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AS 1940:2017
(Incorporating Amendment Nos 1 and 2)

AS 1940:2017



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 13 July 2017.

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- Australasian Fire and Emergency Service Authorities Council
- Australasian Institute of Dangerous Goods Consultants
- Australian Industry Group
- Australian Institute of Petroleum
- Australian Paint Manufacturers Federation
- Department of Defence
- Department of Justice, Tas.
- Department of Mines and Petroleum, WA
- Engineers Australia
- Fire Protection Association Australia
- Insurance Council of Australia
- Plastic and Chemicals Industries Association
- SafeWork SA
- WorkCover NSW
- Workplace Health and Safety, Qld
- WorkSafe, Vic.

Additional Interests:

- Accord Australasia
 - AusSpill Association
 - WorkCover Queensland
-

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Australian Standard[®]

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—2004. The objective of this Standard is to promote the safety of persons and prevent damage to property and the environment where flammable or combustible liquids are stored or handled.

This Standard incorporates Amendment No. 1 (August 2019) and Amendment No. 2 (June 2021). 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.

The changes in this revision of the Standard include alignment for the classification criteria of C1 combustible liquids to the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). The use of plastic polyethylene or other composite polymeric tanks for the minor storage of combustible liquids is now permitted. Some changes to fire hydrants requirements were also made in Section 11, dealing with fire protection for package stores.

Committee ME-017 reviewed the report with recommendations into the Buncefield oil depot fire in Hertfordshire UK in 2005, and implemented engineering controls accordingly, wherever possible.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendices 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 Class 3 and related dangerous goods presently comprises the following Standards:

AS

1894	The storage and handling of non-flammable cryogenic and refrigerated liquids
2106	Methods for the determination of the flash point of flammable liquids (closed cup) (series)
2507	The storage and handling of agricultural and veterinary chemicals
2585	Determination of flash and fire points—Cleveland open cup method
2714	The storage and handling of organic peroxides
3780	The storage and handling of corrosive substances
3846	The handling and transport of dangerous cargoes in port areas
3961	The storage and handling of liquefied natural gas
4326	The storage and handling of oxidizing agents
4332	The storage and handling of gases in cylinders
4897	The design, installation and operation of underground petroleum storage systems
4976	The removal and disposal of underground petroleum storage tanks

AS/NZS

1596	The storage and handling of LP Gas
2022	Anhydrous ammonia—Storage and handling
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
5026	The storage and handling of Class 4 dangerous goods
60079	Explosive atmospheres
60079.10.1	Part 10.1: Classification of areas—Explosive gas atmospheres
60079.14	Part 14: Electrical installations design, selection and erection

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STANDARDS AUSTRALIA

Australian Standard

The storage and handling of flammable and combustible liquids

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 Safe Work Australia, Model Code of Practice, *Managing Risks of Hazardous Chemicals in the Workplace* and legislation which underpins 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.

NOTE: Fuel blends that contain biofuel (e.g. ethanol) have physical and chemical properties that require additional precautions and design considerations.

1.2 APPLICATION**1.2.1 Where this Standard applies**

This Standard applies to the storage and handling of Class 3 dangerous goods as defined in Clause 1.4.8 or relevant legislation, 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 legislation that applies in any area.

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: 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/SDS) 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/SDS, 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.
- (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 NORMATIVE REFERENCES

The normative documents referred to in this Standard are listed in Appendix A.

NOTE: Documents referenced for informative purposes are listed in the Bibliography.

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 Code for the Transport of Dangerous Goods by Road and Rail.

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

1.4.6.1 General

The maximum volume or space within a container or compound.

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

1.4.6.2 Normal fill level (normal capacity)

The maximum level to which the tank will intentionally be filled on a routine basis, using the normal process control system. It is sometimes referred to as the safe fill level.

1.4.6.3 Tank rated capacity

The level below the overfill level that will allow time for any action necessary to prevent the maximum capacity from being reached/exceeded.

1.4.6.4 Tank capacity (overfill level)

The point at which either the tank will suffer mechanical damage or product will be lost from the tank.

1.4.7 Category of tank

That category of a tank, as classified in AS 1692 and includes tanks constructed of materials other than steel, 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 m³ 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 m³ 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:

- (a) *Class C1*—A combustible liquid that has a closed cup flash point of greater than 60°C and no greater than 93°C.

- (b) *Class C2*—A combustible liquid that—
- (i) has a flash point of greater 93°C; or
 - (ii) has been excluded from being a flammable liquid by any of the criteria for sustaining combustion.

NOTES:

- 1 A water miscible solution with a water content of more than 90% by mass, which has been excluded from being a flammable liquid and which does not have a fire point less than its boiling point is not a combustible liquid.
- 2 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.
- 3 ISO 2592, IP 36 and ASTM D92 are technically equivalent test methods for the determination of fire point 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) are defined in the ADG Code; or
- (b) are determined to be dangerous goods by relevant legislation.

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 18th 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 (flammable limit)

1.4.22.1 General

LFL and UFL, as defined below are derived from IEC 60050-426, and adopted in AS/NZS 60079.10.1.

1.4.22.2 Lower flammable limit (LFL)

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

1.4.22.3 Upper flammable limit (UFL)

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 five 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 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).

1.4.25 Fire-safe valve

A valve complying with the fire type test requirements of ISO 10497, API Spec 6FA, API Spec 6FD, API Std 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.

1.4.26 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

For the purpose of this Standard, 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°C, closed cup test, normally referred to as the flash point.

Flammable liquids include—

- (a) liquids stored or handled at temperatures at or above their flash point; and
- (b) substances that are stored or handled at elevated temperatures in a liquid state and which give off a flammable vapour at a temperature at or below the maximum storage or handling temperature.

Flammable liquids do not include liquids meeting the above definition with a flash point of more than 35°C which do not sustain combustion if—

- (i) they have passed a suitable combustibility test (refer to Sustained Combustibility Test prescribed in the UN Manual of Tests and Criteria, Part III, sub-section 32.5.2); or
- (ii) their fire point according to ISO 2592:2000 is greater than 100°C; or
- (iii) they are water miscible solutions with a water content of more than 90% by mass.

NOTES:

- 1 The above definition is consistent with the definition of flammable liquids in ADG 7.4 except for the omission of open-cup testing for flash point. This has been omitted to conform to GHS classification which is based solely on closed cup testing. This omission is consistent with a provision in the UN Model regulations.

GHS does provide for exemption based on the UN Sustained Combustibility Test, but does not provide for—

- (a) inclusion of heated liquids (as GHS has no consideration of temperature); and
 - (b) exclusions based on fire point or water miscibility.
- 2 Liquids excluded as not sustaining combustion are included within the definition of combustible liquids in this Standard.
 - 3 Packing group provides further information on flammable liquid classification (see Clause 1.4.50).
 - 4 Liquids with a flash point less than 60°C that are excluded by not sustaining combustion, may present a risk of fire and explosion if there is a hazardous area in the head space of a tank or package. An assessment of the risk needs to be undertaken based on AS/NZS 60079.10.1.

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, the properties of which are such that the foam may be used as a flame-smothering blanket, to prevent the entry of air, and 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 20.
 - (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 GHS

The Globally Harmonized System of Classification and Labelling of Chemicals published by the United Nations.

1.4.35 Hazardous area

An area (three-dimensional space) in which an explosive atmosphere, due to flammable gas or flammable vapour, is or may be expected to be present, in quantities such as to require special precautions for the construction, installation and use of equipment.

NOTE: The classification of hazardous areas in relation to flammable liquids is given in AS/NZS 60079.10.1.

1.4.36 Hot work

The use or operation of any equipment that is likely to produce a source of ignition or a direct source of ignition including the following:

- (a) Welding or flame cutting equipment.
- (b) Grinders, electric drills, lights, connectors and other electrical equipment not deemed suitable for the hazardous area.
- (c) Hot tapping equipment.

- (d) Spark ignition engines or compression engines not specifically designed or deemed to be suitable for hazardous areas.
- (e) Matches, naked lights, cigarettes, cigarette lighters, flame or sparks.
- (f) Hand tools that through normal use could create a spark.
- (g) Any other thing that is likely to produce a source of ignition or be an ignition source.

1.4.37 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 sparks, electrical discharge due to static electricity, and electrical, electronic or mechanical equipment not suitable for use in hazardous areas.

1.4.38 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.

1.4.39 Installation

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

1.4.40 Intermediate bulk container (IBC)

Rigid or flexible portable container for the transport of dangerous goods with a capacity of up to 3 m³ as defined in the ADG Code and complies with UN Recommendations on the Transport of Dangerous Goods—Model Regulations.

NOTES:

- 1 Requirements for the construction and testing of IBCs are included in the ADG Code.
- 2 For IBCs suitable for flammable liquids complying with the ADG Code that are connected to any piping or product delivery system, there are additional risk controls. See Clause 5.10.

1.4.41 Liquids

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

1.4.42 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-based paints, lacquers and polishes.
- 2 Reference should be made to the ADG Code.

1.4.43 Material safety data sheet (MSDS)/Safety data sheets (SDS)

NOTE: See Clause 1.4.63.

1.4.44 May

Indicates the existence of an option.

1.4.45 Minor storage

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

1.4.46 Non-combustible

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

1.4.47 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.

1.4.48 Package

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

1.4.49 Packaging

A receptacle and any other components or materials necessary for the receptacle to perform its containment function, and in relation to dangerous goods, a container having a capacity not exceeding 500 L and having a net mass of not more than 500 kg.

1.4.50 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).

The following flammable liquids are assigned to Packing Group III:

- (a) Liquids stored or handled at temperatures at or above their flash point.
- (b) Substances that are stored or handled at elevated temperatures in a liquid state and which give off a flammable vapour at a temperature at or below the maximum storage or handling temperature.

Other flammable liquids are assigned to packing groups in accordance with ADG criteria which correspond to GHS categories as shown in Table 1.1.

TABLE 1.1
PACKING GROUP, GHS CATEGORY AND ADG CRITERIA

Packing Group	GHS Category	Criteria
I	1	Flash point <23°C and initial boiling point ≤35°C
II	2	Flash point <23°C and initial boiling point >35°C
III	3	Flash point ≥23°C and ≤60°C
(See Note)	4	Flash point >60°C and ≤93°C

NOTE: For GHS Category 4, see under combustible liquids.

1.4.51 Pipework

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

1.4.52 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.

1.4.53 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.

1.4.54 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).

1.4.55 Premises

The area under the control of the occupier.

1.4.56 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.

1.4.57 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.

1.4.58 Rail tank vehicle (rail tanker)

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

1.4.59 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.

1.4.60 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.

1.4.61 Restricted area

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

1.4.62 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.

1.4.63 Safety data sheets (SDS)/Material safety data sheet (MSDS)

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

NOTE: Refer also to Safe Work Australia, *Model Code of Practice: Preparation of Safety Data Sheets for Hazardous Chemicals*.

1.4.64 Segregated

Isolated from each other within the store.

1.4.65 Separated

Isolated from the storage by a given minimum distance.

1.4.66 Shall

Indicates that a statement is mandatory.

1.4.67 Should

Indicates a recommendation.

1.4.68 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.

1.4.69 Tank

A container other than a package, intended for the storage or transport of a liquid and having a capacity greater than 500 L. Where a tank category is mentioned, it means the category specified in AS 1692 and defined in Clause 1.4.7.

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.

NOTE: For IBCs when used as static storage tanks, see Clause 5.10.

1.4.70 Tank vehicle (tanker)

A road tank vehicle or a rail tank vehicle.

1.4.71 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.

1.4.72 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.

1.4.73 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.

1.4.74 Winery

An establishment for making wine.

1.4.75 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/SDS 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.

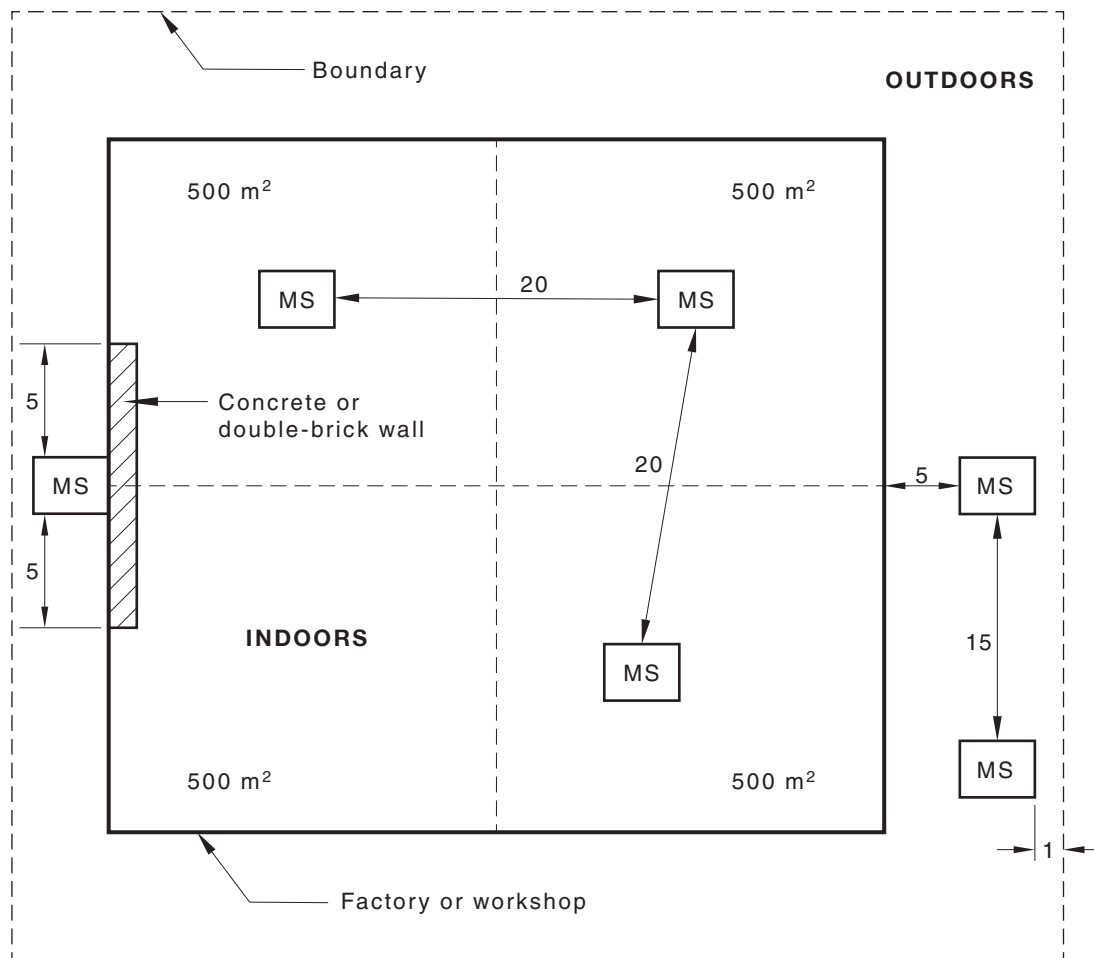
2.2.3 Multiple minor storages

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.



LEGEND:
MS = Designated minor storage area

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

2.2.5 Minor storage on open land

2.2.5.1 General

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.

NOTE: Additional assessment, and consultation with the authority having jurisdiction, should be undertaken if the minor storage is proposed to be located on open land within a designated bushfire prone area.

2.2.5.2 Polyethylene or composite storage tanks for minor storage

This Clause specifies requirements for the storage of combustible liquids within above-ground polyethylene storage tanks that are rotationally moulded in one piece seamless construction in accordance with AS/NZS 4766, or composite storage tanks, as follows:

- (a) The maximum capacity of such tanks shall not exceed 10 000 L.
- (b) Such tanks shall have provision to dissipate static electricity and prevent splash filling.
- (c) Such tanks shall have sufficient means for venting to prevent damage to the tank as a result of normal operational use of the tank.
- (d) Such tanks are to be located within a bund compliant with Clause 5.8.
- (e) Such tanks shall be separated from security fences and both onsite and offsite protected places by a distance of no less than 15 m.
- (f) Such tanks shall not be located within the confines of a building unless they comply with Clause 5.6.3 for C1 Products.
- (g) If the liquid level is measured by a dipstick, a suitable plate to prevent puncture to the bottom of the tank shall be required.

Polyethylene or composite tanks shall only be used with secondary containment that is non-combustible.

2.2.6 Minor storage on construction sites

The requirements and conditions set out in Clause 2.2.5.1, with the exception of Item (a), shall apply to minor storage on construction sites. Polyethylene or composite tanks shall not be used on construction sites.

TABLE 2.1
MINOR STORAGE

Location	Flammable liquids		Combustible liquids	Manufactured products
	PG I or PG II	PG III	C1, C2	
<i>Residential buildings of any type</i>				
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 (see AS 1691) is excluded from any calculation of the quantity stored on the premises				
<i>Educational establishments (excluding laboratories)</i>	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				
<i>Laboratories</i> (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 m ² of floor space	100 L per 50 m ² of floor space	200 L total C1 and C2	
<i>Commercial buildings</i>				
Indoors	10 L per 50 m ² of floor space, but 5 L for any tenancy of less than 50 m ² area	25 L per 50 m ² of floor space, but 25 L for any tenancy less than 50 m ² area	500 L total C1 and C2 per 50 m ² of floor space but 500 L for any tenancy less than 50 m ² area	

(continued)

TABLE 2.1 (continued)

Location	Flammable liquids		Combustible liquids	Manufactured products
	PG I or PG II	PG III	C1, C2	
<i>Hospitals</i> 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
<i>Factories, workshops</i> Indoors	1 L per 2 m ² of floor space with no more than 250 L in any 500 m ² area	1 L per 1 m ² of floor space with no more than 500 L in any 500 m ² area	4 L per 1 m ² of floor space with no more than 2000 L in any 500 m ² area	In packages only— 2000 L
<i>At commercial buildings, factories, workshops, hospitals and warehouses</i> 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 1400 L in tanks not over 700 L each, or in packages	 2500 L 5000 L	
<i>Shops</i>	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
<i>Warehouses</i>	As for factories and workshops (above)			
<i>Service stations</i> Indoors	500 L total in packages Any packages kept in a sales area shall be unopened packages not over 20 L capacity	1250 L total in tanks or packages	3000 L total C1 and C2	As for factories, workshops

(continued)

TABLE 2.1 (continued)

Location	Flammable liquids		Combustible liquids	Manufactured products
	PG I or PG II	PG III	C1, C2	
<i>Service stations</i> Outdoors		An additional 1000 L in packages can be kept outdoors		As for factories, workshops
<i>Open land</i> Outdoors above ground	5000 L	5000 L	10 000 L	As for shops
Underground tank(s)	5000 L	5000 L	10 000 L	
<i>Construction sites</i>	2500 L	5000 L	10 000 L	As for shops

NOTES:

- 1 In the case of laboratories, commercial buildings and the like, this Table 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 this Table.
- 3 It is permissible to store at the same time in 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 analysed, used, mixed, blended or reacted upon on laboratory benches or in fume cupboards are exempt from the limitations of this Table.

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).

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 chlorine.
- (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 a manner that reduces the likelihood of spillage, vapour escape or fire.

NOTE: Section 9 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 60079.10.1 shall be consulted for hazardous area classification 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 uncontrolled sources of ignition 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 shall 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 spill-response kit may consist of—
 - (a) a readily identifiable, suitable container with a lid or cover containing absorbent materials;
 - (b) suitable personal protective equipment; and
 - (c) suitable equipment required for spill clean-up.
- 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 following words shall be displayed:

DANGER—FLAMMABLE LIQUIDS—NO SMOKING—KEEP FIRE AWAY

Signs shall 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 liquids shall comply with AS 1692 or other appropriate specification. A Category 1 tank shall not be used for flammable liquid. Polyethylene or composite tanks may be used for minor storage on open land in accordance with Clause 2.2.5.2.

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.

NOTE: Further guidance is given in Section 9.

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 B.

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 published by Safe Work Australia.

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 are defined in AS/NZS 60079.10.1.

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 as 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 is in place, but providing for the alteration, redevelopment or change of ownership of either site.

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 MECHANICAL EQUIPMENT AND INSTALLATIONS

Mechanical equipment that meets any recognized industry standard for handling flammable liquids is deemed to meet the intent of Clause 1.4.37 for control of ignition sources in hazardous areas.

Examples of such standards include API standards for pumps and EN or AS/NZS standards for industrial trucks in hazardous areas.

NOTE: While standards under the ISO/IEC 80079 series may be used to provide guidance on possible ignition sources for mechanical equipment in hazardous areas, it is not a requirement of this standard that equipment complies with or is certified to these standards.

3.4 ELECTRICAL INSTALLATIONS AND EQUIPMENT

The following requirements shall apply to both electrical equipment and installations in areas designated as hazardous areas under the AS/NZS 60079.10.1:

- (a) *Electrical installations* All electrical installations shall be installed in compliance with the provisions of AS/NZS 3000 and AS/NZS 60079.14 that relate to electrical equipment in hazardous areas. 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 selected and used in accordance with AS/NZS 60079.14, 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 C is complied with in all respects.

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

3.5 INTERNAL COMBUSTION ENGINES

Internal combustion engines may be used in hazardous areas as designated in the AS/NZS 60079.10.1 under the following conditions:

- (a) An engine designed and certified to AS 2359.12 may be used in the areas 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 area 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 area, 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 area.

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 suitable 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 C and a work permit has been issued.

3.6 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.

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- (c) Any lighting in a hazardous area shall be suitable to operate in that area.

3.7 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 Divisions 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.

3.8 FIREWALLS AND VAPOUR BARRIERS

3.8.1 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 distances in Tables 4.1, 4.2, 5.3 and 5.4 to protected places, public places and security fences.

3.8.2 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 National Construction Code (NCC) for building purposes.

3.8.3 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 AS/NZS 60079.10.1.

3.9 SECURITY, SIGNS AND NOTICES

3.9.1 Control of access

All installations shall be appropriately secured against unauthorized access and tampering.

3.9.2 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 shall 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' switches.

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.

3.10 TRANSIT STORAGE

3.10.1 General

This Clause (3.10) specifies requirements for the transit storage (as defined in Clause 1.4.72) of flammable and combustible liquids.

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

3.10.2 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.

3.10.3 Requirements for transit storage

The following requirements 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 the greater of—
 - (i) 100% of the capacity of the largest tank, freight container, IBC or tanker compartment; or
 - (ii) 10% of the aggregate quantity of 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 area in the transit storage area.

3.10.4 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 shall 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.

3.11 IGNITION SOURCES

A vehicle shall not be regarded as an ignition source while it is entering or leaving a hazardous area 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 shall apply.

A vehicle shall not be regarded as an ignition source while it is entering or leaving the hazardous area outside a package storage area for the purposes of loading or unloading packages, provided that the hazardous area 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 area as given in AS/NZS 60079.10.1; or
- (b) the store and vehicle comply with Appendix C and a work permit has been issued (see also Clause 3.5).

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 D 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:

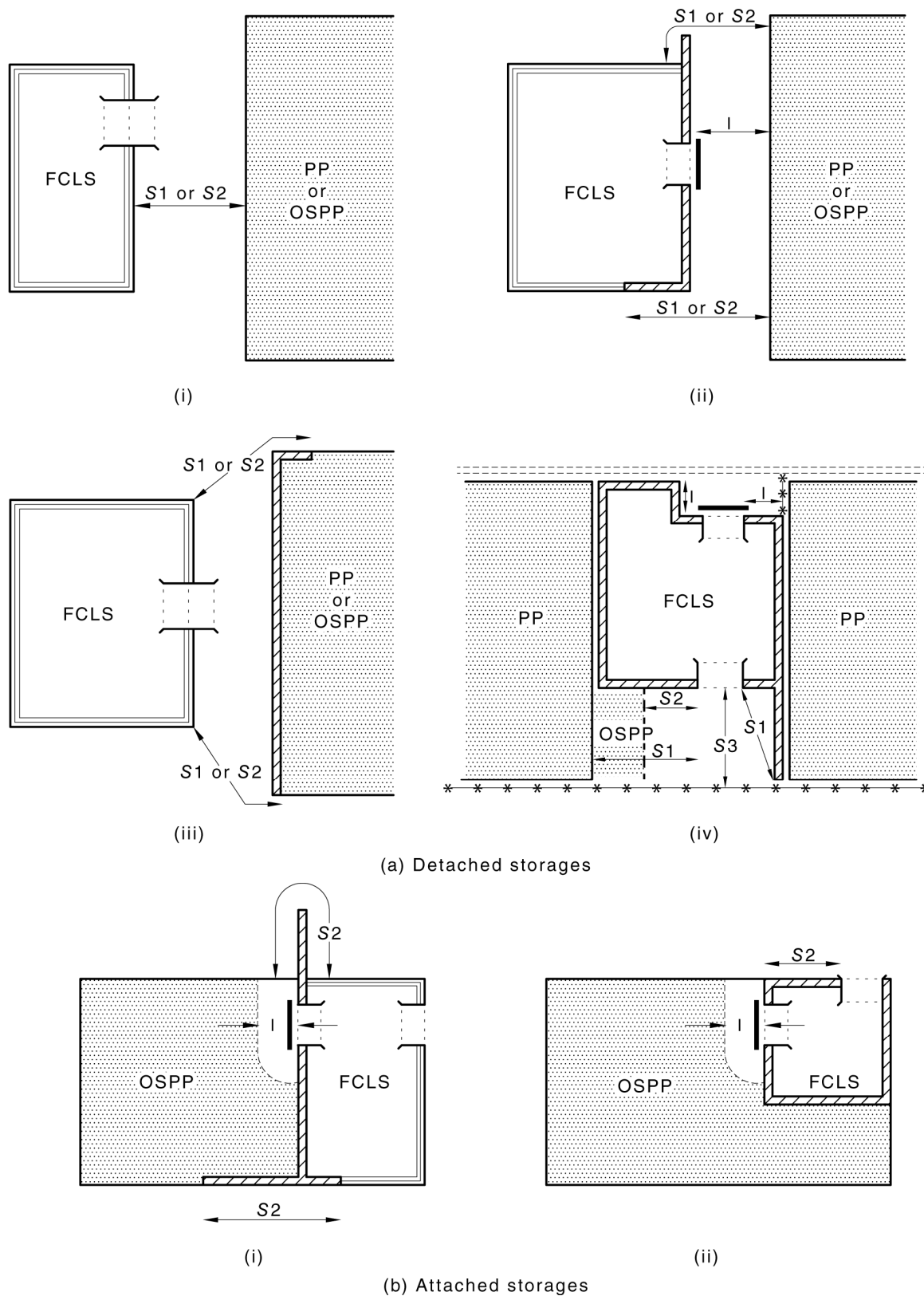
- (a) A detached store, being a store with or without a roof, or walls other than a bund [see Figure 4.1(a)(i), (ii), (iii), (iv)].
- (b) An attached fire-separated store, being a store attached to a building with outside entry and no communication to the associated building.
- (c) An attached store, sharing a wall or walls with the associated building and with a communicating fire door between the store and the associated building [see 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 [see Figure 4.1(c)(i), (ii)].
- (e) Fire-separated stores, being grouped stores with no communication between adjacent storages [see 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), as shown in Figure 4.1, include—

- (i) stores with facilities for filling, decanting and cleaning of packages; or
- (ii) stores either at ground level or on a platform [see Figure 4.1(e)]; or
- (iii) a combination of both.

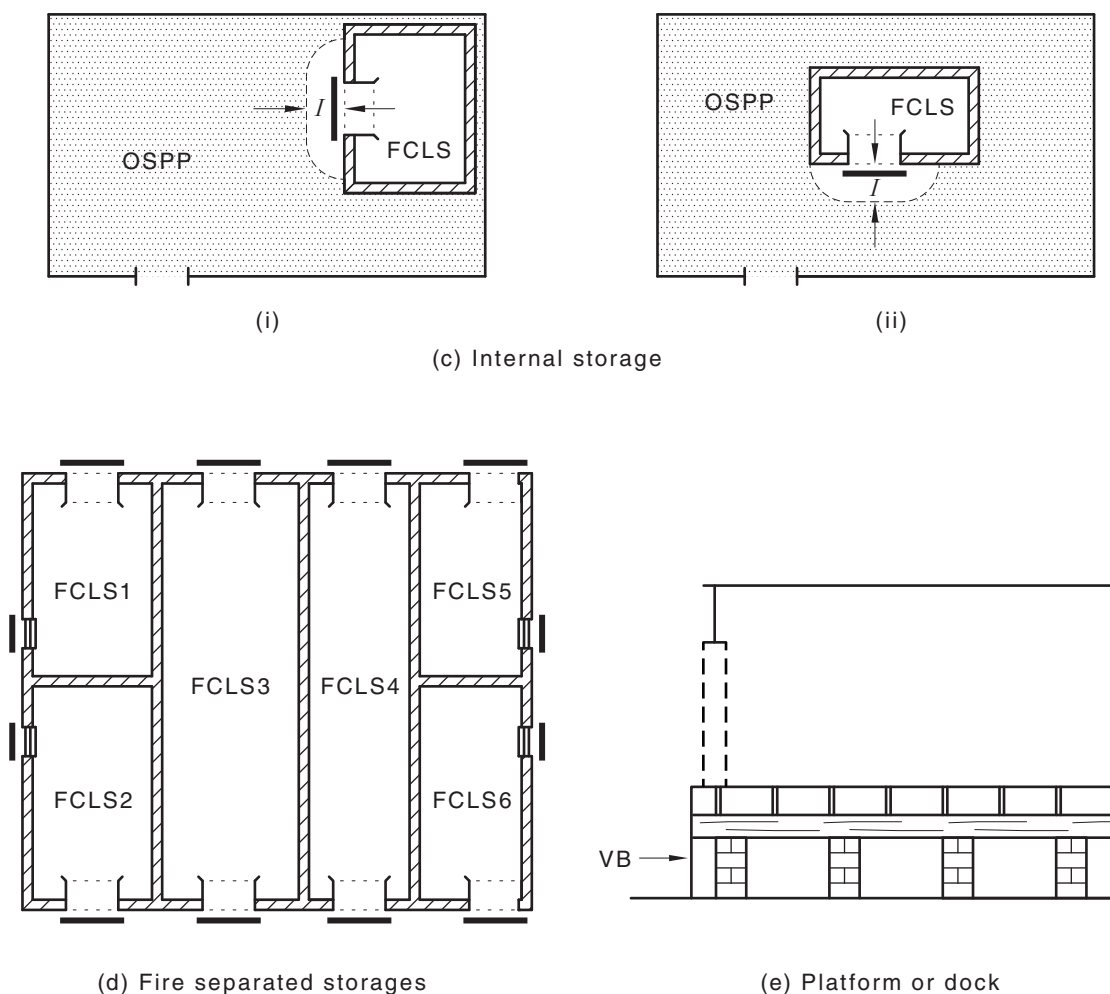
Further examples of package stores, including those not permitted by this Standard, are given in Figure 4.2.

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NOTE A fire door has been added to (b)(i).

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



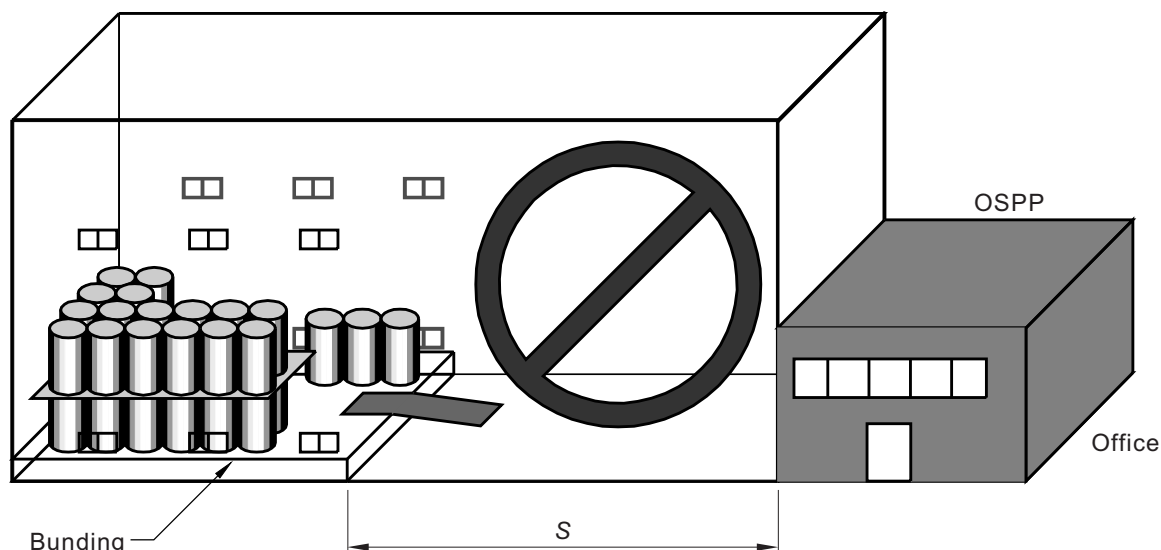
SEPARATION DISTANCES

- I Ignition source distance
 $S1$ Protected place distance
 $S2$ On-site protected place distance
 $S3$ Boundary distance

LEGEND:

	Fire wall		Property boundary
	Wall, not fire-rated		Street boundary
	Fire door		Opening, no fire door
	Bund wall		
	Boundary of facility (not fire-rated)		
	Ramp		
			All structures are roofed
	FCLS		Flammable or combustible liquid store
	OSPP		On site protected place
	PP		Protected place
	VB		Vapour barrier

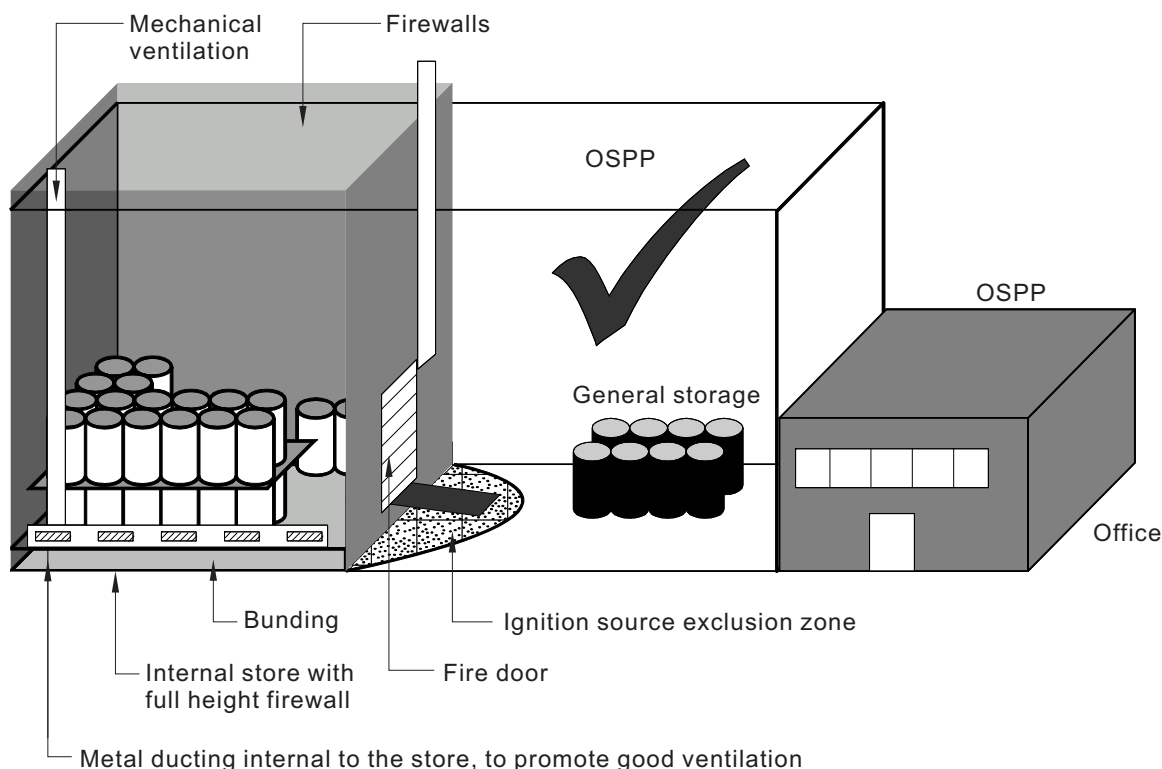
FIGURE 4.1 (in part) TYPICAL PACKAGE STORES—TYPES AND LOCATIONS



NOTE: Separation distance to OSPP cannot be measured via the air space from the compound to the office, as this is an attached storage. Unlike some other classes of dangerous goods, there is no provision for an area within a building to be a flammable liquid package store.

LEGEND:
 OSPP = on-site protected place
 S = separation distance

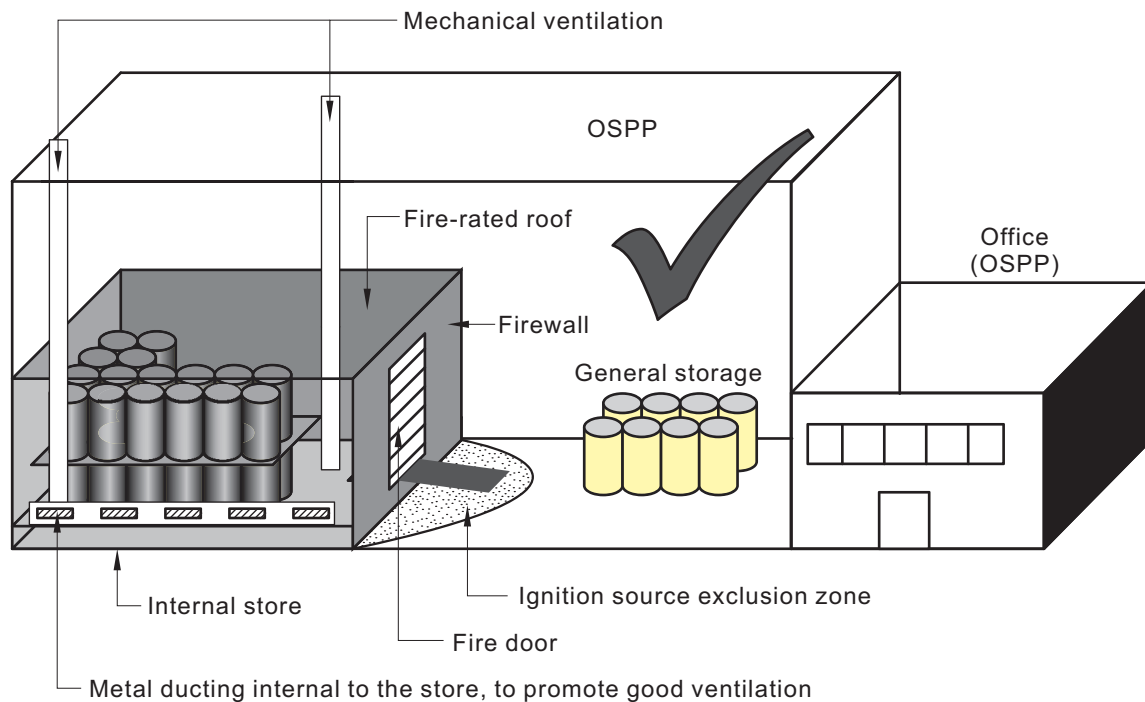
(a) Package storage compound within a naturally ventilated building



LEGEND:
 OSPP = on-site protected place

(b) Package store having mechanical ventilation and firewalls

FIGURE 4.2 (in part) EXAMPLES OF PACKAGE STORES



LEGEND:
OSPP = on-site protected place

(c) Package store within a warehouse

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, and 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 greater.
- (e) Separation distances shall be measured from the internal perimeter of the bund except where Item (f) 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 with the relevant requirements of AS/NZS 60079.10.1.
- (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:
 - (i) The separation distance from the storage area itself shall be as required by Items (e) and (f).
 - (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 area as determined by AS/NZS 60079.10.1.
- (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:

- 1 Separation distances may be measured around any intervening vapour barriers or firewalls, as described in Clause 3.8 and illustrated in Figure 4.1.
- 2 Adjacent stores which are separated by firewalls having FRLs of 240/240/240, fitted with doors having a 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. Clauses 4.3.1(a) and 4.3.1(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, m³ (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	
2	8	20	40	
4	16	40	80	
7	28	70	140	
10	40	100	200	
14	56	140	280	
20	80	200	400	
26	104	260	520	
34	136	340	680	
42	168	420	840	
52	208	520	1040	
64	256	640	1280	
77	308	770	≥1540	
170	680	1700		
310	1240	≥3100		
500	2000			
750	≥3000			
1100				
1500				
≥2000				

NOTES:

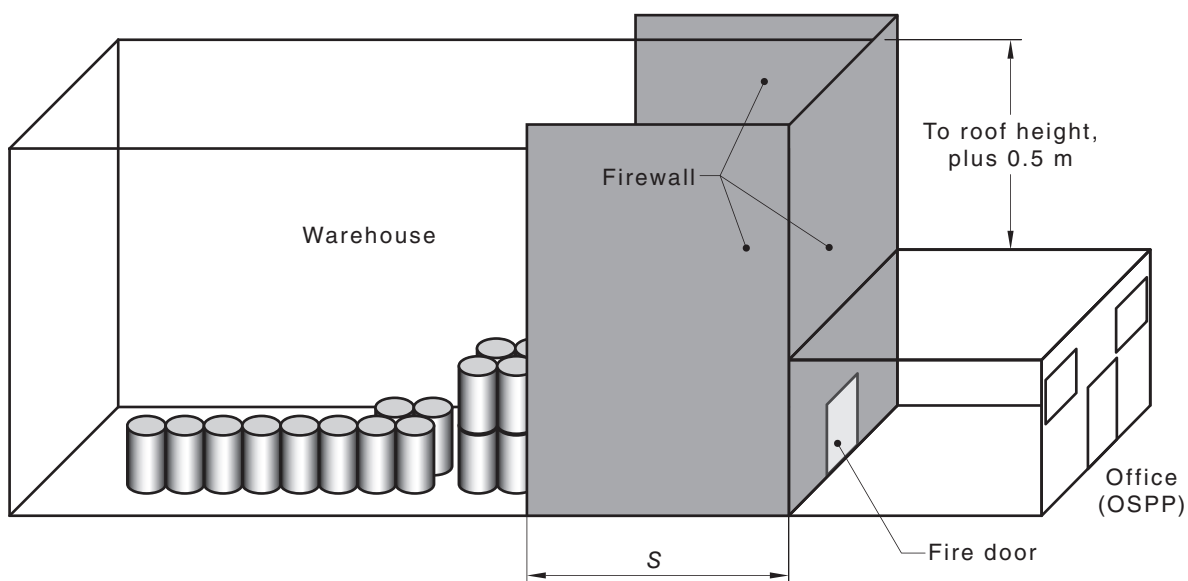
- 1 The distances that apply to any intermediate capacity may be obtained by linear interpolation.
- 2 Separation distances may be measured around firewalls and vapour barriers. See Clause 3.8 and Figures 4.1, 4.2 and 4.3.

TABLE 4.2
SEPARATION DISTANCES FROM PACKAGE STORES
OF FLAMMABLE LIQUIDS TO PUBLIC PLACES

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

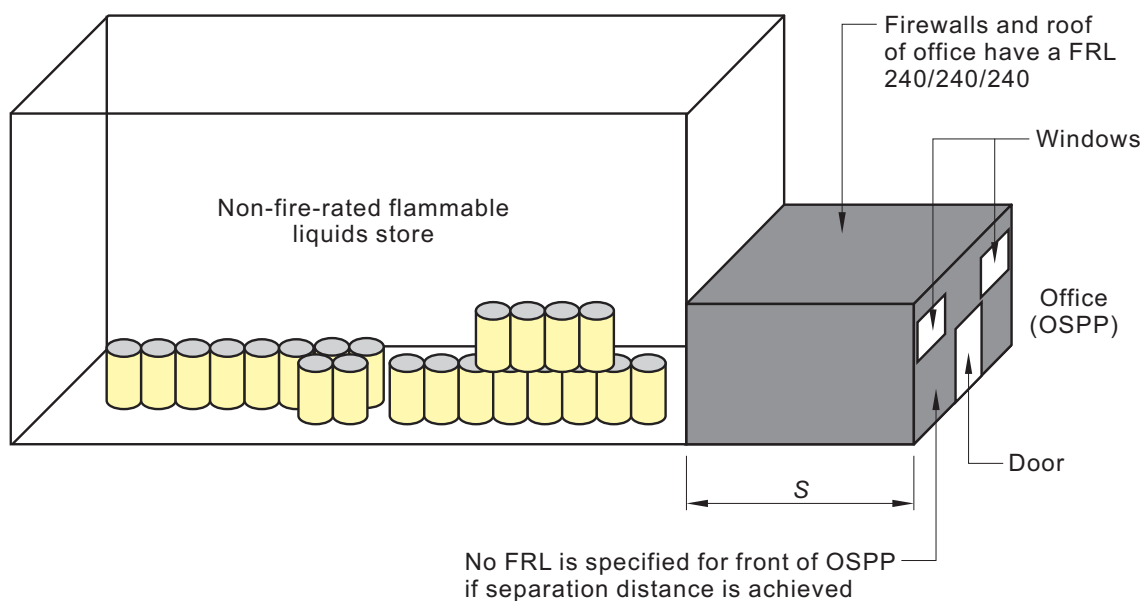
NOTES:

- 1 Separation distances may be measured around firewalls and vapour barriers. See Clause 3.8 and Figures 4.1, 4.2 and 4.3.
- 2 Where there is an ignition source on adjacent premises, reference should be made to Clause 3.2.4.
- 3 AS/NZS 60079.10.1 should also be consulted.



LEGEND:
 OSPP = on-site protected place
 S = separation distance

(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

(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

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.
- (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 m², 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 minutes.
- (f) Any drainage system shall be capable of carrying the output of the sprinkler system for the number of sprinklers operating at the required operating pressure (refer to AS 2118.1).
- (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

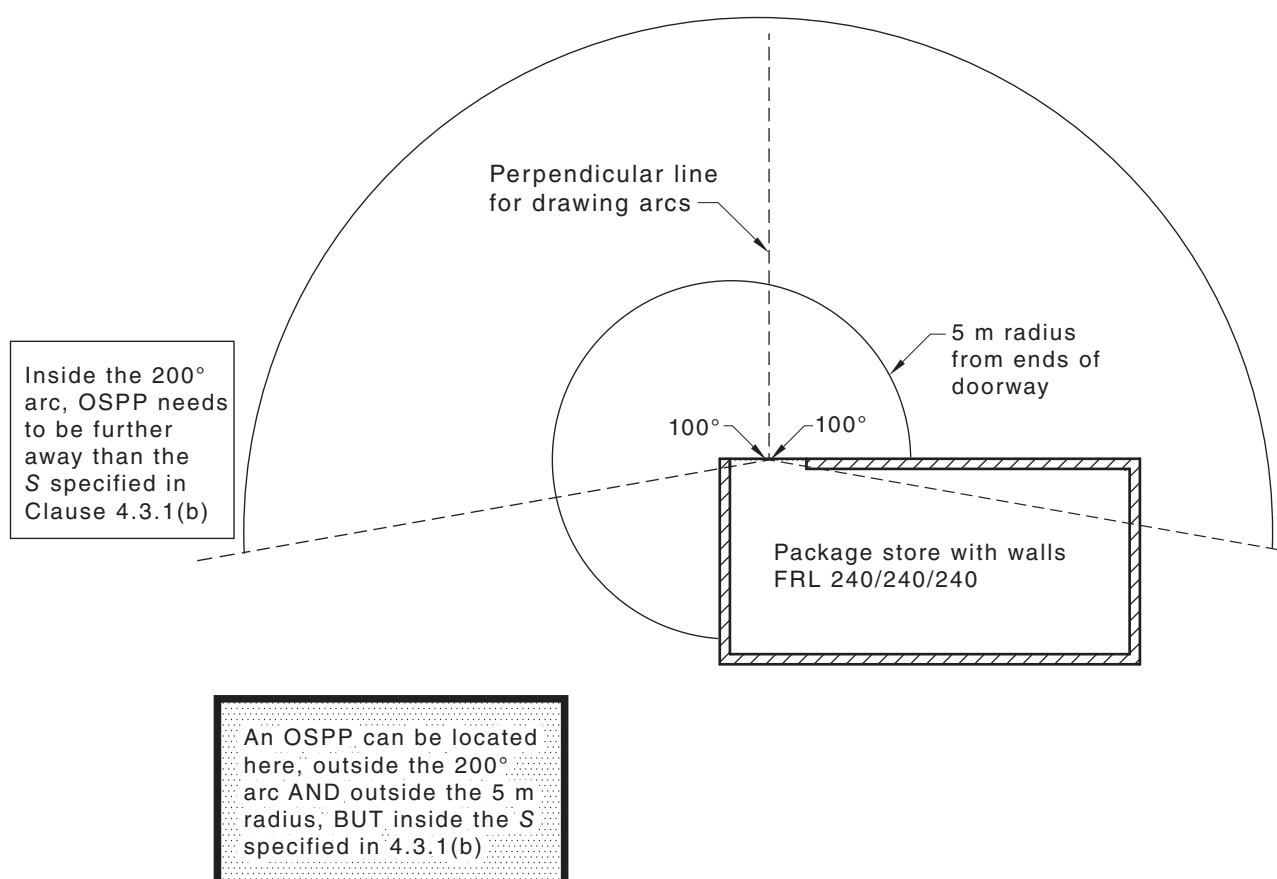
Any doorway through a firewall separating a package store from an on-site protected place shall be provided with a door. Such a door shall—

- (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.

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 published by Safe Work Australia, also apply.

With respect to hazardous area classification, AS/NZS 60079.10.1 shall be consulted.

Stores ventilated in accordance with the following requirements are deemed to comply with this Clause (4.5.1):

- (a) A natural ventilation system that complies with Clause 4.5.4.
- (b) A mechanical ventilation system that complies with Clause 4.5.5.
- (c) A cool room with ventilation that complies with Appendix D.

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)].
- (b) 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.
- (c) 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)].
- (d) 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.
- (e) One wall open to atmosphere as in Item (b), and vents in one opposite or adjacent wall [see Figure 4.5(c)].
- (f) 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 m² or 0.15 m².
- 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 m², or 0.15 m² 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 m² 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 m³ per square metre of floor area per minute or 5 m³/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 (refer also to AS/NZS 60079.14, AS/NZS 1020 and the AS/NZS 60079.10.1). 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.