



The storage and handling of liquefied chlorine gas



AS 2927:2019

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- Accord Australasia
- Australasian Fire and Emergency Service Authorities Council
- Australasian Institute of Dangerous Goods Consultants
- Australian Institute of Petroleum
- Australian Logistics Council
- Australian Paint Manufacturers Federation
- Chemistry Australia
- ComCare (Commonwealth Government)
- Department of Mines, Industry Regulation and Safety (WA)
- Engineers Australia
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The storage and handling of liquefied chlorine gas

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Preface

This Standard was prepared by the Australian members of the Standards Australia Committee CH-009, Safe Handling of Chemicals, to supersede AS/NZS 2927:2001, *The storage and handling of liquefied chlorine gas*.

After consultation with stakeholders in both countries, Standards Australia and Standards New Zealand decided to develop this Standard as an Australian Standard rather than an Australian/New Zealand standard.

The objective of this Standard is to promote the safety of persons and property where chlorine is stored or handled in its gaseous or liquefied forms by providing requirements and recommendations that are based on industry best practices.

This edition has been reformatted to improve clarity and to align with the other published Standards for the storage and handling of dangerous goods. Attention has been paid to ensuring that this Standard does not replicate the requirements of the various State, Territory and National regulatory authorities and emergency services.

Key changes to this edition include:

- (a) Incorporation of a requirement for a management of change process for chlorine facilities.
- (b) Use of calculated risk-based separation distances that are related to land or facility use. The latter change enables the impact (or credit) of risk mitigation measures to be readily understood.
- (c) Clearer detailing of the requirements for storage only facilities, including transit areas.

Standards covering the storage and handling of dangerous goods presently comprise the following:

AS 1894, *The storage and handling of non-flammable cryogenic and refrigerated liquids*

AS 1940, *The storage and handling of flammable and combustible liquids*

AS 2507, *The storage and handling of agricultural and veterinary chemicals*

AS 2714, *The storage and handling of organic peroxides*

AS 3780, *The storage and handling of corrosive substances*

AS 3846, *The handling and transport of dangerous cargoes in port areas*

AS 3961, *The storage and handling of liquefied natural gas*

AS 4326, *The storage and handling of oxidizing agents*

AS 4332, *The storage and handling of gases in cylinders*

AS/NZS 1596, *The storage and handling of LP Gas*

AS/NZS 2022, *Anhydrous ammonia—Storage and handling*

AS/NZS 3833, *The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers*

AS/NZS 4081, *The storage and handling of liquid and liquefied polyfunctional isocyanates*

AS/NZS 4452, *The storage and handling of toxic substances*

AS/NZS 4681, *The storage and handling of Class 9 (miscellaneous) dangerous goods and articles*

AS/NZS 5026, *The storage and handling of Class 4 dangerous goods*

The terms “normative” and “informative” have been used in this Standard to define how appendices apply. A “normative” appendix is an integral part of the Standard, whereas an “informative” appendix is for information only.

Statements expressed as mandatory terms in notes and footnotes to figures and tables are deemed to be requirements of this Standard.

Notes that appear in the main text of the Standard are intended to provide information only.

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NOTES

Australian Standard®

The storage and handling of liquefied chlorine gas

Section 1 Scope and general

1.1 Scope

This Standard sets out requirements and recommendations for the safe storage and handling of liquefied chlorine gas in sites where chlorine is used, e.g. water treatment facilities and sites where chlorine containers are stored e.g. transport depots. It also provides requirements and recommendations for vaporizers, chlorinators and other parts of systems in which chlorine is reticulated and distributed.

NOTE 1 Physical and chemical data for chlorine is provided in [Appendix A](#).

NOTE 2 The hazardous properties of chlorine are discussed in [Appendix B](#).

For the purposes of this Standard, quantities are expressed in kilograms (kg).

This Standard is written for end users in water treatment in particular; however, parts of the Standard will apply to other end users.

1.2 Application

Australian and Australian/New Zealand Standards are voluntary. They do not include contractual, legal or statutory requirements. Voluntary Standards do not replace laws with which users of Standards are understood to comply and which take precedence.

NOTE Refer to the National Construction Code (NCC) for all matters relating to building works.

This Standard does not apply to —

- (a) manufacture of chlorine gas and associated storage of containers at these sites;
- (b) chlorination of swimming pools by means of powders or liquids, e.g. calcium hypochlorite, isocyanurates or sodium hypochlorite solution;
- (c) transport of liquefied chlorine gas, which is covered by other rules and codes, e.g. the ADG Code;
- (d) handling and transport of chlorine in port areas which, in Australia, is covered by AS 3846.

1.3 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document.

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

AS 1210, *Pressure vessels*

AS 1345, *Identification of the contents of piping, conduits and ducts*

AS 1530.1, *Methods for fire tests on building materials, components and structures, Part 1: Combustibility test for materials*

AS 1530.4, *Methods for fire tests on building materials, components and structures, Part 4: Fire-resistance tests for elements of construction*

AS 1603.5, *Automatic fire detection and alarm systems, Part 5: Manual call points*

AS 1668.2, *The use of ventilation and airconditioning in buildings, Part 2: Mechanical ventilation in buildings*

AS 1670, *Fire detection, warning control and intercom systems (all parts)*

AS 1674, *Safety in welding and allied processes (all parts)*

AS 1680.1, *Interior lighting, Part 1: General principles and recommendations*

AS 1725.1, *Chain link fabric fencing, Part 1: Security fences and gates — General requirements*

AS 1851, *Routine service of fire protection systems and equipment*

AS 2030.1, *Gas cylinders, Part 1: General requirements*

AS 2118, *Automatic fire sprinkler systems (all parts)*

AS 2419.1, *Fire hydrant installations, Part 1: System design, installation and commissioning*

AS 2441, *Installation of fire hose reels*

AS 2444, *Portable fire extinguishers and fire blankets—Selection and location*

AS 2700, *Colour standards for general purposes*

AS 2809, *Road tank vehicles for dangerous goods (all parts)*

AS 2865, *Confined spaces*

AS 2941, *Fixed fire protection installations—Pumpset systems*

AS 3600, *Concrete structures*

AS 4041, *Pressure piping*

AS 4100, *Steel structures*

AS 4265, *Wheeled fire extinguishers*

AS 4775, *Emergency eyewash and shower equipment*

AS 60529, *Degrees of protection provided by enclosures (IP Code)*

AS/NZS 1221, *Fire hose reels*

AS/NZS 1716, *Respiratory protective devices*

AS/NZS 1841.1, *Portable fire extinguishers, Part 1: General requirements*

AS/NZS 1841.2, *Portable fire extinguishers, Part 2: Specific requirements for water type extinguishers*

AS/NZS 1841.4, *Portable fire extinguishers, Part 4: Specific requirements for foam type extinguishers*

AS/NZS 1841.5, *Portable fire extinguishers, Part 5: Specific requirements for powder type extinguishers*

AS/NZS 1841.6, *Portable fire extinguishers, Part 6: Specific requirements for carbon dioxide type extinguishers*

AS/NZS 1850, *Portable fire extinguishers—Classification, rating and performance testing*

AS/NZS 2022, *Anhydrous ammonia—Storage and handling*

AS/NZS 2210.1, *Safety, protective and occupational footwear, Part 1: Guide to selection, care and use*

AS/NZS 2210.2, *Occupational protective footwear, Part 2: Test methods (ISO 20344:2004, MOD)*

AS/NZS 3000, *Electrical installations (Australian/New Zealand Wiring Rules)*

AS/NZS 4503.2, *Protective clothing—Protection against liquid chemicals, Part 2: Test method: Determination of resistance to penetration by a jet of liquid (Jet test)*

AS/NZS 4503.3, *Protective clothing—Protection against liquid chemicals, Part 3: Test method: Determination of resistance to penetration by spray (Spray Test)*

AS/NZS ISO 6529, *Protective clothing — Protection against chemicals — Determination of resistance of protective clothing materials to permeation by liquids and gases*

AS/NZS ISO 31000, *Risk Management — Principles and guidelines*

ISO 6529, *Protective clothing — Protection against chemicals — Determination of resistance of protective clothing materials to permeation by liquids and gases*

1.4 New designs and innovations

Any materials, designs, methods of assembly and procedures that are alternative to the requirements of this Standard are not necessarily prohibited if equivalent performance and safety can be demonstrated, e.g. by a formal risk assessment as described in AS/NZS ISO 31000.

1.5 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

1.5.1

automatic shut-off device

ASD

emergency shut-off devices

automatic shut-off devices are risk mitigation devices which are attached to drum or cylinder valves, intended to stop chlorine leaks by closing off the container valve

1.5.2

authorized

authorized by the legal occupier of the installation

1.5.3

canister respirator

filtration type escape respirator

respiratory device incorporating filters which remove certain particles and gases or vapours from the air being inhaled by the wearer for a limited period, e.g. during escape from a respiratory hazard

1.5.4

capacity

total internal volume of the receptacle at a temperature of 15 °C, expressed in litres

Note 1 to entry: The capacities of typically used cylinders and drums in Australia are:

- (a) Drums 920 kg: 789 L or 731 L, depending on the design (see [Appendix D](#)).
- (b) Cylinders 70 kg: 59 L.
- (c) Cylinders 33 kg: 29 L.

1.5.5

chlorinator

piece of equipment that regulates the flow of chlorine gas into the user system, e.g. swimming pool, sewage effluent

1.5.6

chlorine

elemental chlorine in its gaseous or liquid form

1.5.7**commercial (land use)**

is deemed to include —

- (a) sports grounds and entertainment venues;
- (b) industrial land uses;
- (c) a factory, workshop, office, store, warehouse, shop, or building where people who are not associated with the operation of the chlorine installation are employed;
- (d) a ship lying at permanent berthing facilities; and
- (e) any storage facility for dangerous goods that exceeds minor storage quantities and is outside the property boundary of the installation

1.5.8**container**

anything in which the chlorine is wholly or partly contained, including cylinders, drums, road tank vehicles and tanks

1.5.9**containment vessel**

enclosed container designed to contain the drum or cylinder and associated pressure components and any pressure leak or release therefrom

1.5.10**cylinder**

rigid packaging which is designed in accordance with AS 2030.1 as a portable pressure vessel for the storage of chlorine and has only one cylinder valve, at one end, used for the withdrawal of chlorine gas

1.5.11**drum**

horizontal, cylindrical steel container having a water capacity of 150 L to 1 000 L and which can be fitted into a protective cradle for storage and transport

Note 1 to entry: Drums are designed for either gas or liquid withdrawal and are not fitted with pressure relief devices. They have inverted-heads (concave ends). If a drum is accidentally over-pressured, the heads will reverse (become convex) or push out, providing an immediate visual indication of over pressurization. The reversed heads also provide additional capacity to reduce the pressure and provide valuable time for safety or corrective action.

Note 2 to entry: Drums have two valves which, when vertically aligned above one another, permit gas to be drawn off from the upper valve and liquid chlorine to be drawn off from the lower valve.

Note 3 to entry: Drums are classified as “Pressure Drums” in the ADG Code.

Note 4 to entry: Further information on drum types and capacities can be found in [Appendix D](#).

1.5.12**dry air**

air that has been dried to –40 °C dew point or below

1.5.13**exposure standard**

airborne concentration of a particular substance in the person's breathing zone, exposure to which should not cause adverse health effects or undue discomfort to nearly all persons

Note 1 to entry: The exposure limit for chlorine has been set by Safe Work Australia (Workplace exposure standards for airborne contaminants) as 1 ppm (peak limitation).

Note 2 to entry: See [Appendix H](#) for more detail about peak limitation.

1.5.14**fire-resistance level****FRL****fire resistance rating****FRR**

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)

Note 1 to entry: Where an FRL/FRR is required, reference should be made to the National Construction Code (NCC) for guidance.

1.5.15**fixed tank**

tank intended to remain permanently in place once installed

1.5.16**handling area**

area where containers other than fixed tanks are unloaded from or loaded onto transport, or transferred to or from a storage area

1.5.17**incompatible**

<goods> in relation to dangerous goods or other goods, goods that are —

- (a) likely to interact with the dangerous goods so as to increase the hazard when mixed or otherwise brought into contact; or
- (b) listed in the ADG Code as being incompatible; or
- (c) declared by the regulatory authority to be incompatible.

<packaging or transfer equipment> in relation to packaging or transfer equipment, a container or item of equipment that is constructed of a material likely to interact such that it is weakened or damaged to the extent that the risk increases

1.5.18**installation**

facilities on a site related to storage, handling and use of chlorine, including connected and standby containers and associated piping and equipment, but not including separate storage areas (where cylinders, drums, portable tanks and road tank vehicles are simply stored)

1.5.19**may**

indicates the existence of an option

1.5.20**nominal effective life (of SCBA)**

time for which SCBA ([1.5.35](#)) has been designed to deliver a specified rate of life-supporting gases to the wearer under normal conditions of use, as determined in accordance with AS/NZS 1716

1.5.21**non-combustible**

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

1.5.22**opening (in a wall)**

in a wall or structure, a break that is permanently open or may readily be opened, e.g. a doorway, window, or vent, and through which chlorine can pass into neighbouring rooms or areas

1.5.23**pip ing**

assembly of pipes, pipe fittings, valves and pipe accessories, including associated bolting, gaskets, and pressure-retaining parts, or other components normally considered to be a part of piping

1.5.24**placard**

includes —

- (a) emergency information panels that meet the requirements of the ADG code;
- (b) outer warning placards (HAZCHEM) at entrances to site; and
- (c) any other signs designated as placards by state or territory regulators

Note 1 to entry: See [Appendix C](#) for further information about placards.

1.5.25**placard load**

load requiring placarding in accordance with the ADG code

1.5.26**portable tank**

multimodal tank that —

- (a) is designed primarily to be loaded onto a vehicle or ship;
- (b) has a capacity of more than 450 L;
- (c) is equipped with skids, mountings, stabilizers and accessories to facilitate manual handling;
- (d) is capable of being loaded and unloaded without removing its service or structural equipment; and
- (e) is capable of being lifted when full.

Road tank-vehicles, cylinders and drums are not considered to be portable tanks

1.5.27**public place**

place other than private property, open to the public, which the public has a right to use and which includes a public road. Private car parking areas are not considered to be public places

1.5.28**public swimming pool**

swimming pool that is not in single-residential premises

1.5.29**regulatory authority**

statutory authority responsible for the administration of control of the storage, transport and use of chlorine

1.5.30**restricted area**

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

1.5.31**road tank vehicle**

truck, trailer or semitrailer, or unit in a road train, incorporating a tank, or having a tank or tanks mounted thereon, either permanently or temporarily (refer to AS 2809 series)

1.5.32**scrubber**

emergency device designed to remove chlorine from a vent gas stream

Note 1 to entry: Absorption, adsorption or reaction media for removal may be solid or liquid.

1.5.33**safety data sheet****SDS**

document providing information on the identification, health hazards, precautions for use, and safe handling of a specific chemical product and which conforms to *Safe Work Australia Model Code of Practice: Preparation of safety data sheets for hazardous chemicals*

1.5.34**self-contained breathing apparatus****SCBA**

portable respirator which supplies oxygen, air or other respirable gas from a source carried by the user

1.5.35**segregation**

isolation of incompatible goods from each other

1.5.36**sensitive uses**

establishments and other uses where vulnerable people are concentrated such as schools, hospitals, day surgeries, aged persons' accommodation and childcare facilities (including creches)

Note 1 to entry: When considering sensitive uses, ease of evacuation by the people using the area should be considered.

Note 2 to entry: In large establishments, actual use of buildings and areas within the defined separation distance should be evaluated. For example, in a large school or hospital surrounded by a garden or playing field or car park, the required separation distance should be maintained from the school or hospital buildings and places of regular occupancy. In addition, the garden or playing field or car park should be considered as sensitive if vulnerable people are normally present in these areas.

1.5.37**separation**

isolation from sensitive uses, residential dwellings, commercial uses, public places, boundaries or other dangerous goods stores

1.5.38**shall**

indicates that a statement is mandatory

1.5.39**should**

indicates a recommendation

1.5.40**storage area**

area, including a building, where containers other than fixed tanks are kept separate from containers connected for use

1.5.40.1**passive storage area**

storage area which is not a transit storage area

1.5.40.2

transit storage area

secure area in which chlorine containers may be stored for a period of between 12 hours and five days when intended for further transport to another location

Note 1 to entry: See [Clause 3.3](#) for requirements relating to transit storage areas.

1.5.41

tank

container designed, constructed and protected, in accordance with AS 1210 or equivalent Standard, including any fittings and other equipment integral to the container, but not including cylinders or drums

Note 1 to entry: In Australia, a tank that is to be used for the transport of chlorine or its residues by road or rail is required to meet the requirements of the ADG Code.

1.5.42

vacuum regulator system

system in which chlorine is drawn from a chlorine drum or cylinder under vacuum conditions, consisting of a vacuum regulator attached directly to the top drum or cylinder valve and connected to one or more chlorinators by a vacuum hose, piping or close coupling etc

1.5.43

vaporizer

evaporator

equipment that converts chlorine from liquid to gas

Note 1 to entry: Vaporizers are used where a relatively high rate of gas flow is required in the user system.

1.5.44

vapour barrier

wall or other barrier intended to prevent vapour passing from any one place to another

1.6 Classification of chlorine

Chlorine is classified as a dangerous good in the United Nations *Recommendations for the Transport of Dangerous Goods—Model Regulations* and listed in the ADG Code as a dangerous good within Division 2.3, with Subsidiary Hazards 5.1 (Oxidising) and 8 (Corrosive).

1.7 Placarding, marking and labelling of containers, equipment, installations and storage areas

Containers of chlorine shall be marked and labelled.

NOTE 1 Refer to Federal, State or Territory legislation for additional requirements related to labelling.

NOTE 2 Refer to [Appendix C](#) for more information on placarding, marking and labelling.

1.8 Security of installations and storage areas

All installations and storage areas shall be secured against access by unauthorized persons. Sites shall, as a minimum, be surrounded by a chain wire fence conforming to AS 1725.1. A security risk assessment shall be undertaken to determine what other additional security treatments should be implemented.

NOTE For further information on security risk assessment refer to National Code of Practice for Chemicals of Security Concern.

1.9 Marking and labelling of pipework

Fixed piping for chlorine shall be coloured Y14 golden yellow, as described in AS 2700 and marked in accordance with the requirements of AS 1345.

Section 2 Minor storage

2.1 Scope of section

This Section specifies the criteria for minor storage of chlorine in cylinders, and the requirements for such storage.

2.2 Criteria for classification as minor storage

Storage of less than 5 kg of chlorine gas in cylinders is classified as minor storage.

NOTE AS 4332 should also be consulted.

2.3 Requirements applicable to minor storage

The following requirements and precautions apply to the minor storage of chlorine in cylinders:

- (a) Areas in which cylinders are kept shall be —
 - (i) away from any artificial sources of heat, e.g. radiators, boilers to steam pipes; and
 - (ii) kept clear of combustible matter and refuse for a distance of at least 3 m.
- (b) All cylinder stores shall be provided with adequate ventilation at all times.

NOTE Workplace exposure standards may specify maximum chlorine exposure levels.
- (c) The base or floor on which a cylinder is kept shall be maintained in good condition so it doesn't create a cylinder tipping risk or trip hazard to personnel, and to prevent pooling of water under cylinders which may cause corrosion.
- (d) Cylinders shall be kept in such a manner that —
 - (i) they are secured against falling; and
 - (ii) they are protected against impact damage.
- (e) Before connection to a cylinder, offtake valves and application equipment shall be checked for their suitability for use with chlorine and the pressure that is intended to be used. After connection, the offtake valves and equipment shall be checked for leaks.
- (f) Cylinder outlets shall be plugged and securely capped when not in use.
- (g) Personnel handling the cylinders shall be trained in the applicable safety regulations and safe handling procedures.
- (h) Grease and oil shall only be used on external threads, and not be in contact with chlorine unless a non-reactive fluorinated lubricant is used.
- (i) Cylinder valves shall not be opened more than one and a half turns, unless advised by the chlorine supplier.

2.4 Outdoor minor storage

Outdoor minor stores of chlorine in cylinders shall be separated from other dangerous goods stores by at least 3 m. They shall be located at least 1 m from any door, window, air vent or duct.

2.5 Indoor minor storage

The indoor storage and use of chlorine cylinders shall only be permitted where a documented review suggests that there is no practicable alternative and a risk assessment is documented. Where providing

an outdoor cylinder and reticulation system is not possible, the following restrictions shall apply to chlorine cylinders indoors:

- (a) Cylinders shall not be kept in basements.
- (b) Indoor minor stores of cylinders of chlorine shall be separated from other minor stores of gases or other dangerous goods by at least 3 m.
- (c) The total capacity of chlorine kept shall not exceed one minor storage quantity in any 200m² floor area.
- (d) The total capacity of cylinders of chlorine in any particular indoor location shall include cylinders in use, spare cylinders not in use, and cylinders that are nominally empty.
- (e) Safe job planning, which may involve review of task work instructions, training and equipment, shall be undertaken before any chlorine cylinder is opened for use, and emergency equipment, e.g. canister respirators or self-contained breathing apparatus, shall be readily available.
- (f) The concentration of chlorine gas in the atmosphere shall be monitored. Consideration shall be given to the monitoring of chlorine gas concentration where chlorine is stored and reticulated.
- (g) Nominally empty cylinders shall be left containing a slight positive pressure, in order to avoid contamination with moisture or air. The cylinders shall be marked empty and removed from any work area as soon as practicable.

Section 3 Transit storage

3.1 Scope of section

This Section applies to the parking, for a period of between 12 h and five days, of road trailers and rigid vehicles loaded with cylinders or drums that have either been preloaded in preparation for delivery, or where, for operational reasons, the transport journey is broken.

3.2 Requirements for vehicles and trailers in transit storage areas

The following requirements apply to the parking of vehicles and trailers loaded with cylinders or drums of chlorine:

- (a) The total capacity of gas cylinders and drums held in the transit storage area shall not exceed 40 000 L (based on two fully loaded trailers).
- (b) The total capacity of cylinders and drums on any trailer shall not exceed 20 000 L.
- (c) Rigid vehicles and trailers shall be parked so they can be driven forward without obstruction.
- (d) Trailers and rigid vehicles shall be loaded in accordance with the ADG Code.
- (e) Trailers and rigid vehicles shall be placarded as per the ADG Code.
- (f) Once parked in the transit storage area, cylinders and drums shall be inspected for leaks using a suitable method (e.g. hand-held leak detector, ammonia solution). Ammonia solution testing shall be conducted as per [Clause 8.8.2.2](#).

3.3 Requirements for transit storage areas

The following requirements apply to the design, location and management of transit storage areas.

3.3.1 Separation distances

The following separation distances shall apply to transit storage areas:

- (a) A minimum of 8 m clear space shall be provided to at least three sides of the trailer or rigid vehicle (two long sides and one short side).
- (b) A minimum of 8 m segregation shall be provided to any other placard load or dangerous goods storage area.
- (c) The transit storage area shall be separated from sensitive uses, residential dwellings, commercial uses and public places by at least 15 m.

3.3.2 Security

The transit storage area shall be secured against access by unauthorized persons in accordance with [Clause 1.8](#).

3.3.3 Emergency planning

The following requirements apply to transit storage areas:

- (a) The design and layout of the transit storage area should consider the points in [Clause 9.2.1](#).
- (b) A site's emergency manifest shall record the dangerous goods in transit storage areas. This may be achieved by placing a copy of the dangerous goods transport documentation, or a compilation thereof, with the site's emergency manifest.

- (c) The transit storage area shall be included in the emergency plan prepared in accordance with [Clause 9.2.2.](#)

3.3.4 Demarcation

The transit area shall be clearly demarcated by means such as signage or pavement markings.

Section 4 Storage and handling areas

4.1 Scope of section

This Section specifies the minimum requirements for storage and handling areas (except transit storage) for chlorine in quantities greater than minor storage, except where AS 4332 applies.

4.2 Handling areas

Areas used as handling areas shall be large enough to accommodate any vehicle to be loaded or unloaded, along with any associated mechanical handling equipment, and their movement.

A traffic flow risk assessment, including consideration of separation of pedestrians and vehicles, shall be undertaken and a traffic plan prepared if identified as necessary by the risk assessment.

Containers shall not be present in non-working hours nor remain in the handling area at the end of the shift.

Containers should remain in the handling area for the minimum time possible.

Containers may be placed on the ground in handling areas prior to loading vehicles or prior to moving containers to a storage area or installation.

4.3 Storage

4.3.1 Separation

Chlorine storage areas shall be —

- (a) located in accordance with [Table 4.1](#);
- (b) protected from direct sources of heat (e.g. steam pipes); and
- (c) separated by at least 3 m from any other dangerous goods with the exception of gases of ADG Code, Division 2.2 and 10 m from anhydrous ammonia storage as per AS/NZS 2022.

From sensitive uses, residential dwelling, commercial and public places, separation distances may be measured horizontally around an intervening non-combustible vapour barrier that is —

- (a) at least 1 m above the highest container; or
- (b) at least 2 m high;

whichever is the greater.

From storage or handling of combustible or flammable liquid, gas or solids, separation distances may be measured horizontally around an intervening wall or structure with a fire-resistance level (FRL) not less than 240/240/240 that is at least 1 m higher than the top of the protected chlorine storage area or the potential fuel source on either side of the barrier, whichever is the higher.

Table 4.1 — Minimum separation distances for chlorine storage

Container type	Aggregate quantity, kg	Minimum distance, m			
		Sensitive uses	Residential dwelling	Commercial and public places	Storage or handling of combustible or flammable liquid or gas ^a
Cylinders	≤ 2 500	15	8	3	8
	> 2 500	30	15	8	15
Drums	≤ 2 000 kg	30	5	5	15
	≤ 2 000 kg with scrubber	5	5	3	15
	>2 000–2 800 kg	40	25	3	15
	>2 000–2 800 kg with scrubber	15	5	3	15
	>2 800–3 700 kg	55	35	3	15
	>2 800–3 700 kg with scrubber	25	5	3	15
	>3 700–10 000 kg	65	40	3	15
	>3 700–10 000 kg with scrubber	30	10	3	15
	> 10 000 kg	150	75	25	15
	> 10 000 kg with scrubber	30	5	3	15

If cylinders are mixed with drums and are less than or equal to 2 500 kg in aggregate quantity, the cylinder separation distances shall be used based on the aggregate quantity of drums and cylinders: Sensitive = 15 m; Residential = 8 m. Above 2 500 kg, the drum separation distances shall be used based on the aggregate quantity of drums and cylinders. For example, 2 600 kg aggregate: Sensitive = 40 m; Residential = 25 m.

NOTE 1 For the purpose of this Standard, any permanently closed and sealed opening in a wall is deemed to be part of the wall.

NOTE 2 Storage area separation distances are only for sites used for storage, not for sites that are operational with a combination of connected and not connected containers.

NOTE 3 The following individual fatality risk levels apply for the determination of separation distances: Sensitive = 0.5 parts per million per year (ppmy); Residential = 1 ppmy; Commercial/Industrial = 50 ppmy.

^a Where a flammable or combustible liquid is stored near a chlorine container, bunding shall be provided in order to prevent any liquid from flowing against or beneath the chlorine container.

4.3.2 Foundations

Containers shall be placed on a firm, stable, level and non-combustible surface. Portable tanks shall not be stacked.

4.3.3 Access

An unobstructed path of at least 850 mm wide shall be maintained between the entrance to the area and the containers, for safe access and egress. Access to valves shall be clear and unobstructed, to enable an operator to approach them readily for inspection and in case of leaks. Consideration should be given for adequate access for personnel wearing self-contained breathing apparatus (SCBA).

4.3.4 Protection from heat sources

Containers shall be protected from direct sources of heat (e.g. radiators, boilers, steam pipes).

4.3.5 Impact protection

Containers and piping shall be protected against accidental damage from vehicles and fork lift trucks. Filling points shall also be protected.

NOTE Where vehicles are manoeuvring at low speed, see [Appendix M](#) for examples of impact protection.

4.4 Securing of containers

4.4.1 Cylinders

Cylinders shall be —

- (a) fitted with valve outlet caps and with valve-protection covers when in storage; and
- (b) securely restrained so that they are kept upright at all times.

NOTE Upright positioning is intended to ensure that, if leaks occur at the valve, gas escapes rather than liquid.

4.4.2 Drums and tanks

Drums and tanks shall be —

- (a) fitted with valve outlet caps and with valve-protection covers when in storage;
- (b) stored horizontally; and
- (c) prevented from moving when in storage.

4.5 Other requirements

The requirements of [Clauses 6.4](#), [6.5](#), and [7.8](#) and [Sections 8](#), [9](#), [10](#) and [11](#) shall also apply.

Section 5 Requirements for chlorine installations at public swimming pools

5.1 Scope of section

This Section specifies minimum requirements for the location, design and construction of chlorine installations at public swimming pools. Any separate storage area shall conform to [Section 4](#). The requirements of [Clauses 6.4, 6.5](#) and [Sections 7 to 11](#) of this Standard shall also be met.

5.2 Location of chlorine installations

The separation distances in [Tables 5.1](#) and [6.1](#) shall apply in addition to the requirements of [Clause 5.3.1](#).

Separation distances may be measured horizontally around an intervening non-combustible vapour barrier that is —

- (a) at least 1 m above the highest container; or
- (b) at least 2 m high,

whichever is the greater.

Table 5.1 — Separation distances from chlorine installations to on-site recreation areas and swimming pools

Separation distance from any opening of room where chlorine containers are connected for use	Minimum distance (m)
Open recreational areas (e.g. picnic, sunbathing areas)	3
For cylinders — Swimming pool or enclosed areas to which patrons have access (e.g. dressing rooms, toilets, first aid rooms, club rooms, foyers, kiosks, grandstands)	2
For cylinders — facilities where it is difficult to evacuate users (e.g. creches, hydrotherapy pools)	7
For cylinders — Storage of combustible or flammable liquid or gas	8
For drums — Swimming pool or enclosed areas to which patrons have access (e.g. dressing rooms, toilets, first aid rooms, club rooms, foyers, kiosks, grandstands)	3
For drums — facilities where it is difficult to evacuate users (e.g. creches, hydrotherapy pools)	30
For drums — Storage of combustible or flammable liquid or gas	15

NOTE [Table 5.1](#) applies to systems configured as per [Clause 5.3.1](#) and not more than 4 cylinders or not more than 2 drums connected for use. [Table 5.1](#) applies to cylinders not greater than 70 kgs in size. For cylinders and drums greater than these quantities, [Table 6.1](#) applies.

5.3 Chlorine installation requirements

5.3.1 System configuration

A chlorine installation located at a public swimming pool shall consist of the following:

- (a) A vapour withdrawal vacuum regulator system.
- (b) Chlorine leak detection in accordance with [Clause 7.8.1](#).
- (c) Automatic shut-off devices (see [Clause 7.8.6](#)) that can effectively shut off the chlorine drum or cylinder valve on detection of a leak.

5.3.2 Wind direction indication

At least one wind direction indicator (e.g. windsock) shall be installed at the chlorine installation, at least 2 m above the installation.

Additional wind direction indicators may be required to assist with emergency management and to overcome any visual obstructions (e.g. tall trees, other buildings).

5.3.3 System configuration restrictions

The following restrictions apply to chlorine installations at swimming pools:

- (a) Only cylinder and drums shall be used. Tanks shall not be installed.
- (b) No pressure piping systems shall be used.
- (c) No liquid withdrawal and vaporizer systems shall be installed.

5.3.4 Chlorine inventory management

The chlorine inventory at a public swimming pool shall be kept to a minimum to limit the potential impact to neighbours and patrons from a chlorine leak.

5.4 Additional risk controls

The following risk controls should be considered in order to minimize risk:

- (a) Using chlorine cylinders instead of drums.
- (b) Housing the chlorine installation inside a building that is designed to effectively contain the gas (i.e. significantly reducing its escape from the building) if there is a leak from the installation.
- (c) Limiting chlorine deliveries and changeovers to off-peak times.
- (d) Linking the gas detection system to the mechanical ventilation system (if fitted), so that the ventilation system can be isolated on detection of a chlorine leak.
- (e) Fitting effective door and ventilation seals to ensure gas is contained within the installation building in case of a chlorine leak.
- (f) Installing a chlorine scrubber system as per [Clause 7.8.5](#), which will also reduce separation distance requirements as per [Table 6.1](#).
- (g) Using chlorine drum or cylinder containment vessels. These can be very effective for vacuum systems provided that all potential points at which leaks of pressure gas may occur are also enclosed within the containment vessel (including the vacuum regulators and relief lines).

5.5 Provision of SCBA

Self-contained breathing apparatus shall be provided in accordance with [Clause 8.11.2](#).

Section 6 Location, design and construction of chlorine installations

6.1 Scope of section

This Section specifies minimum requirements for the location, design and construction of installations for chlorine in quantities greater than minor storage.

6.2 Application

The requirements of [Clause 6.3](#) apply to all chlorine installations greater than minor storage. Additional requirements and recommendations for outdoor installations are set out in [Clause 6.4](#). [Clause 6.5](#) sets out requirements and recommendations for indoor installations that are additional to those in [Clause 6.3](#).

6.3 Location, design and construction of chlorine installations

6.3.1 Location of chlorine installations

6.3.1.1 General

Installations for chlorine shall be —

- (a) located in accordance with [Table 6.1](#);
- (b) protected from direct sources of heat (e.g. steam pipes); and
- (c) separated by at least 3 m from any other dangerous goods with the exception of gases of ADG Code, Division 2.2 and 10 m from anhydrous ammonia storage as per AS/NZS 2022.

6.3.1.2 Measurement of separation distances

From sensitive uses, residential dwelling, commercial and public places, separation distances may be measured horizontally around an intervening, non-combustible vapour barrier that is —

- (a) at least 1 m above the highest container; or
- (b) at least 2 m high;

whichever is the greater.

From storage or handling of combustible or flammable liquid, gas or solids, separation distances may be measured horizontally around an intervening wall or structure with an FRL not less than 240/240/240 that is at least 1 m higher than —

- (i) the top of the protected chlorine installation; or
- (ii) the potential fuel source on either side of the barrier;

whichever is the higher.

Table 6.1 — Minimum separation distances for chlorine installations

Container type and aggregate quantity connected for use (See Note 6)	System Configuration (See Note 7)	Minimum distance, m			
		Sensitive Uses	Residential Dwelling	Commercial and Public Places	Storage or handling of combustible or flammable liquid ^a gas or solids
For gas withdrawal					
Cylinders ≤ 280 kg	Pressure	50	40	25	15
	Pressure with ASD	10	8	3	15
	Vacuum	10	8	3	15
	Vacuum with ASD	7	5	2	15
	With Scrubber	5	5	2	15
Cylinders > 280 kg	Pressure	55	45	25	15
	Pressure with ASD	10	8	5	15
	Vacuum	10	8	5	15
	Vacuum with ASD	7	5	3	15
	With Scrubber	5	5	3	15
Drums ≤ 2 000kg	Pressure	80	60	30	15
	Pressure with ASD	55	30	5	15
	Vacuum	55	30	5	15
	Vacuum with ASD	30	20	3	15
	With Scrubber	10	5	3	15
Drums >2 000 – 2 800kg	Pressure	90	65	30	15
	Pressure with ASD	60	35	5	15
	Vacuum	60	35	5	15
	Vacuum with ASD	40	25	3	15
	With Scrubber	15	5	3	15
Drums >2 800 – 3 700kg	Pressure	110	70	50	15
	Pressure with ASD	80	55	5	15
	Vacuum	80	55	5	15
	Vacuum with ASD	55	35	3	15
	With Scrubber	25	5	3	15
Drums > 3 700kg	Pressure	110	80	50	15
	Pressure with ASD	95	60	5	15
	Vacuum	95	60	5	15
	Vacuum with ASD	65	40	3	15
	With Scrubber	30	10	3	15
For liquid withdrawal					
Drums	No ASD	530	380	180	15
	With ASD	65	30	5	15
	With Scrubber	5	5	3	15

NOTE The following individual fatality risk levels apply for the determination of separation distances: Sensitive = 0.5 parts per million per year (ppmy); Residential = 1 ppmy; Commercial/Industrial = 50 ppmy.

^a Where a flammable or combustible liquid is stored near a chlorine container, bunding shall be provided in order to prevent any liquid from flowing against or beneath the chlorine container.

NOTE 1 For the purpose of this Standard, any permanently closed and sealed opening in a wall is deemed to be part of the wall.

NOTE 2 Additional risk mitigation measures ([Clause 5.4](#) provides examples) should be implemented where chlorine cylinders are connected for use and are located within 150 m of sensitive uses.

NOTE 3 Additional risk mitigation measures ([Clause 5.4](#) provides examples) should be implemented where chlorine drums are connected for use and are located within 400 m of sensitive uses.

NOTE 4 Federal, State or Territory major hazard facility (MHF) legislation may supersede the above table.

NOTE 5 For high density housing four storeys and above and caravan parks, sensitive use column applies.

NOTE 6 Aggregate quantity includes all containers with valve covers and cap nuts removed.

NOTE 7 Pressure — Pressure chlorine systems include installations that utilize pipework normally containing liquid chlorine or chlorine gas at greater than atmospheric pressure.

Pressure with ASD — Pressure systems as outlined above, including an automatic shutdown system designed, installed and maintained in accordance with [Clause 7.8.6](#), on all chlorine containers where valves are open for service.

Vacuum — Chlorine systems with vacuum regulators mounted directly onto chlorine valves (including any required adaptors and joints to facilitate connection of automatic shutdown devices).

Vacuum with ASD — Systems as outlined above, including an automatic shutdown system designed, installed and maintained in accordance with [Clause 7.8.6](#), on all chlorine containers where valves are open for service.

Scrubber — Any chlorine system that includes a scrubber designed, installed and maintained in accordance with [Clause 7.8.5](#).

6.3.2 Design and construction of chlorine installations

6.3.2.1 General

The following requirements apply:

- (a) The installation shall be protected from direct sources of heat (e.g. radiators, boilers, steam pipes).
- (b) The chlorine container shall be positioned in a way that places no stress on its associated pipework during normal operations. The container shall be immobilized while it is in service.

6.3.2.2 Foundations

Fixed tanks shall be mounted on concrete foundations constructed in accordance with AS 3600, or steel foundations constructed in accordance with AS 4100. Cylinders, portable tanks or drums shall be placed on a firm, stable, level, non-combustible surface, with or without floor coverings.

NOTE For the purpose of this Standard, hardwood is deemed to be non-combustible.

6.3.2.3 Access and egress

An unobstructed path that is at least 850 mm wide shall be maintained between the entrance to the area and the containers, for safe access and egress. A similar clearance of 850 mm shall be maintained in all parts of the area where personnel need to have access for work purposes.

Access to valves shall be clear and unobstructed, so as to allow an operator to approach them readily.

NOTE Consideration should be given for adequate access for personnel wearing SCBA and using emergency capping equipment.

6.3.2.4 Electrical equipment

The following requirements apply to electrical equipment in an area where chlorine is stored, handled, processed or distributed:

- (a) Any electrical safety equipment that is essential to the installation shall have an Ingress Protection (IP) rating appropriate for service conditions according to AS 60529.
- (b) All electrical installations shall be in accordance with AS/NZS 3000.

Except for any electrical equipment necessary for the operations being carried out, it is recommended that any switchgear, fuse boxes or meters should not be installed in an area where chlorine is stored, handled, processed or distributed.

6.4 Additional requirements for outdoor installations

6.4.1 General

The following additional requirements apply to outdoor chlorine installations:

- (a) Containers shall be located so that any spillage of flammable or combustible liquids cannot flow against or under the chlorine container.

NOTE A kerb or bund may be used to achieve this requirement.
- (b) Containers and their pipework shall be located so as to avoid other service pipelines or be otherwise protected.
- (c) The base or floor of the installation shall be paved or constructed of suitable material that can maintain its integrity under all weather conditions.
- (d) Any solid wall or fencing provided in an outdoor installation shall include ground level cross ventilation as per [Clause 6.5.3.4](#) (natural ventilation). This can be configured to support the operation of chlorine leak sensors. A vapour barrier is excluded from this requirement (see [Clause 6.3.1.2](#)).

6.4.2 Egress from outdoor installations

Where the aggregate capacity of the containers is 2 000 kg or less, the fence shall have at least one gate that opens outward, be at least 850 mm from the container, and be able to be locked. Where the aggregate capacity of the containers is more than 2 000 kg, the fence shall be at least 1.5 m from the container and shall have at least two such gates.

The fence and gates shall be maintained in good condition.

If the distance between the chlorine container and the fence is less than 3 m, gates shall be fitted with holdback devices and shall be held open while personnel are inside the installation.

NOTE The intention of this requirement is to facilitate clear access for emergency responders wearing full protective clothing and equipment.

6.5 Additional requirements for indoor installations

6.5.1 General

The following requirements apply to indoor installations for chlorine, in addition to those already given in [Clause 6.3](#):

- (a) The cladding or lining of any indoor installation shall be non-combustible.