulically disadvantaged in the system, shall each be capable of providing pressure and flow in accordance with AS 2419.1.

NOTE: It is essential that, when determining pipe sizes, allowance be made for the deterioration of capacity over a period because of the growth of internal deposits.

11.13.4.3 *Hydrant accessories, hoses and fittings*

Where trained on-site personnel are available to operate a hydrant system, the following accessories, hoses and fittings shall be provided:

(a) For each fire hydrant within the installation, at least one 30 m hose length of 38 mm minimum size, complete with couplings, together with one adjustable spray pattern hose nozzle having a capacity of at least 4 L/s, complete with hose coupling and hydrant valve spanners.

(b) For each portable monitor, two 30 m hose lengths of 65 mm minimum size, complete with hose connectors and spanners.

(c) One additional 30 m hose length of 65 mm minimum size for every three fire hydrants or part thereof, subject to a maximum of six additional hoses. Such additional hoses may be stored in a central location that is readily accessible at all times.

(d) For every six fire hydrants, one foam-making branchpipe with pick-up tube, to a maximum of three units, with each branchpipe capable of producing 240 L/min (4 L/s) of foam solution at a minimum of 400 kPa.

(e) Sufficient foam concentrate in containers to provide 20 minutes operation of each foam branchpipe as required in Item (d), in addition to any concentrate required for other purposes.

NOTES:

1 The fire authority should be consulted as to whether they would use this equipment if it were provided for their use in an emergency.

2 A foam-making branchpipe producing 240 L/min (4 L/s) of foam solution for 10 min will provide a 50 mm deep foam blanket to an area of 360 m^2 when generating foam at an expansion ratio of 8 to 1.

The accessories shall be housed at locations appropriate to the arrangements and the staffing levels of the particular installation, and shall be provided with identifying signs.

11.13.5 Water supply duration

Sufficient water shall be available from mains or static storage or a combination of both, to supply the sum of the requirements for cooling water for at least 1.5 h, plus the water requirements of the tank having the largest foam demand for at least 20 min or as designed. The water supply for the hydrant system shall be as required by AS 2419.1.

NOTE: If it is intended to take advantage of any convenient existing dam, river, lake or sea as static storage, the possible effects of short-term or long-term water level variations should be kept in mind.

11.13.6 Fire alarm system

A fire alarm system shall be provided.

11.13.7 Combustible liquids

Where only combustible liquids are stored, the installation shall be provided with at least the following:

(a) A hydrant system comprising at least one hydrant riser per tank, which is capable of reaching all parts of all compounds.

(b) Accessories and foam concentrate, as applicable.

(c) One powder-type extinguisher per tank, with a minimum of three powder-type extinguishers for the storage area, strategically located around the storage.

11.14 PIPING AND PUMPING SYSTEMS

11.14.1 General

The requirements of this Clause (Clause 11.14) shall apply to hydrant systems, fixed foam systems and their water supplies.

11.14.2 Fire pumps

Where pumping is necessary to meet the performance requirements of the water supply or foam system, the requirements of AS 2941 and the following shall apply where appropriate:

(a) Pumping arrangements shall be either of the following:

(i) Two automatic pumps, at least one of which shall be compression ignition engine-driven. The other may be electric motor-driven. Each pump shall be capable of providing independently the necessary flow and pressure.

(ii) Three automatic pumps, at least two of which shall be compression ignition engine-driven, and any two of which shall be capable of providing in aggregate the necessary flow and pressure.

NOTE: A single-pump system may be installed, provided that a risk assessment can demonstrate that an equivalent level of reliability is achieved. Electric motors are considered more reliable than compression ignition engine-driven except in a few cases where supply conditions in the area are adverse, e.g. limitations of motor size in the district, or the inability of the local supply system to provide electricity from at least two directions for a single pump.

(b) Pump inlets may be interconnected by a common manifold where feasible, in which case isolation valves under the control of the site owner shall be provided in the common manifold.

(c) There shall be a bypass around the pumps with a non-return valve on the bypass. The bypass shall be not less than the diameter of the pump discharge manifold.

(d) The diameter of the water supply connection to the pumps shall be such that a velocity of 4.0 m/s is not exceeded when a pump is operating at its maximum flow rate.

(e) Sufficient fuel shall be kept on-site to operate all pump engines continuously for 6 hours at maximum fuel consumption rates.

(f) Where both supplies are comprised of tanks, with or without pumps, the tanks shall be either separate units or a single unit partitioned to hold the required water storage capacity in each compartment.

(g) The location of fire pumps and associated equipment shall be determined in consultation with the authority and in conjunction with the evaluation of heat flux contours generated from storage areas.

11.14.3 Strainers

Water and foam systems shall be provided with such strainers as may be necessary to prevent blockage of the equipment. Any such strainers shall be readily accessible and cleanable.

11.14.4 Piping

11.14.4.1 *General*

All pipework and fittings shall comply with AS 4041. Piping shall have suitable wall thickness, and shall be selected to anticipate internal pressure, internal and external pipe wall corrosion, and mechanical bending requirements.

11.14.4.2 *Pipe materials*

Within any hazardous area piping shall be of steel or other alloy rated for pressure and temperature. Steel pipe shall be not less than AS 1074 medium weight or Schedule 40 medium weight.

Galvanized pipe shall be used to conduct cooling water in atmospheres that are normally non-corrosive. Where corrosion could occur, piping shall be corrosion resistant or protected against corrosion. The quality of the water supply should also be considered, e.g. potable or raw water, and whether the pipe is normally dry or charged with water.

11.14.4.3 *Foam system piping*

Piping carrying or in constant contact with foam concentrate shall not be galvanized, and shall be constructed for material compatible with, and not affected by, the concentrate. The piping shall not have a detrimental effect on the foam concentrate.

For the purpose of computing friction loss in foam solution piping, the following C-values shall be used in the Hazen-Williams formula:

(a) Black steel or unlined cast iron pipe—100.

(b) Galvanized steel pipe—120.

11.14.4.4 *Pipe supports and protection of pipework*

The following requirements shall apply:

(a) Pipe supports for sprinkler and deluge systems shall be provided in accordance with AS 2118 and AS 2419 series for hydrant and foam systems.

(b) The supply piping to foam outlets that protect a given hazard in a fire area shall not pass over another hazard in the same fire area.

(c) Where there is a possibility of explosion, pipework shall be routed to afford the best protection against damage.

11.14.5 Valves

Any manually-operated isolating valves used in a water or foam system shall be full-flow outside screw and yoke wheel gate valves or butterfly valves closed by turning the wheel clockwise.

The open and shut positions shall be obvious and the direction of closing clearly marked.

Where a valve for isolating or switching is underground, an aboveground open/closed indicator shall be provided.

For foam systems, both the injection line and concentrate feed line shall be fitted with isolating ball valves.

11.14.6 Backflow prevention

Where the foam system is permanently connected to the town's main potable water supply, backflow prevention or a water supply break-tank shall be provided in accordance with AS/NZS 3500.1.2.

11.15 COOLING WATER

11.15.1 Where required

Cooling water for the protection of tanks against fire exposure shall be provided in the circumstances described in, and in the quantities required by, Appendix J.

If hydrants are to be used to supply tank cooling water, such hydrants shall be additional to those required under Clause 11.13.4.

NOTE: The arrangement of hydrants on the site may be rationalized to avoid unwarranted duplication, provided that in the resulting arrangement, not all of the hydrants are committed to tank cooling.

11.15.2 Methods of application

The method of application of cooling water shall comply with the following requirements:

(a) Cooling water shall be applied by means of fixed piping on the tank, by hand hoses or portable monitors.

NOTE: For hoses and monitors, the water wastage inherent in some application methods should be allowed for, so that the water that actually reaches the fire-exposed area of the tank is applied in the quantities and at the rates required.

(b) The water application system shall be convenient and safe to use.

(c) Locally-operated monitors or hand hoses shall only be used if the operator will not be exposed to any heat flux greater than 4.7 $kW/m^{2.}$

11.16 FIXED FOAM SYSTEMS FOR TANKS

11.16.1 General

The term 'fixed' in the context of this Clause shall mean both 'fixed' and 'semi-fixed' as defined in NFPA 11.

Where a fixed foam system is required, it shall be designed in accordance with NFPA 11 and the requirements of this Clause (Clause 12.16). Where there is conflict between NFPA 11 and this Clause, the requirements of this Standard shall apply.

On large or segregated sites, it might not be practicable to have multiple proportioning and storage facilities. In such cases, it is acceptable to provide fixed foam piping to storage tanks from connection points outside the compound, to which mobile facilities can be attached. Consideration should be given to availability of, and access for such mobile facilities.

11.16.2 System controls

Controls for the initiation of the foam system shall be readily accessible. They shall incorporate a maximum three-step action, designed to be as simple as possible to operate as logically possible.

Instructions shall be provided for the initiation, shutdown, flushing and reinstatement of the foam system. The instructions shall be permanent, clearly legible and located reasonably adjacent to the system controls.

For permanently-installed foam proportioning equipment, a block plan of the complete foam system and a schematic of the foam proportioning and distribution system shall be displayed adjacent to the foam system controls. The following information shall be provided as a minimum:

(a) Foam concentrate quantity, type and mixing ratio.

(b) Foam solution flow rates and pressures required for each protected tank.

(c) Fire brigade water supply booster flow and pressure requirements.

(d) Fire brigade foam concentrate injection point flow and pressure requirements.
NOTE: This only applies to systems using bladder tank storage.

(e) Town mains and fire pump pressure and flow duty for annual water supply flow testing.

(f) Any pressure switch or pressure relief valve settings.

(g) Emergency and system maintenance contact details.

All valves that form part of the system controls to initiate the operation of the foam system or permit fire brigade shall be permanently marked to indicate their name or function.

The system shall be designed so that it can be adapted for fighting fires other than in the tank, e.g. a spillage or compound fire.

11.16.3 Foam system equipment

The following equipment associated with the preparation of foam shall be readily accessible and located outside any compound, in a position not exposed to the hazard to be protected:

(a) Permanently-installed proportioning equipment.

(b) Connections for water and concentrate for mobile foam-proportioning equipment.

(c) Foam concentrate tanks.

(d) Pumps and associated drives.

The positioning of the equipment is subject to agreement with the fire authority, with heat flux levels taken into consideration. If housed, the foam system and equipment shall be in a non-combustible structure.

11.16.4 Foam concentrate quantities

Sufficient foam concentrate shall be kept to ensure that the tank having the largest foam requirement can be supplied for a continuous period of not less than the following:

(a) For a Type I discharge outlet foam application system: 30 min for PG I or PG II liquid or 20 min for PG III liquid.

Discharge outlets are described in Note 2 to Clause 11.13.1.

(b) For a Type II or subsurface application system: 55 min for PG I or PG II liquid or 30 min for PG III liquid.

(c) For an installation in which the class of liquid stored is likely to change: the longer of the times specified above.

(d) For a floating roof tank: 20 min for 'top of seal' application, or 12 min for 'below seal' application.

NOTES:

1 When determining the quantity of foam concentrate required, the quantities of foam necessary to extinguish the fire and to provide a continuing seal over the liquid surface (to allow the liquid to cool below its re-ignition temperature) should be considered.

2 The storage volume may need to be increased to provide for possible additional demands, such as the volume necessary to fill the piping in any fixed foam solution reticulation system, or the needs of a hydrant-operated manual application system.

3 It is necessary to be able to replenish stocks of foam concentrate quickly, and within not more than 24 h. In the absence of an adequate nearby supplier, or common pooling arrangements with nearby installations, it may be necessary to store additional concentrate on-site.

4 Foam concentrate storage provisions may need to be designed to minimize possible long term deterioration of the foam concentrate and its storage container, e.g. by insulation or standing.

11.16.5 Foam concentrate storage

Foam concentrate shall be stored in accordance with the manufacturer's data sheet, in either dedicated storage tanks or the manufacturer's IBCs. The following requirements shall apply to such storage:

(a) Any storage tanks for foam concentrate shall comply with the appropriate requirements of AS 2118.3.

(b) The type, mixing ratio and quantity of foam concentrate shall be clearly and permanently marked on the storage vessel. Means shall be provided to readily determine the quantity of concentrate in the storage vessel at any time, and to draw liquid samples for annual testing.

NOTE: A sight glass may be used as a contents gauge, provided that any inlet to the glass below liquid level has a 'loss of contents' device fitted to guard against glass breakage.

(c) The surface area in contact with air shall be minimized by providing a nozzle or dome in the top of the tank where the liquid surface is located when the tank is full.

(d) The quantity of foam concentrate stored shall be maintained at all times, in volumes at least as required by Clause 11.16.4.

(e) Provision for replenishing foam concentrate while the foam system is in use shall be provided. For bladder tank systems, a fire brigade foam concentrate injection point shall be provided, located in the concentrate feed line to the foam proportioner.

(f) A reserve supply of concentrate shall be provided in separate tanks or manufacturer's IBCs on the premises, or available from an outside source within 24 h.

NOTE: The foam storage should be protected from heat and mechanical damage.

11.16.6 Product sealing

Discharge outlets shall be provided with a seal, frangible under low pressure, to prevent the entry of liquid or vapour from the protected tank into the foam supply piping.

Means shall be provided to allow for the inspection and replacement of such seals.

11.16.7 Foam concentrate compatibility

The type of foam used should be determined on the basis of compatibility with the liquid being stored and with other foam on site or available in a common pool. Foams generated separately from protein, fluoroprotein, FFFP and AFFF concentrates may be applied to fire in sequence or simultaneously.

The foam concentrate, its storage and the proportioning equipment shall be mutually compatible. Different types of foam concentrate shall not be mixed for storage. Different brands of the same type of concentrate shall not be mixed unless the manufacturer's data indicates that they are compatible.

NOTES:

1 Recognized bodies such as Underwriters Laboratories (UL) provide listings of foam products that are considered satisfactory.

2 The foam used should be compatible with that used by the local fire authority except where the product stored demands a particular type.

11.16.8 System design requirements

Any fixed foam system on a storage tank shall comply with the following requirements:

(a) The number of foam outlets shall be as given in Table 11.5.

(b) The rate of foam application shall be as given in Table 11.6.

(c) Foam inlet nozzles for fixed roof tanks shall enter—

(i) through the top strake, provided that the riser is designed and connected so as to allow for distortion of the upper strake and roof under fire or explosion conditions; or

(ii) through the second strake from the roof, with the interior pipe and discharge outlet not connected to the top strake or roof; or

(iii) through a low-level connection, or the product filling line, but above any established water bottom, for subsurface application.

(d) Where two or more discharge outlets are required, they shall be equally spaced around the tank's perimeter, and each outlet shall be sized to deliver foam at approximately the same rate.

11.16.9 Foam system design limitations

11.16.9.1 *General*

The design requirements given in Table 11.6 shall be limited by the requirements of this Clause (Clause 11.16.9).

11.16.9.2 *Fixed roof tanks—Surface application*

The following requirements and recommendations apply:

(a) Alcohol-resistant foams shall be used for gasohols and unleaded petrols containing more than 10% oxygenated additives (e.g. ethanol) by volume.

(b) Flammable liquids having boiling points of less than 38°C may require greater application rates. Such rates should be determined from the manufacturer's data sheet.

(c) Lower application rates should be used for high-viscosity liquids heated above 95°C, in order to reduce frothing and overflow of the stored liquid.

(d) If the discharge outlet has a delivery rate of greater than 4 L/min/m^2, a proportionate reduction in the foam discharge time may be applied, provided that the period is not less than 70% of the minimum discharge time.

NOTES:

1 Extreme caution should be used when applying foams to tanks containing hot oils, burning asphalts, or burning liquids that have boiling points above that of water.

2 Although the comparatively low boiling point of the foam can beneficially cool such liquids at a slow rate, it can also cause violent frothing and overflow of the tank's contents.

11.16.9.3 *Fixed roof tanks—Subsurface application*

NOTES:

1 In addition to the control provided by the smothering effect of the foam and the cooling effect of the water in foam that reaches the surface, fire control and extinguishment can be further enhanced by the rolling of cool product to the surface.

2 Subsurface injection of foam is not recommended for liquids having a viscosity greater than 440 cSt at their minimum anticipated storage temperature. The most viscous liquid that has been extinguished by subsurface injection when stored at ambient conditions (16°C) had a viscosity of 440 cSt and a pour point of –9°C.

The following requirements shall apply:

(a) Subsurface injection shall not be used on—

(i) any hydrocarbon liquid having both a flash point of less than 23°C and a boiling point of less than 38°C; or

(ii) hydrocarbons containing greater than 10% polar solvents such as ethanol; or

(iii) other products requiring the use of alcohol-resistant foams, e.g. alcohols, esters, ketones, aldehydes, anhydrides.

(b) The foam velocity for subsurface injection at the point of discharge into the tank shall not exceed—

(i) for PG I or PG II liquids, 3 m/s; or

(ii) for PG III liquids, 6 m/s.

(c) Fluoroprotein, AFFF and FFFP foams for subsurface injection shall have expansion ratios between 2:1 and 4:1.

11.16.9.4 *Floating roof tanks*

Subsurface or semi-subsurface injection shall not be used for protection of open-top or floating roof tanks because of the possibility of improper distribution of foam at the liquid surface.

TABLE 11.5
FOAM OUTLETS FOR TANKS

Tank diameter, m		Fixed-roof tank			Floating roof tank	
		Number of outlets			Maximum spacing of outlets around pontoon circumference m	
Over	Up to and including	Surface application	Subsurface application		Foam dam height, mm	
			Flammable liquid PG I or PG II	Flammable liquid PG III	300	600
0	24	1	1	1	12	24
24	36	2	2	1		
36	42	3	3	2		
42	48	4	4	2		
48	54	5	5	2		
54	60	6	6	3		
Over 60		One additional outlet for each additional 450 m^2 of surface	One additional outlet for each additional 450 m^2 of surface	One additional outlet for each additional 700 m^2 of surface		

TABLE 11.6
FOAM APPLICATION RATES

Liquid stored	Foam solution application rate L/min.m^2 of area of tank surface or foam dam annulus (see Note)				
	Fixed roof tank			Floating roof tank	
	Surface application		Subsurface application	Applied to annular foam dam only	
	AFFF or fluoroprotein	Alcohol-resistant AFFF	AFFF or fluoroprotein	AFFF or fluoroprotein	Alcohol-resistant AFFF
Hydrocarbons	4	—	4	12	—
Gasohols containing more than 10% alcohol by volume	—	6.5	—	—	12
Methanol, ethanol, and butanol	—	6.5	—	—	12
Acetone, MEK	—	6.5	—	—	12
Isopropyl ether, ethyl acetate, acrylonitrile	4	—	—	12	—
Other	Specifically determined for the material. See UL listings or manufacturer's recommendations based on specific fire tests.				

NOTE: Foam application rates specified in Table 11.6 are appropriate for AFFF and fluoroprotein foam only. Protein foam is not dealt with.

SECTION 12 WASTE STORAGE AND DISPOSAL

12.1 SCOPE OF SECTION

This Section sets out procedures for the safe storage and disposal of wastes, spills, damaged containers and items contaminated with flammable or combustible liquids.

12.2 STORAGE OF WASTES

Any installation in which flammable or combustible liquids are kept shall be provided with facilities for the storage of wastes and contaminated items. Such facilities shall comply with all of the requirements applicable to stores for flammable and combustible liquids.

12.3 WASTE MANAGEMENT

An assessment shall be made regarding the continued storage or appropriate disposal, which may include recycling, of the following items and liquids:

(a) Liquids that have been on the site for an excessive storage or appropriate disposal, which may include recycling, of the following items and liquids.

(b) Wastes and residues from spills and leaks.

(c) Liquids that cannot be identified.

(d) Contaminated clothing and equipment.

(e) Liquids that are in excess of possible use or demand.

(f) Foam generated in test and emergency use or demand.

NOTE: The principles of pollution prevention and cleaner production should be applied in order to eliminate the generation of flammable and combustible liquid wastes. If elimination is not feasible, then re-use in a process or recycling should be considered. The only disposal options normally available are the use of the liquid as a fuel in very specific circumstances, or disposal by incineration.

12.4 WASTE DISPOSAL

Wastes should be handled with the same precautions as apply for flammable liquids.

Waste flammable liquids (e.g. used solvents) may be collected in a clean metal drum for a short time. The screw cap needs to be kept tightly closed at all times. Liquid should be poured in slowly using a metal funnel to reduce static electricity.

Any drum should be labelled with the Class 3 dangerous goods ‘diamond’ and a clear indication of its contents e.g. ‘waste acetone’. The drum should be kept in a well-ventilated area at least 3 m away from any ignition sources.

Solid combustible waste (e.g. rags soaked with flammable liquid) may be kept in a clean, water-filled metal drum with a tightly fitting metal lid and label accordingly.

Wastes should not be allowed to accumulate, but should be removed by a specialist hazardous waste disposal contractor. Wastes containing flammable or combustible liquids, even at low concentrations, shall not be poured down to the stormwater drain or included with general garbage.

Where large volumes of waste solvent are generated, a portable recycling unit may be used.

12.5 PRE-DISPOSAL TREATMENT OF EMPTY CONTAINERS

Empty containers shall be rendered safe by cleaning, and then punctured or crushed.

12.6 METHODS OF DISPOSAL

If disposal is necessary, the local waste disposal authority, the environment protection authority and the health department, as appropriate, shall be consulted on the acceptability of the proposed method of disposal.

NOTE: Advice may also be obtained from the supplier of the goods, environmental service companies or waste disposal companies.

APPENDIX A

FLAMMABLE LIQUIDS

(Informative)

A1 INTRODUCTION

The following information is taken from the 6th edition of the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code). The current edition of the ADG Code should be consulted for further information.

A2 DEFINITION AND GENERAL PROVISIONS

A2.1 Definition

Flammable liquids are liquids, or mixtures of liquids, or liquids containing solids in solution or suspension (for example paints, varnishes, lacquers, etc., but not including substances otherwise classified on account of their dangerous characteristics) which give off a flammable vapour at temperatures of not more than 60.5°C, closed-cup test, or 65.6°C, open-cup test, normally referred to as the flash point. This class also includes—

(a) liquids offered for transport at temperatures at or above their flash point; and

(b) substances that are transported, are offered for transport or are at elevated temperatures in a liquid state and which give off flammable vapour at a temperature at or below the maximum transport temperature.

NOTES:

1 The word ‘flammable’ has the same meaning as the now deprecated ‘inflammable’.

2 The flash point of a flammable liquid may be altered by the presence of an impurity. The substances listed as Class 3 in the Dangerous Goods List in Appendix 2 of the ADG Code are generally regarded as chemically pure. Since commercial products may contain added substances or impurities, flash points may vary, and this may have an effect on classification or determination of the Packing Group for the product. In event of doubt regarding the classification of Packing Group of a substance, the flash point of the substance should be determined experimentally.

3 The results of flash point tests, both open-cup and closed-cup, are not strictly comparable and even individual results by the same test are often variable.

A2.2 Exceptions

Liquids meeting the definition in Paragraph A2.1 with a flash point of more than 35°C which do not sustain combustion need not be considered as flammable liquids for the purposes of the ADG Code. Liquids are considered to be unable to sustain combustion for the purposes of the ADG Code (i.e. they do not sustain combustion under defined test conditions) if—

(a) they have passed a suitable combustibility test (see the sustained combustibility test prescribed in Part III, subsection 32.5.2 of the UN *Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria*); or

(b) their fire point, according to ISO 2592, is greater than 100°C (this criterion exempts many flammable liquids, water mixtures and blends of petroleum products for which the flash point does not truly represent the flammability hazard); or

(c) they are water miscible solutions with a water content of more than 90% by mass.

A2.3 Exclusions

The following substances are excluded from Class 3:

(a) Combustible liquids as defined in Clause 1.4.9 of this Standard.

(b) Aqueous solutions of ethanol containing not more than 24% ethanol by volume.

(c) Substances otherwise classified on account of their other more dangerous characteristics.

A3 ASSIGNMENT OF PACKING GROUPS

A3.1 Flammability risk

The criteria given in Table A1 are used to determine the Packing Group of a liquid that presents a risk due to its flammability. For a liquid whose only risk is flammability, the Packing Group for the substance is the hazard grouping shown in Table A1.

For a liquid with additional risk(s), the hazard group determined from Table A1 and the hazard group based on the severity of the additional risk(s) shall be considered. In such cases, the table of the precedence of hazard given in the ADG Code should be used to determine the correct classification of the liquid. The hazard grouping indicating the highest degree of danger based on the different risks of a substance then becomes the Packing Group of the substance.

A3.2 Determination of flash point

Tests for the determination of flash point are set out in AS/NZS 2106 series and in the UN *Recommendations on the Transport of Dangerous Goods.*

TABLE A1

HAZARD GROUPING BASED ON FLAMMABILITY

Packing Group	Flash point (closed cup), °C	Initial boiling point, °C
I	—	≤ 35
II	< 23	> 35
III	≥ 23 ≤ 60.5	> 35

A3.3 Viscous flammable liquids

Viscous substances such as paints, enamels, lacquers, varnishes, adhesives and polishes having a flash point of less than 23°C may be placed in Packing Group III in conformity with the procedures described in Part III, subsections 32.3.7, 32.4.2.2, 32.4.3 and 32.5.1 of the UN *Recommendations on the Transport of Dangerous Goods—Manual of Tests and Criteria* on the basis of—

(a) viscosity, expressed as the flow time in seconds;

(b) closed-cup flash point; and

(c) solvent separation test.

Viscous flammable liquids such as paints, enamels, lacquers, varnishes, adhesives and polishes having a flash point of less than 23°C are included in Packing Group III provided that —

(i) less than 3% of the clear solvent layer separates in the solvent separation test; and

(ii) the mixture does not contain any substance with a primary or a subsidiary risk of Class 6.1 or Class 8; and

(iii) the viscosity and flash point are in accordance with the following Table A2; and

(iv) the capacity of the receptacle does not exceed 450 L.

TABLE A2

CRITERIA FOR FLAMMABLE VISCOUS SUBSTANCES

Flow time (t), s		Flash point, °C
4 mm jet cup	**6 mm jet cup**	
$20 < t \leq 60$	—	>17
$60 < t \leq 100$	—	>10
—	$20 < t \leq 32$	>5
—	$32 < t \leq 44$	>–1
—	$44 < t \leq 100$	>–5
—	$100 < t$	≤–5

APPENDIX B

LIST OF REFERENCED DOCUMENTS

(Normative)

AS	
1019	Internal combustion engines—Spark emission control devices
1074	Steel tubes and tubulars for ordinary service
1170	Minimum design loads on structures (known as the SAA Loading Code)
1170.4	Part 4: Earthquake loads
1210	Pressure vessels
1216	Class labels for dangerous goods
1288	Glass in buildings—Selection and installation
1319	Safety signs for the occupational environment
1345	Identification of the contents of pipes, conduits and ducts
1482	Electrical equipment for explosive atmospheres—Protection by ventilation—Type of protection v
1530	Methods for fire tests on building materials, components and structures
1530.1	Part 1: Combustibility test for materials
1530.4	Part 4: Fire-resistance test of elements of building construction
1580	Paints and related materials—Methods of test
1580.301.1	Method 301.1: Non-volatile content by mass
1603	Automatic fire detection and alarm systems
1603.5	Part 5: Manual call points
1657	Fixed platforms, walkways, stairways and ladders—Design, construction and installation
1670	Fire detection warning control and intercom systems—System design, installation and commissioning (series)
1674	Safety in welding and allied processes (series)
1680	Interior lighting
1680.1	Part 1: General principles and recommendations
1691	Domestic oil-fired appliances—Installation
1692	Tanks for flammable and combustible liquids
1722	Pipe threads of Whitworth form (series)
1726	Geotechnical site investigations
1851	Maintenance of fire protection equipment (series)
1915	Electrical equipment for explosive atmospheres—Battery-operated vehicles
2118	Automatic fire sprinkler systems (series)
2118.1	Part 1: General requirements
2118.3	Part 3: Deluge

AS
2129 Flanges for pipes, valves and fittings

2243 Safety in laboratories
2243.10 Part 10: Storage of chemicals

2359 Powered industrial trucks (series)

2419 Fire hydrant installations (series)
2419.1 Part 1: System design, installation and commissioning

2441 Installation of fire hose reels

2444 Portable fire extinguishers and fire blankets—Selection and location

2452 Non-destructive testing—Determination of thickness
2452.3 Part 3: Use of ultrasonic testing

2683 Hose and hose assemblies for distribution of petroleum and petroleum products (excepting LPG)

2700 Colour Standards for general purposes

2809 Road tank vehicles for dangerous goods
2809.2 Part 2: Tankers for flammable liquids

2832 Cathodic protection of metals
2832.2 Part 2: Compact buried structures

2919 Industrial clothing

2941 Fixed fire protection installations—Pumpset systems

3600 Concrete structures

3664 Road/rail tankers—Transfer connectors for flammable and combustible liquids

3711 Freight containers
3711.6 Part 6: Tank containers

3765 Clothing for protection against hazardous chemicals
3765.1 Part 1: Protection against general or specific chemicals
3765.2 Part 2: Limited protection against specific chemicals

3846 The handling and transport of dangerous cargoes in port areas

3961 Liquefied natural gas—Storage and handling

4041 Pressure piping

4100 Steel structures

4214 Gaseous fire extinguishing systems

4265 Wheeled fire extinguishers

AS/NZS
1020 The control of undesirable static electricity

1221 Fire hose reels

1337 Eye protectors for industrial applications

1596 The storage and handling of LP Gas

1715 Selection, use and maintenance of respiratory protective devices

1716 Respiratory protective devices

1768 Lightning protection

AS/NZS

1800 Occupational protective helmets—Selection, care and use
1801 Occupational protective helmets

1841 Portable fire extinguishers
1841.4 Part 4: Specific requirements for foam type extinguishers
1841.5 Part 5: Specific requirements for powder type extinguishers
1841.6 Part 6: Specific requirements for carbon dioxide type extinguishers

1850 Portable fire extinguishers—Classification, rating and performance testing

1905 Components for the protection of openings in fire-resistant walls
1905.1 Part 1: Fire-resistant doorsets

2106 Methods for the determination of the flash point of flammable liquids (closed cup) (series)

2161 Occupational protective gloves (series)

2210 Occupational protective footwear (series)

2381 Electrical equipment for explosive atmospheres—Selection, installation and maintenance
2381.1 Part 1: General requirements

2430 Classification of hazardous areas
2430.3 Part 3: Examples of area classification (series)
2430.3.3 Part 3.3: Examples of area classification—Flammable liquids

2832 Cathodic protection of metals
2832.1 Part 1: Pipes and cables

2865 Safe working in a confined space

2906 Fuel containers—Portable—Plastics and metal

3000 Electrical installations (known as the Australian/New Zealand Wiring Rules)

3500 National Plumbing and Drainage Code
3500.1.2 Part 1.2: Acceptable solutions

4360 Risk management

ISO

2592 Determination of flash and fire points—Cleveland open cup method

ANSI

Z358.1 Emergency eyewash and shower equipment

ADVISORY COMMITTEE ON THE TRANSPORT OF DANGEROUS GOODS

ADG Code Australian Dangerous Goods Code
Volume 1: Requirements and recommendations, comprising the Australian Code for the Transport of Dangerous Goods by Road and Rail (6th edition) and the Rail (Dangerous Goods) Rules, and including the Road Transport Reform (Dangerous Goods) Regulations
Volume 2: Technical appendices

Specifications for Intermediate Bulk Containers for the Transport of Dangerous Goods

AUSTRALIAN BUILDING CODES BOARD

BCA Building Code of Australia

AUSTRALIAN HEALTH MINISTERS' ADVISORY COUNCIL

SUSDP Standard for the uniform scheduling of drugs and poisons

NOHSC NATIONAL OCCUPATIONAL HEALTH AND SAFETY COMMISSION
1003 Adopted National Exposure Standards for Atmospheric Contaminants in the Occupational Environment

1015 National Standard for the Storage and Handling of Dangerous Goods
2011 National Code of Practice for the Preparation of Material Safety Data Sheets

2012 National Code of Practice for the Labelling of Workplace Substances

3010 Guidance Note for Emergency Services Manifests

NFPA NATIONAL FIRE PROTECTION ASSOCIATION
11 Standard for Low-, Medium- and High-Expansion Foam Systems

15 Standard for Water Spray Fixed Systems for Fire Protection

16 Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems

30 Flammable and Combustible Liquids Code

AIP AUSTRALIAN INSTITUTE OF PETROLEUM
CP4 Design, Installation and Operation of Underground Petroleum Storage Systems

CP5 Pipeline and Underground Tank Identification

CP6 Vehicle Bottom Loading and Vapour Recovery

CP8 Precautions Against Electrostatic Ignition During Tank Vehicle Loading

CP16 Inspection and Integrity Monitoring of Large Steel Vertical Petroleum Storage Tanks

CP20 Safe Handling of Bitumen Products

CP22 The Removal and Disposal of Underground Petroleum Storage Tanks

AG AUSTRALIAN GAS ASSOCIATION
901 Code of Practice for NGV Refuelling Stations

API AMERICAN PETROLEUM INSTITUTE
Spec 6FA Fire Test for Valves
Std 607 Fire Test for Soft-Seated Quarter-Turn Valves

Std 620 Design and Construction of Large, Welded, Low-Pressure Storage Tanks

Std 653 Tank Inspection, Repair, Alteration and Reconstruction

Std 2000 Venting Atmospheric and Low-pressure Storage Tanks: Nonrefrigerated and Refrigerated

PICA PETROLEUM INDUSTRY CONTRACTORS ASSOCIATION

RP001 Recommended practices for installation of underground petroleum storage systems

UN UNITED NATIONS

Manual of Tests and Criteria

Recommendations for the Transport of Dangerous Goods—Model Regulations

IMO INTERNATIONAL MARITIME ORGANIZATION

IMDG Code International Maritime Dangerous Goods Code

ASTM
D92 Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester

IP INSTITUTE OF PETROLEUM
36 Standard method of test for flash and fire points by Cleveland open cup

BS BRITISH STANDARDS
6755-2 Testing of valves. Specification for fire type-testing requirements

UL UNDERWRITERS LABORATORIES
2085 Protected Aboveground Tanks for Flammable and Combustible Liquids

APPENDIX C

RECOMMENDATIONS FOR THE DESIGN AND CONSTRUCTION OF BLENDING PLANTS

(Informative)

C1 INTRODUCTION

This Appendix provides recommendations for the location, design and construction of installations where flammable or C1 liquids are used in blending, in quantities greater than those specified for minor storage. It sets out provisions for the location of dedicated blending and mixing areas, buildings and vessels and their associated equipment and control rooms. These recommendations are additional to the requirements given in the body of this Standard.

C2 LOCATION OF BLENDING AREAS

C2.1 Blending areas outside of buildings

A dedicated blending area should—

(a) be located at least 15 m from any on-site protected places outside the blending area;

(b) be separated from protected places on adjacent properties by at least the distances specified in Table 4.1 of this Standard, but in no case less than 15 m; and

(c) comply with the relevant Part of AS/NZS 2430 with respect to distances from ignition sources.

NOTE: The 15 m separation distance addresses the minimum requirement by local fire authorities in emergency situations.

The separation distance (see Table 4.1 of this Standard) is based upon the maximum blending capacity at any one time and the highest hazard Packing Group that is to be used in the process area or building.

C2.2 Enclosed and partially-enclosed, single storey, non-fire rated blending buildings

NOTE: For the purpose of this Clause, a roofed area with more than one wall enclosed is considered a building.

The separation distances set out in Paragraph C2.1 apply. Distances from ignition sources may be measured around vapour barriers.

C2.3 Single-storey blending buildings with fire rated walls

In such areas, the separation distances to other buildings specified in Paragraph C2.1 apply. Such distances may be measured around a fire rated wall.

C2.4 Multi-storey plants

In such areas, the separation distances given in Paragraph C2.2 and Paragraph C2.3 apply. In order to ensure building stability under fire conditions, the main structural members of a multi-level building should have an FRL of at least 240/240/240 wherever—

(a) flammable liquids or bulk tanks are placed at levels above the ground floor level;

(b) the building has a control room; or

(c) personnel work within such a plant.

In other areas, structures do not need to be fire-rated, provided that the separation distances to on-site and off-site protected places exceed 25 m for a two storey structure and 50 m for any structure of three storeys or more.

The above distances are the minimum, unless exceeded by Table 5.4 of this Standard, based on the maximum aggregate quantity of flammable liquids capable of being blended at any one time.

C3 SPILLAGE CONTAINMENT

Spillage containment should be provided for all process areas, with a capacity of 25% of the total maximum processing volume at any one time. This containment needs to be capable of containing the output of any fire sprinklers over a 20-minute period.

Such containment may be either directly under the process area or shall run off to an adjacent catchment area. Reference should be made to Clause 5.8 of this Standard.

C4 VENTILATION

With the exception of open-air process areas, any enclosed buildings should be provided with mechanical ventilation in accordance with Clause 4.5 of this Standard, except that the air transfer rate in the process area needs to be increased to 1.5 times the air transfer rate for storage areas.

Good design guidance would include a floor scavenging system meeting the requirements of Clause 4.5 of this Standard, in addition to dedicated systems at vapour release points. A system complying with Clause 4.5 alone generally would not be adequate in a blending area.

C5 HAZARDOUS ZONES AND AREAS

The relevant requirements of the AS/NZS 2430 series apply to blending areas. Electrical equipment needs to be suitable for use in that particular zone.

C6 DESIGN CRITERIA FOR BLENDING AREAS

C6.1 Blending vessels

The following recommendations apply:

(a) All blending vessels having a capacity of more than 450 L should be designed—

(i) to AS 1692 for tanks; or

(ii) to AS 1210 for pressure vessels.

Other Standards or codes may be used, provided it can be demonstrated that they are at least equivalent to the above Standards.

Specialized equipment such as high-speed dispersers, ball mills and variable speed agitators should incorporate the requirements of the above Standards.

(b) Blending vessels should be located at least 600 mm apart and from the walls of the process building.

NOTE: A distance of 1 m is preferred, but 600 mm is the bare minimum to allow safe operation and service of such vessels.

(c) The blending vessel's supports or legs should have an FRL of at least 120/120/120 if they are more than 1 m in height. Similarly, where process vessels are suspended on a mezzanine floor, the floor's supports should have an FRL of at least 120/120/120.

(d) Any uncontrolled reaction should be able to be handled either within the reactor itself or transferred via a bursting/rupture disc to a nearby knockout drum or vessel.

C6.2 Blending areas

General walkways, platforms, piping and electrical wiring shall be carefully planned to provide clean areas, free of hazards to the operators.

C7 CONTROL ROOMS

Where there is a control room associated with the blending area, the following recommendations apply:

(a) Where the control room is less than 15 m from the process area, its walls should have an FRL of at least 60/60/60.

NOTE: If the control room is physically separated by at least 15 m from the process area, no special requirements apply with regard to FRL.

(b) Where the control room is in a hazardous zone, it should be under positive pressure. This system should be in continuous operation whenever flammable liquids are being processed.

(c) Fresh air should be supplied to the room from a safe plenum located outside of the hazardous area (see also Paragraph C5).

(d) The control room's ventilation system should be interconnected to either an air flow monitor in the supply duct or a positive pressure switch in the control room.

When such a switch is tripped, an audible and visual alarm should be activated within the room if it is occupied. Additional alarms should sound externally if the room is unmanned during long periods of automatic blending. Where pressure is not restored to the control room within a predetermined time, all electrical equipment not suitable for use in a hazardous area within the room needs to be shut down. This shut-down procedure needs to be designed to ensure that in any shut-down mode, the process can continue to operate safely or default to safe shutdown.

NOTE: AS 1482 should be consulted.

(e) Control rooms within multi-level process buildings shall be carefully assessed, apart from the normal requirements for completely enclosing the room with fire-rated walls.

NOTE: A safe means of allowing operators and emergency services personnel to enter such buildings during an emergency should be considered.

C8 SAFETY REVIEWS

In designing such plants, the steps of Hazard and Operating Studies (HAZOP), safety review workshops and other safety process management system reviews should be carried out. These steps are vital to ensure that such plants are tested in a deliberate manner for all of the envisaged failure modes that could occur. This is to ensure that the plant will operate safely within the site and the surrounding environment.

APPENDIX D

USE OF NON-FLAMEPROOF FORK-LIFT TRUCKS AND VEHICLES IN FLAMMABLE LIQUIDS PACKAGE STORES

(Normative)

D1 INTRODUCTION

This Appendix sets out requirements for a system under which a non-flameproof fork-lift truck or similar vehicles may be operated in a Zone 2 hazardous area within a flammable liquids package store.

Such a package store shall comply with all relevant requirements of the body of this Standard, including—

(a) Clause 1.1, Scope;

(b) Section 3, General requirements;

(c) Section 4, Package storage and handling areas, in particular Clause 4.10, Activities within package stores;

(d) Section 9, Operational and personnel safety, in particular Clause 9.4, Management of leaks and spills, and Clause 9.10, Personnel training;

(e) Section 10, Emergency management; and

(f) Section 11, Fire protection.

NOTE: The above list is not exhaustive.

D2 FACTORS CONSIDERED

The following factors have been considered when compiling the requirements set out in this Appendix:

(a) The minimum ratio of floor to quantity stored provides sufficient volume of air to disperse any vapours (e.g. from minor leakage).

(b) The restricted storage quantity limits the likely frequency of access by the fork-lift truck.

(c) The restricted package size limits the magnitude of any spillage.

(d) The restricted storage height reduces the likelihood of leaks and spills resulting from dropped and damaged packages.

(e) The use of a checklist is intended to ensure that the fork-lift truck has no immediately obvious faults, and that no flammable vapours are evident in the package store when operations are commenced.

D3 SPECIFIC REQUIREMENTS

D3.1 Requirements for the package store

The package store shall comply with the following:

(a) The total volume of Class 3 dangerous goods (primary and subsidiary risk) stored shall be less than 25000 L.

(b) Liquids of PG I shall not be stored.

(c) The package store shall have a floor area of at least 100 m^2 for every 1000 L of flammable liquid stored. In any case, the floor area shall be at least 100 m^2.

(d) All packages shall be of a type that complies with the ADG Code.

(e) Packages shall be kept tightly closed at all times.

(f) Packages shall not be larger than 250 L.

(g) Packages larger than 25 L shall be kept on pallets.

(h) Packages shall not be stored higher than 2 m maximum drop height (i.e. the bottom of the highest package) above floor level.

NOTE: Pallets of 200 L drums may be stacked three-high.

D3.2 Requirements for the fork-lift truck

Any fork-lift truck that is to be used in the package store (as described in Paragraph D3.1) shall comply with the following:

(a) The fork-lift truck shall be serviced and maintained in good repair.

(b) The fork-lift truck shall carry a powder-like fire extinguisher in a quick-release bracket.

(c) The fork-lift truck shall not be garaged, refuelled, charge or serviced within the package store.

D3.3 Procedures and work permit

The following procedures shall apply:

(a) The fork-lift truck and the package store shall be inspected to ensure that they comply with the requirements of the relevant checklist before any work permit is issued.

NOTE: There may be a need to check behind any stacked packages or pallet racks in case any packages have fallen and spilt.

(b) A work permit shall be in effect whenever a fork-lift truck is driven into or within the package store.

(c) The work permit shall be valid only for the day or shift on which it is issued, and shall be re-validated each day or at each change of shift.

Following are examples of work permit for issue when a non-flameproof fork-lift truck is to be used within a flammable liquids package store.

Work Permit for Internal Combustion Fork-lift Trucks

For premises: .....

.....

Fork-lift identification (registration or identification number).....

The fork-lift has been inspected and—

Permission is given only for the day of issue or reissue of this permit for the fork-lift to enter the store(s) for Class 3 primary or subsidiary risk, as listed below:

	Day 1	2	3	4	5	6
• it does not have any apparent fuel or oil leak (e.g. with an LP Gas fork-lift, no gas smell, loose hose or pipe connections frayed or kinked hoses, loose cylinder fittings)	☐	☐	☐	☐	☐	☐
• all electric equipment appears to be in good order (e.g. no broken light covers or globes, bare wires, loose connectors)	☐	☐	☐	☐	☐	☐
• the exhaust system allows exhaust gas to escape only through the muffler tailpipe (e.g. no passing gaskets or joints, corroded or damaged exhaust manifold, pipe or muffler)	☐	☐	☐	☐	☐	☐
• all tyres appear to be in good working condition	☐	☐	☐	☐	☐	☐
• the brakes appear to be in good working condition	☐	☐	☐	☐	☐	☐
• the fan belt and any other drive belt does not appear to be slipping	☐	☐	☐	☐	☐	☐
• the required fire extinguisher is in place on the fork-lift	☐	☐	☐	☐	☐	☐
• the fork-lift appears to be safe to use and free from defects that might be a source of ignition or cause a fire risk	☐	☐	☐	☐	☐	☐
The store(s) identified below has been inspected and there are no apparent leaks or spills of flammable liquids.	☐	☐	☐	☐	☐	☐

Permission is given only for the day of issue or reissue of this permit for the fork-lift to enter the store(s) for Class 3 primary or subsidiary risk, as listed below:

Store: Store:

	Signed	Title	Date	Time
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

Work Permit for Electrical Fork-lift Trucks

For premises: .....

.....

Fork-lift identification (registration or identification number).....

The fork-lift has been inspected and—

	Day	1	2	3	4	5	6
• The battery is secure and its water level is adequate.		☐	☐	☐	☐	☐	☐
• All electric equipment appears to be in good order (e.g. no broken light covers or globes, bare wires, loose connectors.		☐	☐	☐	☐	☐	☐
• The battery connections are clean and tight.		☐	☐	☐	☐	☐	☐
• All tyres appear to be in good working condition.		☐	☐	☐	☐	☐	☐
• The brakes appear to be in good working condition.		☐	☐	☐	☐	☐	☐
• All covers and seals are intact.		☐	☐	☐	☐	☐	☐
• The required fire extinguisher is in place on the fork-lift.		☐	☐	☐	☐	☐	☐
• The fork-lift appears to be safe to use and free from defects that might be a source of ignition or cause a fire risk.		☐	☐	☐	☐	☐	☐
The store(s) identified below has been inspected and there are no apparent leaks or spills of flammable liquids.		☐	☐	☐	☐	☐	☐

Permission is given only for the day of issue or reissue of this permit for the fork-lift to enter the store(s) for Class 3 primary or subsidiary risk, as listed below:

Store: Store:

	Signed	Title	Date	Time
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

APPENDIX E

RECOMMENDATIONS FOR THE STORAGE AND HANDLING OF PACKAGED FLAMMABLE LIQUIDS IN COOLROOMS

(Informative)

E1 INTRODUCTION

This Appendix sets out recommendations for the storage of packaged flammable liquids in coolrooms. These are additional to the requirements set out in the relevant Sections of the Standard.

E2 TYPES OF STORE

Cooled storage may be —

(a) the entire flammable liquids store;

(b) a partitioned section of the flammable liquids store; or

(c) a modified flammable liquids cabinet.

E3 INSULATION

A2

Materials used for insulation should not be capable of promoting a fire. The materials' potential for releasing toxic gases in a fire situation should also be considered.

Non-fire rated sandwich panels that could melt in a fire should not be used. Such panels, when made from polystyrene or polyurethane, are unsuitable for internal walls.

Insulating material should be protected against exposure to and absorption by liquids and vapours. The insulating material should be checked from time to time.

E4 VENTILATION

E4.1 Principles of ventilation

Where ventilation in accordance with Clause 4.5 cannot be achieved, measures should be taken to —

(a) prevent exposure to harmful atmospheres, e.g. concentrations of flammable vapour, or oxygen depletion;

(b) identify any concentration of flammable vapour in air of 5% of LEL or more; and

(c) remove any flammable vapours by forced extraction.

E4.2 Air replacement systems

The air removal system should comply with Clause 4.5.5. Where an external air supply cannot be used, air may be drawn from the surrounding store. Vapour detectors should be used to —

(a) activate an alarm if the exposure threshold is exceeded; and

(b) switch a continuously recirculating cool air system from recirculation to exhaust at 5% of LEL; or

(c) activate air extraction fans if a high concentration of vapour persists for several minutes or if 10% of LEL is exceeded.

E5 COOLING SYSTEM REQUIREMENTS

The cooling system should comply with the requirements regarding hazardous area zoning and ignition sources given in Section 4. Materials of construction should not generate sparks.

Where a cabinet provides cooled storage, coils chilled with water or brine piped in from a water cooling unit may provide effective cooling.

For small rooms, domestic non-explosion protected airconditioners may be used if—

(a) their location complies with hazardous zoning requirements;

(b) they are hard-wired for fresh air intake only;

(c) at least 3 m of ducting is installed outside the store, between the air conditioner outlet and the air intake to the store; and

(d) in case of air-flow failure, a there is a suitable device to automatically close off the duct from the airconditioner and open the duct to the atmosphere, in order to prevent any flammable vapours from being drawn back into the coolroom (see Figure E1).

E6 STORAGE BELOW FLASHPOINT

Where flammable liquids are to be continually stored below their flash point, in order to exclude the need for hazardous atmosphere zoning, a documented risk assessment should be carried out. The following items need to be considered:

(a) The temperature of the liquids should be maintained at least 10°C below the lowest flash point.

(b) Appropriate temperature monitoring, alarm and response systems should be provided and records of testing kept.

NOTE: A response system may include back-up refrigeration, removal to another storage or elimination of ignition sources.

(c) Any vehicle, equipment or goods brought into the store should not cause the temperature to rise above a specific, stated minimum.

(d) Spills and leaks of flammable liquids should be prevented from coming into contact with any surfaces that have not cooled to storage temperature. This may require special precautions for equipment such as powered forklift trucks.

(e) All electrical equipment within the coolroom needs to be suitable for use within a hazardous area as defined in the AS/NZS 2430 series.

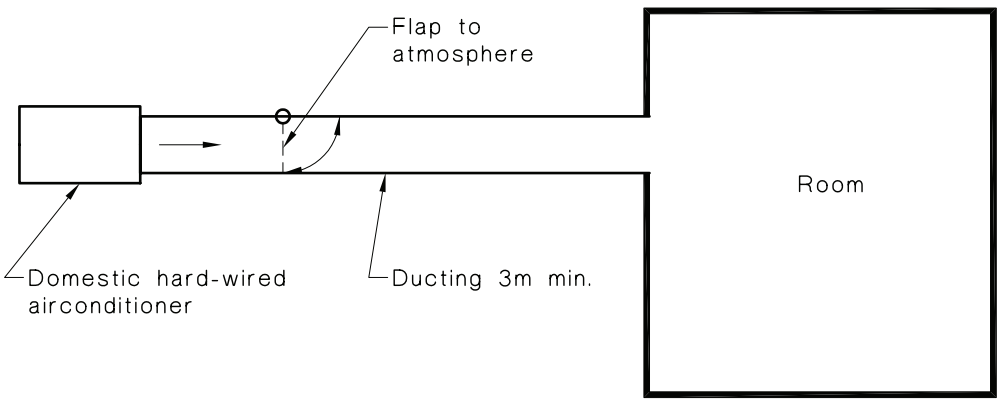


FIGURE E1 AIR COOLING SYSTEM

APPENDIX F

ISSUES TO BE CONSIDERED IN A RISK ASSESSMENT

(Informative)

F1 HAZARD ASSESSMENT

F1.1 Introduction

The following paragraphs outline the hazards that should be considered when planning a store for flammable and/or combustible liquids. A thorough assessment can help to detect and correct any potentially hazardous situations, and is best carried out using systematic methods including safety studies and check lists.

NOTE: AS/NZS 4360 provides further information on risk management.

F1.2 Factors to be considered

When evaluating the suitability of a location for the store, the following features should be considered:

(a) The nature and quantities of liquids to be kept on the site.

(b) The manner by which the liquids are to be handled, including the type of equipment to be used (e.g. flameproof fork lift trucks).

(c) The store operator's technical, operational, organizational and emergency procedures and safeguards, including communications and emergency response.

(d) Access to the store, including that required for normal transport operations, emergency response vehicles, and any evacuation routes.

(e) Surrounding land uses, population densities and proximity to other hazardous installations.

(f) The interaction of the abovementioned factors.

F1.3 Hazards presented by the liquids being stored

Flammable and combustible liquids can present the following potential hazards:

(a) *Flammability*—the potential to burn or explode when ignited.

(b) *Instability*—the potential to undergo a spontaneous reaction (e.g. decomposition, polymerization), which could be violent.

(c) *Reactivity*—the potential to react with other chemicals, water or fire-extinguishing media.

(d) *Toxicity*—the immediate, delayed or long-term health effects on humans or animals, through inhalation, skin absorption or ingestion.

(e) *Environmental impact, including ecotoxicity*—the effect on the environment, in particular to aquatic life.

(f) *Corrosivity*—the potential corrosive chemical action on other materials, in particular, packagings and living tissue (including skin).

Further information may be obtained from product labels, MSDS and the supplier of the liquids.

F1.4 Hazards presented by package storage conditions

The manner in which the liquids are stored should be considered. For package stores, these include the following conditions:

(a) Storage arrangements, including—

  (i) the volume of liquids in each storage;

  (ii) stacking height and density;

  (iii) palletizing pattern;

  (iv) segregation of liquids having different hazards; and

  (v) high-rack storage.

(b) The nature of the packaging, especially where small packages are stored. Paper and plastics packagings can be highly combustible. The mechanical strength of the packagings is also important, as damage could lead to leaks and spills.

(c) The design and construction of the store, fittings (e.g. lighting and heating), alarms and firefighting equipment.

(d) Activities within the store, including maintenance, handling, introduction of ignition sources and other potential causes of incidents.

F1.5 Hazards related to the environment

The following hazards should be considered:

(a) Proximity of the store to nearby industrial plants, hazardous installations, other dangerous goods stores, or traffic.

(b) Natural events, e.g. floods.

(c) Extreme climatic conditions, e.g. high or low temperature or humidity. These could affect the integrity of packagings or the stability of the liquids being stored.

(d) Security of the store.

F2 RISK ASSESSMENT

F2.1 Introduction

A risk assessment is a systematic approach to the analysis of what can go wrong in a complex system. The normal conditions of operation are defined, and then the following questions are asked:

(a) What events (e.g. accidents, incidents) can occur?

(b) How frequently can they occur?

(c) What are the consequences of each event?

(d) What are the total risks (i.e. the probability and consequence of events) of the system?

(e) What is the significance of the calculated risk levels?

These questions form the basic components of a quantitative risk assessment (QRA).

F2.2 Objectives of risk assessment

The primary objectives of risk assessment can be summarized as follows:

(a) Determine the risks generated by activities within the store.

(b) Prepare the structure of a safety management system.

(c) Ensure the risk is maintained at an acceptable level. This may be by implementing controls.

(d) Provide assurance to the operator, the regulatory authority and the public that the operations of the store do not pose an unacceptable level of risk.

(e) Provide assurance that the safety management system is maintained and applied so as to achieve the above objectives.

F2.3 Risk analysis/assessment

Risk analysis/assessment involves the following basic steps:

(a) System evaluation, in which information on the facility and the environment in which it operates, is collated and assimilated.

(b) Hazard identification, in which events within and external to the store (which could lead to the release of hazardous material) are identified.

(c) Frequency estimation, in which the likelihood of an event is estimated. This is normally based on historical data.

(d) Consequence assessment, in which all possible consequences of each event are estimated.

F2.4 Risk reduction

If the risks are assessed as being too high, the system should be modified to attempt to reduce the risks to a tolerable level.

APPENDIX G

STORAGE AND HANDLING OF POTABLE SPIRITS IN BULK

(Normative)

G1 INTRODUCTION

This Appendix provides requirements that apply to the storage and handling of bulk potable spirits having an alcohol (ethanol) content of more than 24% v/v. These requirements are alternative to those given in Section 5, but apply only to those liquids as described above.

This Appendix covers the traditional methods of production used in the wine and brandy industries at existing installations. It has been derived from traditional methods of storage, and it is recognized that the level of performance requirements are lower than those that apply in the body of this Standard.

Installations at which potable spirits having an alcohol content greater than 60% v/v, quantities greater than 60 000 L, shall comply with the requirements of the main body of the Standard as appropriate.

New installations are advised to either comply with the body of this Standard (in particular, Sections 3 and 5) or carry out a risk assessment.

Where the requirements of this Appendix need to be varied, either Section 5 shall apply, or a risk assessment conducted and appropriate control measures implemented.

G2 LOCATION AND SEPARATION OF CONTAINERS

G2.1 Location

Containers may be located indoors or in the open air, with or without a roof.

Where they are located indoors, the following requirements and recommendations apply:

(a) Sufficient high and low level ventilation shall be provided, to ensure that the concentration of vapours from foreseeable spills or tank filling does not exceed 10% of the LEL.

NOTE: A minimum of 2% of the total area of roof and walls is considered adequate.

(b) Where containers are to be installed in a multi-storey structure, a risk assessment shall be conducted to consider the possibility of vapour release and ignition, and steps shall be taken to mitigate or control the consequences.

Potable spirits may be kept in a multi-purpose building, provided that the vessels containing the flammable potable spirits are clearly marked and protected as required (e.g. tank venting, building ventilation and bunding).

G2.2 Separation distances

G2.2.1 *At wineries, distilleries and similar installations*

The following requirements and recommendations apply:

(a) The separation distance from the store to the boundary shall be sufficient to allow firefighting operations to be carried out from a safe distance and from two separate locations.

(b) Where a room or office is inside the store and is used for the direct supervision of the store, the requirements of Clause 4.11 shall apply.

(c) Any office or location where people congregate (e.g. a display or customer area) shall be separated from the containers by a distance of at least 5 m or by a barrier having an FRL of at least 120/120/120.

(d) Clusters of tanks, barrels or vats are acceptable, provided they are accessible by firefighting equipment from a safe distance and from at least two directions.

G2.2.2 *At other locations*

The provisions of Sections 3 and 5 of this Standard shall be observed.

G3 SPILLAGE CONTAINMENT

In rural areas, a means of confining a spill, for the purpose of environmental protection, shall be provided. Spillage containment shall be capable of retaining at least 100% of the volume of the largest container.

At all other premises, spill catchment shall be provided in the immediate vicinity of the container. Such a catchment shall be capable of retaining at least 110% of the volume of the largest container.

G4 CONTAINERS

G4.1 Materials of construction

Containers shall be constructed from a material which will not be detrimentally affected by the liquid being stored. Wooden containers are acceptable provided that the integrity of the liquid being stored can be ensured.

G4.2 Design of containers

The following requirements apply:

(a) Containers shall be designed to withstand the load of their contents and any pressure and vacuum variations that could occur during normal operations.

(b) Where a container will be installed in the open air, it shall be designed to take wind loading into account.

(c) Any container with a capacity of more than 60 kL and intended to store liquids with an alcoholic strength greater than 60% v/v shall be designed to AS 1692 or other equivalent standard. Smaller tanks shall be designed so as to be fit for purpose.

G4.3 Installation of containers

The following requirements apply:

(a) The container shall be installed upon a firm foundation.

(b) A container shall be placed either directly on the floor, or on supports resting on the floor.

(c) Any container installed out of doors shall be firmly secured to the ground.

G4.4 Vents

Wooden containers do not need vents, provided that operations are managed so that the container will not be pressurized beyond its design capability.

Other containers that have a capacity greater than 60 kL and that contain liquids having greater than 60% v/v alcohol shall have venting conforming to the requirements given in Section 5 of this Standard.

Where containers are kept within a room that has non-flameproof electrical equipment, a flame arrester should be provided if the vent discharges into the room.

G4.5 Emergency fire relief vents

Emergency relief venting in accordance with Section 5 shall be provided for all containers except the following:

(a) Wooden containers.

(b) Containers installed in rural areas, or separated from boundaries by at least 15 m.

G4.6 Valves

The following requirements apply:

(a) Valves shall be of a material that is compatible with that of the container, and shall not cause any electrochemical corrosion from the use of dissimilar materials.

(b) All valves shall be located as close as possible to the shell of the container.

(c) Valves shall be designed so that they cannot open by themselves. Plug cocks shall not be used, as the plug might be lifted from its housing by the head of liquid in the container.

G4.7 Level indication

Each storage tank shall be provided with a means of ascertaining the liquid level. If the indicator is of a type designed to be read at a remote location, additional facilities for checking its accuracy shall be provided. The maximum permitted filling level shall be indicated on the gauge.

Acceptable types of indicators include float gauges, hydrostatic pressure gauges, dipsticks or dip tapes. If a dipstick is used, it should be kept in or near to the container.

Where a tank contains a potable liquid having an alcohol content of 60% v/v or greater, the liquid level shall be monitored regularly and a high level alarm shall be fitted.

NOTE: Any change of contents of the tank may alter the maximum permitted filling level.

G4.8 Container identification

Every container shall be identified by a number.

G5 PIPES AND HOSES

Wherever possible, liquids shall be transferred using fixed pipework. The length of any flexible hose used shall be kept to a minimum.

Pipework shall comply with Section 6.

G6 ELECTRICITY EQUIPMENT

The area in which the potable alcohol is stored shall be classified into hazardous zones as described in the AS/NZS 2430.3.3 series and electrical equipment shall be selected so as to be suitable for use in that zone.

G7 OPERATIONS

G7.1 Identification of stores

Where a liquid having an alcohol content of 24% v/v or greater is stored, the store shall display the Class 3 dangerous goods diamond.

G7.2 Filling of tanks

A written, displayed system of work shall be in place to ensure that the volume of liquid transferred is that which the receiving tank can safely accept.

A bulk container shall not be filled beyond its safe fill level. The information on the level of liquid in the container shall be available at the point where the transfer is to take place, or at a central control point.

It is preferable to have a constant indication of the liquid level in the container at the transfer point or central control point. If this is not possible, information on the ullage space in the container shall be available to the person conducting the transfer.

When potable spirit with an alcohol content greater than 60% v/v is transferred, a constant level indication or high level alarm shall be provided at either the transfer point or the central control point.

G7.3 Filling into road tankers or other transportable tanks

The requirements of the ADG Code shall be observed.

G8 FIRE PROTECTION

Fire protection should comply with Section 11 of this Standard. Any foam used in firefighting should be alcohol resistant.

APPENDIX H

POWER STATION AND GRID TRANSFORMERS

(Normative)

H1 INTRODUCTION

This Standard relates specifically to storage and handling and generally does not apply to electrical equipment which in normal operation uses combustible mineral oil as an insulating and cooling medium. However, the requirements of the Standard regarding containment of liquid spills apply in principle, since large volumes of oil can be involved.

Electrical equipment filled with combustible oil shall comply with the requirements of Clause 5.8, amended as set out below.

H2 SPILL CONTAINMENT

Spill containment shall be in the form of a tank, pond, or other storage. It shall—

(a) have a net capacity not less than that of the largest single unit draining to it; and

(b) be equipped with underflow discharge.

H3 COMPOUND DRAINAGE

Where a compound is provided with continuous drainage, draining shall be via a flame trap or traps to an oil spill containment facility.

H4 AUXILIARY EQUIPMENT

This Appendix does not apply to instrument transformers, circuit breakers, and similar items in outdoor switchyards.

APPENDIX I

TANK VENTING

(Normative)

I1 INTRODUCTION

This Appendix is derived from API 2000, converted to SI units. When more detailed information is required, the original document should be consulted.

I2 VENTING ATMOSPHERIC AND LOW-PRESSURE STORAGE TANKS

I2.1 Normal venting capacity

The total normal venting capacity shall be at least the sum of the venting requirements for liquid movement and thermal effect due to maximum change in atmospheric temperature.

Vacuum relief (in-breathing)

Total venting capacity (m^3/h) = 0.06 (maximum outflow, L/min) + column 2 of Table I1.

Pressure relief (out-breathing)

For liquid with a flash point of 38°C or above:

Total venting capacity (m^3/h) = 0.064 (maximum inflow, L/min) + column 3 of Table I1.

For liquid with a flash point below 38°C:

Total venting capacity (m^3/h) = 0.128 (maximum inflow, L/min) + column 2 of Table I1.

NOTE: Appendix K of API 620 states that the maximum inflow terms in the above formulas should be multiplied by the ratio of the absolute tank pressure to standard atmospheric pressure. This correction would be insignificant, and may be ignored, unless the tank pressure is substantially above atmospheric pressure.

I2.2 Emergency venting capacity

The emergency venting capacity shall be not less than that given in Table I2.

The total venting requirements determined from Table I2 or Note 4 thereof are based on the assumption that the stored liquid will have the characteristics of hexane, since this will provide results which are within an acceptable degree of accuracy for almost all petroleum liquids encountered. However, if a greater degree of accuracy is desired, the total emergency venting requirement for any specific liquid may be determined by the following equation:

$$\text{Emergency venting capacity } (m^3/h) = \frac{3100 q_v}{u\sqrt{M}}$$

where

q_V = emergency venting capacity from Table I2, in cubic metres per hour

u = specific latent heat of vaporization of the liquid, in kilojoules per kilogram

M = molar mass of the liquid, in grams per mole

Full credit may be taken for the vent capacity provided for normal venting, since the normal thermal effect can be disregarded during a fire, and it can also be assumed that there will be no liquid movement into the tank.

Under certain conditions an environment factor may be applied in the calculation of the rate of emergency venting required; reference should be made to API 2000 which outlines appropriate factors.

TABLE I1

THERMAL VENTING REQUIREMENTS

Tank capacity	Free air venting capacity (Notes 1 and 2) m^3/h	
m^3	Flash point <38°C	Flash point ≥38°C
10	1.8	1.2
15	2.7	1.6
20	3.6	2.2
50	9.0	5.4
75	14	8.0
100	18	11
200	36	22
500	89	54
1 000	178	107
2 000	356	214
3 000	534	320
4 000	683	427
5 000	828	498
6 000	925	569
7 000	1 031	640
8 000	1 140	684
10 000	1 280	768
12 000	1 420	852
14 000	1 560	936
16 000	1 700	1 124
18 000	1 845	1 110
20 000	1 980	1 192
25 000	2 290	1 393
30 000	2 645	1 575

NOTES:

(a) Interpolate venting capacity for tanks of intermediate size.

(b) At 101.5 kPa (absolute) and 15°C.

I3 CAPACITIES OF FREE ORIFICE-TYPE VENTS

The capacity of a vent which consists of a free circular opening, or which is of such a simple construction that it practically is a free circular opening, may be determined from Table I3 for 200 mm diameter or less.

For free circular openings larger than 200 mm in diameter, the following equation is used:

$$\text{Venting capacity } (m^3/h) = 0.0575 d^2 \sqrt{\Delta p}$$

where

d = diameter of orifice, in millimetres

Δp = difference in pressure between the inside and the outside of the tank, in kPa

TABLE I2

EMERGENCY VENTING CAPACITY

Wetted area (Note 1) m^2	Free air venting capacity (Notes 2, 3) m^3/h	Wetted area (Note 1) m^2	Free air venting capacity (Notes 2, 3) m^3/h
1	321	35	8 510
2	643	40	9 200
3	964	45	9 875
4	1 286	50	10 450
5	1 607	55	11 010
6	1 929	65	12 110
7	2 250	75	13 130
8	2 572	85	14 100
9	2 893	95	15 000
10	3 214	100	15 680
12	3 857	130	16 600
14	4 500	150	17 400
16	5 143	170	18 170
18	5 786	200	19 200
20	6 200	230	20 170
25	7 030	260	21 000
30	7 800	(Note 4)	

NOTES:

1 The wetted area for a tank is calculated as follows:

Sphere or spheroid: Total exposed surface up to the maximum horizontal diameter or to a height of 8 m, whichever is greater.

Horizontal tank: 75% of the total exposed surface.

Vertical tank: Total exposed surface of the shell within a maximum height of 8 m above grade.

2 Interpolate venting capacity for intermediate values of wetted area.

3 At 101.5 kPa (absolute) and 15°C.

4 If the wetted area exceeds 260 m^2 but the tank is designed for pressures of 7 kPa or lower, no increase in venting capacity is required. If the wetted area exceeds 260 m^2 and the tank is designed for pressures higher than 7 kPa, the *total* venting capacity is determined by the following formula:

Emergency venting capacity (m^3/h) = $220\ A^{0.82}$

where A = wetted area, in square metres.

TABLE I3
DIAMETERS OF FREE CIRCULAR OPENINGS

Venting capacity	Orifice diameter*, mm					
	Differential pressure, kPa					
m^3/h	0.25	0.50	0.75	7	17.5	35
50	42	35	32	32	32	32
100	60	50	45	32	32	32
250	93	78	71	41	32	32
500	132	111	100	57	46	38
750	162	136	123	70	56	47
1 000	187	157	142	81	65	54
1 250	—	175	158	91	72	61
1 500	—	192	174	99	79	66
2 000	—	—	200	115	91	77
4 000	—	—	—	162	129	108
6 000	—	—	—	200	158	133
8 000	—	—	—	—	182	153
10 000	—	—	—	—	200	172
12 000	—	—	—	—	—	188
14 000	—	—	—	—	—	200

* Interpolate diameter for intermediate values of venting capacity and differential pressure.

APPENDIX J

FIRE EXPOSURE PROTECTION

(Normative)

J1 INTRODUCTION

In certain circumstances a tank may need to be protected from the radiant heat emanating from a tank fire nearby. The usual means of protection is to apply cooling water to the tank surfaces.

This Appendix gives a procedure for determining which tanks need cooling water, how much water is required for each tank, and how much water is required in total for the group. It also provides for a basic minimum volume of cooling water, recognizing the possibility that a comparatively large installation could, by a combination of circumstances, fall outside all the other conditions that call for cooling.

The assumptions on which this Appendix is based are as follows:

(a) Any vertical fixed-roof tank that contains flammable liquid is considered to be a potential tank-on-fire, and therefore to be a potential source of heat radiation to an adjacent tank. A tank containing a combustible liquid which shares a compound with a tank storage of flammable liquid is also considered to be a potential tank-on-fire.

(b) Radiation levels were established on the basis of a burn-down rate of the liquid level of 300 mm/h.

(c) The intention is to control the temperature rise of an adjacent tank to a safe level by applying cooling water to that portion of the tank shell or roof that might be exposed to radiant heat.

(d) For the purpose of calculation, the surface of the tank subject to radiant heat is taken as approximately 1/3 the tank circumference multiplied by its height plus any corresponding surface of the roof.

(e) Safe temperature levels were established in relation to the ignition temperature of the type of products being dealt with, i.e. 250°C, to provide a substantial margin below that figure.

(f) Where the adjacent tank is separated from the tank-on-fire by more than 1.5 times the latter tank's diameter, the calculated temperature rise remains below the safe limit without the need for cooling water.

(g) The method ignores the potential cooling effect of the latent heat of evaporation of the water, so there is an additional safety factor which is not taken into the calculations.

(h) Special circumstances on the day, such as wind strength and direction, may require that tanks at distances greater than 1.5 diameters be cooled, or it may be considered desirable to increase the water rate to tanks already covered. It is intended that the uncommitted reserves available in the hydrant system, plus spare cooling water available as the result of reduced upwind cooling needs, would provide the required degree of flexibility in the operation of the system.

(i) A floating-roof tank is not considered to be a potential tank-on-fire. It may, however, qualify as a tank at risk, and thus require cooling water.

(j) The formula assumes that the water quantity supplied reaches the tank surface where it is required.

J2 CALCULATION OF WATER QUANTITIES

J2.1 Identify tanks requiring cooling water

The procedure shall be as follows:

(a) List every fixed-roof tank which could be used for storing a flammable liquid, or which could contain a combustible liquid and is the same compound as the flammable liquid tank. Each is a potential tank-on-fire and is the basis for the rest of the procedure.

(b) For each such tank, define a circle concentric with it, and having a radius equal to twice the tank's diameter.

(c) List all other tanks, including floating-roof tanks, irrespective of the class of contents, which fall wholly or partly within these circles. They need not necessarily be in the same compound. These are the tanks whose separation distances from the potential tank-on-fire are less than 1.5 times its diameter; they are therefore within radiating range, and will need cooling water.

(d) If no tank qualifies for listing because of separation distances or the use of floating roofs, go to Paragraph J2.3(b).

J2.2 Calculate water requirements for each tank

The procedure below shall be followed for each tank listed under Paragraph J2.1(a):

(a) Determine the value of the S/D ratio, which is—

$$\frac{\text{Separation distance (shell-to-shell)}}{\text{Diameter of tank-on-fire}}$$

(b) Read from the graph in Figure J1 the value of factor W for the S/D ratio.

(c) Calculate the cooling water needed for the shell of the particular tank facing the tank-on-fire from the following equation—

$$q_V = dhW$$

where

q_V = flow rate of water supply, in litres per minute, to be applied to that part of the tank exposed to the heat flux

d = diameter of the tank being protected, in metres

h = height (or length) of the tank being protected, in metres

W = factor read from Figure J1, in litres per minute, square metre

(d) For any fixed-roof tank within one diameter of the tank-on-fire, add an amount of water equal to $0.25\ d^2W$ to allow for cooling the fire-exposed area of the roof.

NOTES:

(a) For the purpose of this Paragraph, the heat-affected area of the tank is taken as being approximately one third of the circumferential area, with sometimes a similar sector of the roof. The location of the area may shift if there are alternative potential radiant heat sources, or because of wind changes.

(b) A single large water outlet at the centre of a conical roof tank is not considered to be a satisfactory means of applying water.

(c) The loss due to wind effects when using hoses may be up to 50% of the water applied.

J2.3 Determine total cooling water demand for tank shells

The procedure shall be as follows:

(a) Total the values of q_V for each of the tanks listed under Paragraph J2.1(c) and select the largest total.

(b) Note the total capacity of the installation, select the related factor from Table J1, and multiply this factor by the diameter of the largest tank in the group (either floating-roof or fixed-roof type) that contains flammable liquid. The result is in litres per minute.

(c) The larger of Items (a) and (b) is the minimum cooling water rate required for the installation.

(d) Add any wastage factor that is necessitated due to the application method.

NOTE: Wastage might occur from the following:

(i) Hand-held hoses, which are vulnerable to windage losses and to inaccuracy.

(ii) Fixed monitors, subject to windage losses.

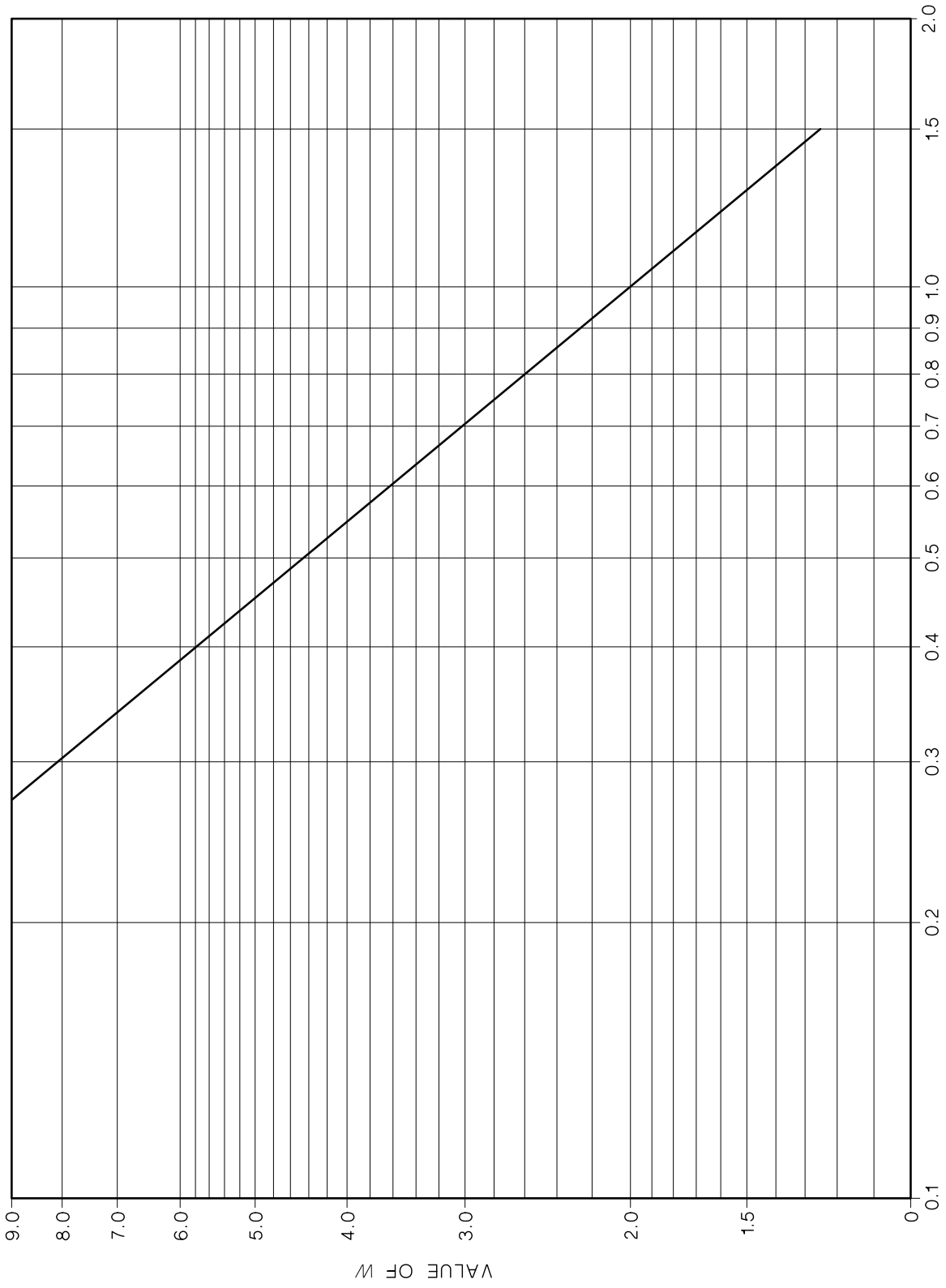
(iii) Fixed piping or spray systems of a design which might apply water to areas of tanks remote from radiation.

TABLE J1

COOLING WATER FACTORS

Total above-ground tank storage, m^3		Minimum cooling water factor
Over	Up to and including	
500	2 500	20
2 500	5 000	30
5 000	25 000	40
25 000		50

W is the rate of cooling water required, in litres per minute, square metre ($L/min.m^2$) of projected (i.e. silhouette) area of the tank.



NOTE: W is the rate of cooling water required, in litres per minute, square metre (L/min.m^2) of projected (i.e. silhouette) area of the tank

FIGURE J1 DETERMINATION OF W

APPENDIX K
COMBUSTION CHARACTERISTICS
(Informative)

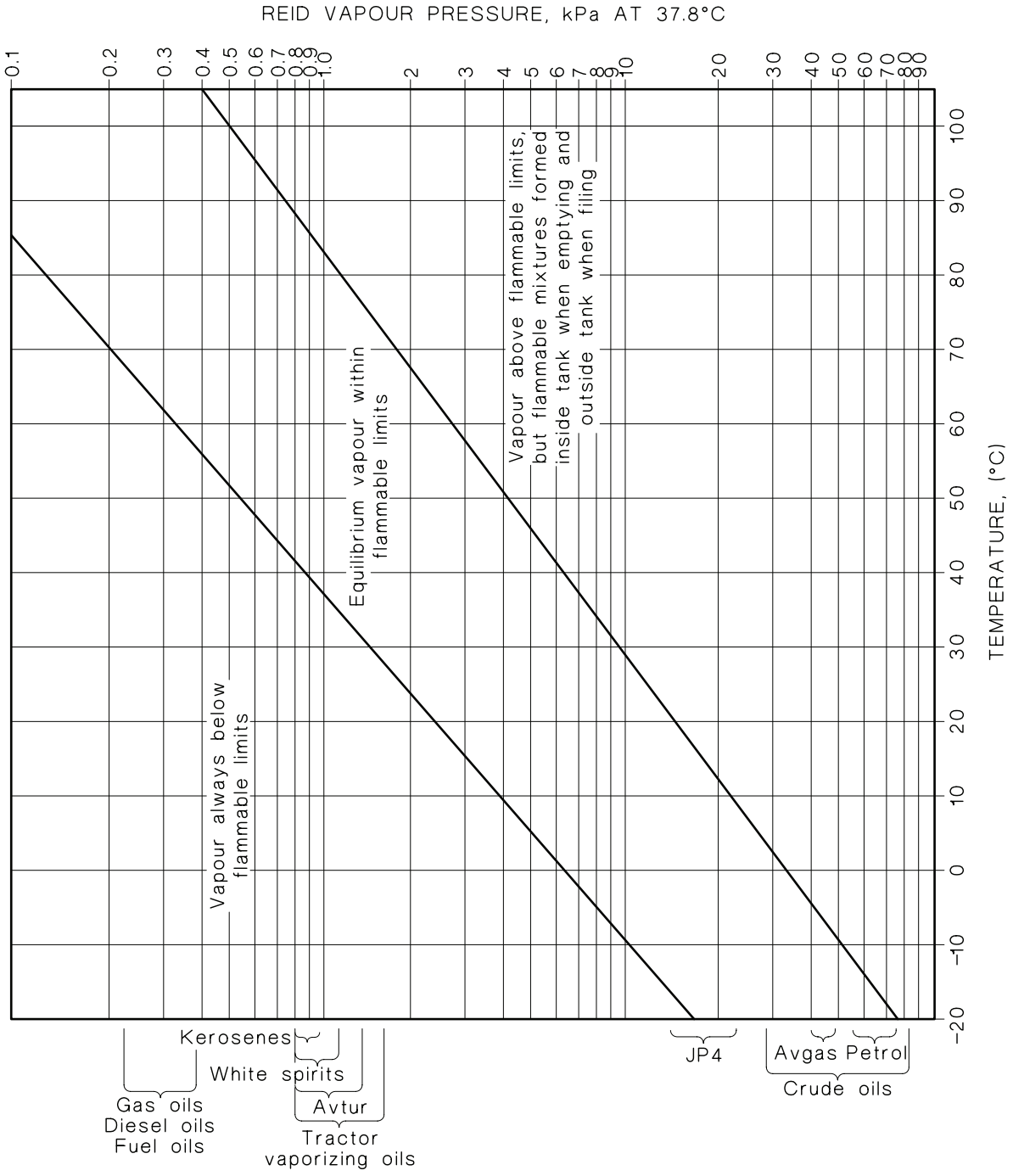


FIGURE K1 VAPOUR CONDITIONS OF PETROLEUM LIQUIDS AT VARIOUS TEMPERATURES

TABLE K1

FLAMMABILITY OF AIR/VAPOUR MIXTURES IN EQUILIBRIUM WITH VARIOUS FLAMMABLE LIQUIDS

Product	Approximate closed-cup flash point	Explosive limit (percentage by volume)		Approximate temperature range in which equilibrium vapour/air mixture is in the explosive range
	°C	Lower	Upper	°C
Crude oil	< –15	1.0	6.0	Below –20 to 5
Jet fuel JP-4	< –15	1.0	7.0	–24 to 26
Kerosene	50	0.7	6.0	38 to 100
Petrol	–43	1.4	7.6	–50 to 0
Hexane solvent	–22	1.2	6.9	–28 to 7
Heptane solvent	–4	1.0	6.0	–5 to 29
VM and P naphtha	10	1.0	6.0	7 to 46
Benzene	–11	1.4	8.0	–14 to 18
Toluene	5	1.3	7.0	4 to 43
Xylene	28	10	6.0	25 to 60
Methanol	11	6.0	36.5	7 to 40
Ethanol	13	3.3	19.0	10 to 33
iso-propyl alcohol	15	2.0	12.0	11 to 38
Carbon disulfide	–30	1.0	50.0	–47 to 26
Acetone	–18	2.2	13.0	–23 to 10

APPENDIX L

GAS-FREEING PRECAUTIONS AND PRINCIPLES

(Normative)

L1 INTRODUCTION

This Appendix specifies precautions and principles to be observed when gas-freeing, which are not necessarily exhaustive

L2 GAS-FREEING WITH AIR

The following requirements shall apply:

(a) Ventilation shall be forced, so as to shorten the purging time.

(b) Expelled vapour shall be discharged at as high an elevation as possible.

(c) Additional care shall be taken in calm weather, when dispersal is minimal, to avoid local concentrations of vapour, e.g. in compounds.

(d) In the event of any abnormal condition which is potentially hazardous, e.g. a thunderstorm, venting shall be stopped and the tank shall be closed.

L3 GAS-FREEING WITH STEAM

The following requirements shall apply:

(a) The contents of the tank shall be of a type that can be cleared successfully by steaming, without leaving a combustible residue.

(b) The temperature of the steam shall be controlled to be at least 50°C below the auto-ignition temperature of any vapour in the tank.

NOTE: The temperature should be as low as possible.

(c) The velocity of the steam emitted from any hose or nozzle shall be kept as low as possible, and any hose nozzle shall be electrically-bonded to the tank.

(d) The rate of supply of steam shall be below that which would cause pressure within the tank to build up to any unsafe level.

(e) For a free flow of steam to be maintained throughout the tank, all manhole covers, valves and blank flanges shall be removed so as to leave open all openings into the tank.

L4 GAS-FREEING WITH WATER

The following requirements and recommendations apply:

(a) Before a tank is filled with water, it should be ascertained that the tank and its foundations are capable of sustaining the mass of the water.

(b) The rate of filling or emptying the water should be controlled in relation to the vent capacity to avoid tank damage under pressure or vacuum.

(c) Static electricity build-up should be avoided by introducing the water at as low a level as possible, keeping the discharge velocity low, and electrically-bonding any hose nozzle to the tank.

(d) Flooding with water should not be relied upon to remove all vapour, liquid or solid residues.

(e) Care shall be exercised to collect all the water used and ensure it is treated and disposed of safely.

NOTES:

(a) The condensate or water will be contaminated with residues of the flammable or combustible liquid, the proportion of which could be relatively high if such liquid is water-miscible. A low flash point liquid that is water-miscible, e.g. ethanol or acetone, may lower the flash point to a temperature at which the condensate is regarded as a flammable liquid, even though it is mainly water.

The condensate or water may require analysis if it is to be disposed of to the sewer. This condensate or water should never be disposed of to stormwater drains.

(b) It is unlikely that the condensate can be returned to the boiler feed without treatment to remove the liquid residues, even at very low levels of contamination.

L5 GAS-FREEING WITH INERT GAS

In addition to the precautions given in Clause 9.9 and to the requirements of AS/NZS 2865, particular attention shall be given to ensuring that there is sufficient oxygen after any inert gas purging operation. If liquefied gas is used, it should be fully vaporized before entry into the tank to avoid the build-up of static electricity from a spray of liquid droplets.

NOTES:

(a) Air purging may be used where steam, water or inert gas are unsuitable. An air mover (air operated venturi extractor) is the preferred method of air purging, allied with a fresh air down-tube.

(b) The effectiveness of steaming decreases as the area of the shell increases, because of the loss of steam due to condensation on the shell. The temperature of the shell is therefore an important indicator of effective steam purging, and should achieve a minimum temperature of 70°C and be maintained for a suitable period.

(c) The atmosphere within a space will not be fit to breathe after purging by inert gas. This method may be used when the effect of steam, water or air on the tank or its contents may be undesirable.

(d) When gas-free testing is done with combustible gas detectors, the presence of toxic residues may not be indicated.

APPENDIX M

RECOMMENDATIONS FOR BATCH BLENDING OF FLAMMABLE LIQUIDS

(Informative)

M1 INTRODUCTION

This Appendix provides guidance for batch blending operations using flammable liquids within the limits set out below. These recommendations are additional to the requirements of the relevant Sections of this Standard:

(a) In one or more vessels up to an aggregate capacity of 2500 L.

(b) Not involving heating, pressurization, or exothermic (self-heating) reactions.

(c) Not using any dangerous goods of PG I, regardless of their class.

Specialist advice should be sought if the above limits have to be exceeded, if any requirements cannot be complied with, or other methods are to be used.

M2 BUILDING RECOMMENDATIONS

In addition to meeting the relevant requirements of Sections 3 and 4 of this Standard, a building for batch blending should be free-standing and separated from any other building by at least 5 m.

A risk assessment may be required if any other building, work area or electrical installation is within 9 m (see also Appendix F).

NOTE: Most warehouse units do not comply with these recommendations and are not suitable for use as blending areas.

M3 THE BLENDING VESSEL

M3.1 Construction and location of the blending vessel

The following recommendations apply:

(a) The vessel should be metal, of substantial construction, and on firm supports.

(b) The area around the blending vessel should be provided with spillage control, e.g. bunding or a floor sloping to a sump.

(c) Provision of an access hatch in the lid of the blending vessel will allow ingredients to be added and samples to be withdrawn.

(d) All pipes below liquid level (especially the bottom outlet) should have a steel isolating valve close to the shell of the vessel.

(e) The lid should be electrically bonded to the vessel. Cable connections should be permanently attached to the lid with screws, as clamps could become loose or not make proper contact.

NOTE: This is especially important if the lid rests on soft insulating seals. Welding cable or jumper lead cable may be used for bonding.

(f) The vessel should always remain in the same location unless all safety requirements are met in any location to which it is to be moved. The vessel should never be moved when full.

(g) Any heating of the vessel requires special precautions and expert advice should be obtained. Gas burners or electric radiators are not suitable.

M3.2 Ventilation of the blending vessel

The following recommendations apply:

(a) Effective ventilation is necessary to reduce the risk of fire or explosion and to protect workers from exposure to harmful vapours and dusts. Any vapour exhaust system should be connected from the vessel's lid to an extractor fan system by the use of flexible ducting.

NOTE: If there is a strong 'solvent' smell when the vessel's lid is closed, it could indicate that the lid is not sealing properly or that a vapour exhaust system is needed.

(b) Any extractor fan should at all times maintain a slight negative pressure in the vessel (i.e. draw air in), to prevent vapours from escaping into the blending area. Alternatively, the vessel could be located in a booth with exhaust ventilation similar to a spray booth.

(c) The exhaust fan should interlock with the lid of the blending vessel, in order to prevent excessive evaporation and to conserve energy. When the vessel lid is opened, the fan should either commence operation or switch from low to high.

M4 CONTROL OF IGNITION SOURCES

Ignition sources are not permitted within the area around the mixing vessel. The following recommendations apply:

(a) Forklift trucks need to be authorized for use in the hazardous area, e.g. by a work permit. It may be possible to use a manual pallet lifter to move goods.

(b) Gas torches are not suitable for shrink-wrapping. Stretch-wrapping should be avoided as the film can cause a build-up of static electricity.

(c) Tools should be selected in order to avoid or reduce sparks.

(d) Items of electrical equipment, e.g. stirrers and pumps, that are not of a type suitable for use in a hazardous area, should be replaced with air-driven equipment, with the air compressor located in a safe place.

M5 HANDLING AND BLENDING OF RAW MATERIALS

Liquids should be pumped in through a pipe terminating near the bottom of the blending vessel. If pumping is not possible, the liquid should be poured in slowly and from the lowest practicable height.

NOTE: Splash filling can release large amounts of flammable vapours and cause a build-up of static electricity, which could cause the vapours to explode.

If water or other non-flammable liquid is an ingredient of the blend, this should be filled into the blending vessel first. The flammable liquid should be pumped in, below the liquid level, in order to reduce the amount of vapour released.

Electrically-driven pumps and all associated cabling and switches should be of a certified, explosion-protected type. Hand-operated pumps or pumps driven by compressed air (with the compressor at a location away from ignition sources) are preferred.

Transfer by air or gas pressure is potentially unsafe and should not be used.

Static electricity can build up when pouring powders into the blending vessel, and the powder or vapours can ignite. To prevent this from occurring —

(a) wet the powder first and add the mixture to the vessel; or

(b) add the powder using a scoop; or

(c) reduce the volume and speed of the powder flow.

It is unsafe to use a forklift truck or hoist to lift a container over the vessel so that its contents can be poured into the mix.

If the vessel can be removed from under the mixer, the mixer drive should be provided with an interlock to prevent its use when it is out of the vessel.

M6 PACKAGE FILLING AREAS

Where packages are gravity-filled, the following recommendations apply:

(a) Where hoses are connected to the outlet of the mixing vessel, one of the vessel's isolating valves should be self-closing (spring loaded) with a remote release.

(b) Drums should be filled using a self-closing nozzle. Where splashing could occur, there should be a clear shatterproof shield between the package and the operator.

(c) An effective vapour removal system should be installed.

(d) Spillage control should be provided.

(e) A spillage clean-up kit should be available. A simple kit may consist of a metal garbage bin with a tightly-fitting lid, partially filled with a non-combustible absorbent (e.g. vermiculite). A broom, shovel, solvent-resistant face shield, gloves and boots should also be provided.

(f) Each package should be closed tightly after filling.

(g) Filled packages should be removed from the area at least at the end of each shift.

M7 FIRE PROTECTION

The following recommendations apply to fire protection for blending areas and are additional to those specified in Section 11:

(a) Where the total volume of flammable liquids does not exceed 1000 L, the fire protection requirements given in Table 11.3 for package stores containing up to 10 m^3 of flammable liquids apply.

(b) Where the total volume of flammable liquids exceeds 1000 L, the fire protection requirements given in Table 11.3 for package stores containing up to 100 m^3 of flammable liquids apply.

(c) Any firefighting foam needs to be compatible with the liquids being stored and handled.

M8 CLEANING OF THE MIXING VESSEL

Pressurized water nozzles should not be used unless the vessel is free from flammable vapours, as static electricity could cause an explosion.

The use of flammable, toxic or corrosive cleaning solvents may require further safety precautions. The MSDS should be consulted or specialist advice sought.

APPENDIX N

EMERGENCY PLANNING AND MANAGEMENT

(Informative)

N1 EMERGENCY PLANS

N1.1 Premises emergency plan

The emergency plan for use by site personnel should set out procedures to be followed by the occupier's personnel in an emergency. It needs to include the following, as appropriate:

(a) Actions to be taken in the event of a fire, spill, explosion, leak or other emergency, including firefighting action, alarm actuation, evacuation procedures, shutdown procedures, the establishment of emergency control centres, and mutual aid arrangements (e.g. cooperation with relevant authorities, use of equipment on neighbouring premises).

(b) A list of contact telephone numbers for emergency services, e.g. fire brigade, ambulance, police, regulatory authorities and local hospital; the criteria for contacting them and procedures to ensure that they are promptly alerted.

(c) Evacuation procedures and the implementation of a warden system.

(d) The establishment of nominated assembly areas, away from the incident area and emergency services operations.

(e) Training of personnel in carrying out the plan (which may involve the local fire brigade).

(f) The location of material safety data sheets (MSDS).

The emergency plan should be reviewed and updated as necessary (see Clause 10.2).

N1.2 Plan for use by emergency services

A second emergency plan may be required for the surrounding area, to assist the emergency services in effectively carrying out their duties. This plan should be developed in conjunction with the emergency services. Such a plan should be kept in a location to the satisfaction of the relevant fire authority.

N1.3 Information to be provided to the emergency services

The information to be provided to the emergency services should include the following:

(a) A site plan, which should include—

  (i) the direction of north;

  (ii) the boundaries of the premises and the names of adjacent streets;

  (iii) the location and identification of all buildings and external stores at the premises;

  (iv) vehicular entry points, and vehicular access within the site;

  (v) the location of the flammable and combustible liquids;

  (vi) the fire service layout;

  (vii) the location of the drainage system, including isolation valves; and

  (viii) the location of alarm points.

(b) A copy of the current manifest listing the quantities, classes, UN numbers and names of the dangerous goods being stored and the location of the goods within the premises.

(c) A list of names and telephone or pager numbers (including at-work and after-hours) of personnel within the occupier's organization who can provide specialist advice or assistance in an emergency.

(d) Details of the evacuation system at the site, including—

(i) the type of alarm and its means of actuation;

(ii) the locations of assembly areas; and

(iii) a means by which the emergency services can identify members of the warden structure for the premises.

(e) Copies of the material safety data sheets (MSDS) for all of the dangerous goods on the site.

N2 DOCUMENTS PROVIDING GUIDELINES FOR THE PREPARATION OF EMERGENCY PLANS

1 AUSTRALIAN INSTITUTE OF PETROLEUM. *GL 8, The content and organisation of emergency plans.* Melbourne, Institute of Petroleum, 1992.

2 PLANNING N.S.W. *Hazardous Industry Planning Paper No. 1*: *Industry Emergency Planning Guidelines*.

3 PLANNING NSW. *Hazardous Industry Planning Paper No. 2*: *Fire Safety Guidelines*. Sydney: Department of Urban Affairs and Planning, 1993.

4 INDUSTRY AND ENVIRONMENTAL OFFICE, UNITED NATIONS ENVIRONMENTAL PROGRAMME. *APELL—Awareness and Preparedness for Emergencies at Local Level A Process for Responding to Technological Accidents.*, Paris, United Nations Publications, 1988.

5 INTERNATIONAL LABOUR OFFICE. *R181, Prevention of Major Industrial Accidents Recommendation*. Geneva: International Labour Office, 1993.

6 QUEENSLAND DEPARTMENT OF EMERGENCY SERVICES (CHEMICAL HAZARDS AND EMERGENCY MANAGEMENT UNIT). *Emergency Planning: Guidelines for Hazardous Industry.* Brisbane: Department of Emergency Services, 1998.

7 QUEENSLAND DEPARTMENT OF EMERGENCY SERVICES (CHEMICAL HAZARDS AND EMERGENCY MANAGEMENT UNIT). *Emergency Plans: Guidelines for Major Hazard Facilities:* Brisbane: Department of Emergency Services, 1996.

AMENDMENT CONTROL SHEET

AS 1940—2004

Amendment No. 1 (2004)

CORRECTION

SUMMARY: This Amendment applies to the Table 2.1, Clause 4.3.1, Clause 4.9.6, Table 5.1, Clause 7.3.4 and Clause 9.8.6.2.

Published on 25 November 2004.

Amendment No. 2 (2006)

REVISED TEXT

SUMMARY: This Amendment applies to Clauses 1.2.2, 2.3.4, 3.9, 4.3.1, 4.4.2, 5.2.5, 5.6.3.2, 5.9.1, 5.9.3, 5.9.5, 7.5.4, 7.6.3, 8.4.4 and 9.2.4, Figures 4.2 and 4.3, Tables 4.1 and 4.2, and Appendix E.

Published on 22 November 2006.

NOTES

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