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Anhydrous ammonia—Storage and handling



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Anhydrous ammonia—Storage and handling

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME-032, Anhydrous Ammonia Storage and Handling to supersede AS 2022—1983, *Anhydrous ammonia—Storage and handling (known as the SAA Anhydrous Ammonia Code)*.

This Standard incorporates Amendment No. 1 (December 2003). 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 objective of this Standard is to provide distributors and users with procedures for the safe storage and handling of anhydrous ammonia.

In addition to the updating of the list of reference documents and editorial changes in accordance with current policy, the following changes have been included in this edition:

- (a) Reference to AS/NZS 3788 for pressure vessel inspections.
- (b) Reduction in test pressure and increase in frequency for the testing of flexible hoses.
- (c) Changes to the requirements for personal protective equipment during transfer operations.
- (d) Alignment with the Australian Dangerous Goods Code, as appropriate.
- (e) Addition of requirements for emergency shut down and drive-away protection systems.
- (f) Addition of requirements for the management of emergencies.

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

CONTENTS

	Page
SECTION 1 SCOPE AND GENERAL	
1.1 SCOPE.....	6
1.2 REFERENCED DOCUMENTS.....	6
1.3 DEFINITIONS.....	6
SECTION 2 GENERAL REQUIREMENTS FOR SYSTEMS AND EQUIPMENT	
2.1 APPLICATION	9
2.2 OPERATING PRESSURE AND DESIGN PRESSURE	9
2.3 MATERIALS.....	9
2.4 ELECTRICAL EQUIPMENT AND WIRING	9
2.5 PROTECTION OF FITTINGS	9
2.6 FILLING AND DISCHARGE CONNECTIONS.....	10
2.7 VALVES AND FITTINGS.....	10
2.8 EXCESS FLOW VALVES AND EXCESS FLOW PROTECTION	10
2.9 PIPING	12
2.10 LIQUID LOADING AND UNLOADING CONNECTIONS.....	13
2.11 FLEXIBLE STEEL HOSE.....	13
2.12 RUBBER HOSE	13
2.13 PUMPS	14
2.14 COMPRESSORS.....	14
2.15 VAPORIZERS.....	15
2.16 EMERGENCY SHUT DOWN SYSTEM	15
2.17 DRIVE-AWAY PROTECTION	16
2.18 SAFETY EQUIPMENT.....	16
2.19 PERSONAL PROTECTION EQUIPMENT	17
SECTION 3 TANK STORAGE	
3.1 APPLICATION	18
3.2 TANKS.....	18
3.3 PRESSURE RELIEF VALVES	18
3.4 EXCESS FLOW VALVES AND NON RETURN VALVES.....	19
3.5 MANUAL SHUT OFF VALVES	19
3.6 VAPOUR RETURN VALVE	20
3.7 LIQUID LEVEL GAUGES	20
3.8 PRESSURE GAUGES.....	20
3.9 TEMPERATURE GAUGES.....	20
3.10 TANK LOCATION	21
3.11 INSTALLATION	22
3.12 SAFETY EQUIPMENT.....	23
SECTION 4 TANKS FOR TRANSPORTATION	
4.1 APPLICATION	25
4.2 GENERAL.....	25
4.3 ROAD AND RAIL TANK VEHICLES.....	25
4.4 SKID TANKS, NURSE TANKS AND APPLICATOR TANKS	25
4.5 PLACARDING.....	26

SECTION 5 CYLINDERS AND CYLINDER SYSTEMS

5.1	APPLICATION	27
5.2	EQUIPMENT	27
5.3	STORAGE AND HANDLING	27
5.4	INSPECTION AND TESTING	28
5.5	FILLING CYLINDERS	28
5.6	CYLINDER HANDLING AND TRANSPORT	28
5.7	SAFETY EQUIPMENT	28

SECTION 6 REFRIGERATED STORAGE

6.1	APPLICATION OF SECTION	30
6.2	TANK CONSTRUCTION	30
6.3	LOCATION AND INSTALLATION	30
6.4	FILLING AND DISCHARGING VALVES	31
6.5	PRESSURE RELIEF	32
6.6	REFRIGERATION SYSTEMS	32

SECTION 7 OPERATIONS

7.1	APPLICATION	35
7.2	ESTABLISHMENT OF PROCEDURES	35
7.3	PLACARDING	37
7.4	TRAINING OF PERSONNEL	37
7.5	WORK ACTIVITIES AND SUPERVISION	38
7.6	COMPLIANCE WITH PROCEDURES	38
7.7	RECORDS	38
7.8	GENERAL PRECAUTIONS	38
7.9	INSPECTION AND TESTING	39
7.10	TRANSFER OF ANHYDROUS AMMONIA	40
7.11	LEAK DETECTION AND LOCATION	41
7.12	REPAIRS	42

SECTION 8 EMERGENCY MANAGEMENT

8.1	APPLICATION	43
8.2	PLANNING FOR EMERGENCIES	43
8.3	MANIFEST	44
8.4	PLACARDING	45
8.5	MANAGEMENT OF LEAKS AND SPILLS	45

SECTION 9 FIRE PROTECTION

9.1	APPLICATION	47
9.2	GENERAL CONSIDERATIONS	47
9.3	FIXED FIRE PROTECTION AND DETECTION SYSTEMS	49
9.4	FIRE ALARM SYSTEMS	49
9.5	FIRE EXTINGUISHERS	49
9.6	HOSE REELS	50
9.7	FIRE HYDRANTS	50
9.8	MONITORS	51
9.9	SPRINKLER SYSTEMS	51
9.10	WATER SUPPLY	51
9.11	FIRE PROTECTION REQUIREMENTS	52
9.12	ACTION IN EVENT OF A FIRE	52

Page

APPENDICES

A	PROPERTIES OF ANHYDROUS AMMONIA	53
B	REFERENCED DOCUMENTS.....	56
C	STRESS CORROSION CRACKING	59
D	CAPACITY OF SAFETY VALVES	61
E	TANK FILLING LEVEL.....	63
F	INFORMATION TO BE PROVIDED TO EMERGENCY SERVICES	66

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Australian/New Zealand Standard
Anhydrous ammonia—Storage and handling

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for the design, repair, alteration, location, installation and operation of plant used for the storage, handling and transport of anhydrous ammonia in industrial and rural situations.

This Standard is not applicable to—

- (a) ammonia manufacturing plants;
- (b) manufacturing plants and other systems involving the use of ammonia; and
- (c) refrigeration systems, where anhydrous ammonia is used solely as a refrigerant.

The storage, handling and transport of anhydrous ammonia associated with these plants are not excluded.

NOTE: A guide to the properties of anhydrous ammonia is given in Appendix A.

1.2 REFERENCED DOCUMENTS

The documents listed in the Appendix B are referred to in the Standard.

1.3 DEFINITIONS

For the purpose of this Standard, the definitions given in AS 4942 and those below apply.

1.3.1 Authorized person

A person specifically appointed by an anhydrous ammonia distributor or the distributor's agent to perform the duties of that position.

1.3.2 Capacity (of a tank, cylinder or drum)

The total volume of the space enclosed within the tank or cylinder, expressed in litres or cubic metres.

NOTES:

- 1 This is synonymous with and numerically equal to water capacity.
- 2 Capacity is sometimes expressed as the equivalent mass of water.

1.3.3 Container

A cylinder or tank specifically designed and constructed for the storage or transport of anhydrous ammonia.

1.3.4 Depot

A stationary anhydrous ammonia storage system, including the container or containers, container fittings and the ancillary equipment essential for the safe operation of the system.

1.3.5 Filler

A competent person authorized to fill containers with anhydrous ammonia.

1.3.6 Mass filling ratio

The ratio of the greatest mass of anhydrous ammonia permitted in a container and the mass of water at 15°C, which would completely fill the container.

1.3.7 Protected places

These are deemed to include—

- (a) a dwelling, place of worship, public building, school or college, childcare facility, hospital, theatre, or any building or open area in which people are accustomed to assemble, whether within or outside the property boundary of the installation;
- (b) a factory, workshop, office, store, warehouse, shop or building where people who are not associated with the operation of the anhydrous ammonia installation are employed;
- (c) a ship lying at permanent berthing facilities; and
- (d) any storage facility for dangerous goods that exceeds minor storage quantities and is outside the property boundary of the installation.

1.3.8 Rail tank vehicle

A railway vehicle with a tank or tanks mounted thereon, either permanently or temporarily.

1.3.9 Road tank vehicle

A 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.

1.3.10 System

An assembly of equipment consisting of containers, interconnecting piping and all ancillary equipment including pumps, compressors, valves and measuring devices and any part thereof.

1.3.11 Tank

A container, other than a cylinder, designed for the storage and transport of anhydrous ammonia. Some specific sub-types of tank are as follows:

- (a) *Static storage tank*—a tank intended to be operated from a fixed position once installed. (Includes both permanent and temporary installations.)
- (b) *Applicator tank*—a tank mounted on a trailer, tractor and used for the application of anhydrous ammonia as a fertilizer.
- (c) *Nurse tank*—a tank permanently mounted on a towed wheeled vehicle. When towed into position, it operates independently for filling skid tanks, applicator tanks and portable tanks.
- (d) *Demountable delivery tank*—a tank intended to be placed on a vehicle from time to time to enable use as a temporary delivery tanker.
- (e) *Skid tank*—a portable tank fitted with suitable skids or supports.
- (f) *Relocatable tank*—a tank not licensed to transport anhydrous ammonia but which can be relocated from site to site and used as a temporary storage tank or a nurse tank.
- (g) *Drum*—a tank with a capacity between 500 and 1 000 L water capacity without safety devices except for fusible plugs, e.g. a container complying with USA. DOT specification 106A-500X.

1.3.12 Maximum filling level

The highest liquid surface level permitted in a tank, account being taken of its actual temperature at the time of loading.

1.3.13 Standard filling level

The highest liquid surface level permitted in a tank for liquid at a temperature of 5°C. It represents a safe but conservative filling level for liquid whose temperature is 5°C or more. It provides the location for the fixed liquid level gauge and a calibration checkpoint for any variable liquid level gauge that may be provided.

1.3.14 Temporary installation

A storage tank with a capacity not greater than 100 m³, which is installed for a period of not more than 12 months.

1.3.15 Volume filling percentage

The maximum volume of liquid permitted in the container, expressed as a percentage of the volume of water, which would completely fill the tank. It is a variable, being dependent on the temperature of the liquid, and is the basis for determining the maximum or the standard filling level.

SECTION 2 GENERAL REQUIREMENTS FOR SYSTEMS AND EQUIPMENT

2.1 APPLICATION

Equipment, systems and ancillary fittings handling anhydrous ammonia shall comply with the applicable requirements of this Section, and with the requirements of any other Section, where applicable.

2.2 OPERATING PRESSURE AND DESIGN PRESSURE

2.2.1 Operating pressure

The ambient temperature in addition to pump or compressor discharge pressures shall be considered when determining the operating pressure of an anhydrous ammonia system. Where the temperature of anhydrous ammonia in a system could reach 46°C, the operating pressure shall be not less than 1.73 MPa.

2.2.2 Design pressure

In selecting the design pressure, a suitable margin above the maximum operating pressure should be made to allow for probable surges in pressure during operating and to prevent unnecessary operating of pressure relief devices (see AS 1210).

2.3 MATERIALS

2.3.1 General

Materials shall be suitable for the conditions of use, and, in particular, any material in contact with ammonia shall be compatible with ammonia.

NOTE: Appendix C gives guidance on the control of risks of stress corrosion cracking of carbon steel in the presence of ammonia.

2.3.2 Minimum design temperature

Materials shall be selected and equipment shall be designed for a minimum temperature appropriate for the duty and in accordance with the applicable design Standard. The atmospheric boiling point of ammonia is -33.35°C and this temperature would usually represent the minimum operating temperature for tanks and other equipment containing liquid anhydrous ammonia capable of being depressurized to atmospheric conditions. Lower equilibrium temperatures are possible at ammonia partial pressures less than atmospheric. (See Appendix A.)

2.4 ELECTRICAL EQUIPMENT AND WIRING

Electrical equipment and wiring for use in anhydrous ammonia installations shall be installed and maintained in accordance with AS/NZS 3000.

2.5 PROTECTION OF FITTINGS

Fittings shall be arranged and protected so that the possibility of their sustaining physical damage as the result of activities on the site, or of accident in the case of transportable tanks, shall be minimized. Safety valves and relief valves of transportable tanks shall be protected so that in the event of overturn of a vehicle onto a hard surface, their opening will not be prevented and their discharge not restricted.

2.6 FILLING AND DISCHARGE CONNECTIONS

Each connection shall be provided with a screwed cap or plug, secured by a chain, and incorporating a vent hole arranged so that it becomes uncovered when the cap is partly unscrewed, giving warning of leakage or pressure within the fitting.

2.7 VALVES AND FITTINGS

2.7.1 General

Any valve, fitting or accessory used for anhydrous ammonia service shall comply with AS 1271, or an appropriate application Standard.

The pressure rating of any valve or fitting shall be not less than the design pressure of the container, the maximum total discharge pressure of a pump or compressor, or 1.73 MPa, whichever is the greatest.

2.7.2 Hydrostatic relief valves

A hydrostatic relief valve shall be installed between each pair of shut off valves on anhydrous ammonia liquid piping, so as to relieve hydrostatic pressure. The start-to-discharge pressure of such valves shall be less than or equal to the design pressure.

NOTE: Where piping may be subject to high ambient temperatures, it may be necessary to increase the margin between the operating pressure and the design pressure (see Clause 2.2.2).

A hydrostatic relief valve is not required between isolation valves in small bore piping of 20 mm or smaller, providing the distance between the valves is less than 0.5 m and the valves are either drain valves in series or a bleed valve is located between them.

The discharge from hydrostatic relief valves shall be directed to a safe location and away from the operators.

NOTE: Where ball valves are used for liquid anhydrous ammonia service, the potential exists for anhydrous ammonia to be trapped within the valves.

2.7.3 Pipeline shut off valve

Where a liquid transfer line, loading arm or hose is not drained of liquid on the completion of the transfer operation, such line or hose shall be fitted with a shut off valve at the discharge end.

2.7.4 Bleed valves

A bleed valve shall be provided at the end of each flexible transfer hose to permit depressurizing and the draining of residual liquid. The orifice of the bleed valve shall be not greater than 6 mm.

NOTE: Where discharge to atmosphere should be avoided, the use of a low pressure drain collection system is recommended.

2.8 EXCESS FLOW VALVES AND EXCESS FLOW PROTECTION

2.8.1 General

Anhydrous ammonia tanks shall be fitted with excess flow protection as specified in Clause 3.4.

Excess flow protection may be required in pipelines downstream or upstream of storage containers to reduce the risk levels to acceptable limits in the event of a pipeline rupture.

2.8.2 Capacity of excess flow valves

The rate-of-flow capacity of an excess flow valve shall be not greater than 1.5 times the design flow rate of the system.

2.8.3 Design of excess flow valves

Each excess flow valve shall incorporate a bypass that has an opening not greater than 1 mm in diameter to allow equalization of pressure. Where an excess flow valve forms an integral part of an internal quick-closing valve, a permanent bypass is not required, provided that the valve has a manual means for equalization of pressure.

Where the piping volume downstream of an excess flow valve is greater than 200 L, a 15 mm bore bypass line fitted with a globe valve and a restriction orifice with a diameter not greater than 6 mm, may be used to enable quicker equalization of pressure across the excess flow valve. The globe valve shall be locked closed when the bypass line is not in use.

2.8.4 Installation of excess flow valves

Any excess flow valve installation shall comply with the following requirements:

- (a) Excess flow valves shall close automatically at the rated flows of vapour or liquid as specified by the manufacturer. The connections and line, including valves and fittings protected by excess flow valve, shall have a greater capacity than the rated flow of the excess flow valve.
- (b) Shut off valves with an integral excess flow valve shall be designed for proper installation in a container opening so that the excess flow valve shall close in the event that the valve body, extending above the coupling, is sheared or broken off.
- (c) Each liquid filling connection shall have a positive shut off valve in conjunction with either an internal backpressure check valve or an internal excess flow valve. Vapour connections shall have a positive shut off valve together with an internal excess flow valve.
- (d) Where the capacity of any individual connection of a multiple connection system downstream of an excess flow valve is less than that of the excess flow valve, an additional excess flow valve shall be fitted in the connection.
- (e) Where a pipe run is unusually long or restricted due to the number of fittings and valves and it is possible that the flow resulting from a rupture at the downstream end is not sufficient to activate the excess flow valve at the upstream end, one or more additional excess flow valves shall be fitted in the line.

Where a pipe may contain a large quantity of ammonia consideration should be given to fitting additional excess flow valves or remote activated fail-safe actuated shut off valves in the pipe to reduce the loss of the contents in the event of a pipeline rupture. Other factors such as proximity to roads and other possible sources of pipeline damage should also be assessed when considering the need for additional pipe line rupture protection.

2.8.5 Alternative excess flow protection system

Remote actuated fail-safe valves which are closed automatically by pipe or loading connection rupture detection systems such as high flow trips, high differential flow across the pipeline, or low line pressure trips may be used in place of excess flow valves. Such automatic trips shall fail to a safe state.

High flow trip settings shall be not greater than 1.5 times the design flow of the system.

Trip sensors shall be located so that they will reliably detect a pipeline rupture.

Remote actuated shut off valves shall be installed at the upstream end of the section of pipe being protected.

Such systems shall be subject to periodic testing at intervals not exceeding 12 months.

2.9 PIPING

2.9.1 Design, fabrication and installation

The design of piping, flanges and fittings shall comply with the requirements of AS 4041, and the design pressure, except for vapour lines from refrigerated storage tanks with design pressures less than 100 kPa, shall be not less than the design pressure of the tank, the maximum total discharge pressure of a pump or compressor in the system or 1.73 MPa whichever is the greatest. Where stress corrosion cracking of pipelines may occur in service, heat treatment should be carried out in accordance with AS 4041. (See also Appendix C.)

The design pressure of vapour lines connected to refrigerated storage tanks with design pressures less than 100 kPa, which under no circumstances could contain liquid and where the vapour flow is out of the tank shall be not less than 200 kPa.

NOTE: Any piping downstream of a pressure regulator, and not open ended, is part of a process involving the use of anhydrous ammonia and is not covered by this Standard.

2.9.2 Joints

Joints in rigid pipework larger than 12 mm internal diameter shall be welded, screwed with threads in accordance with AS 1722, Part 1 or Part 2 as appropriate for the sealing arrangements or ANSI/ASME B1.20.1, or flanged, provided that—

- (a) where the nominal bore of the pipe exceeds 50 mm screwed joints shall not be used;
- (b) screwed joints for use at pressures above 140 kPa, where the sealing is provided by the screw threads shall be taper-to-taper in accordance with AS 1722.1 or ANSI/ASME B1.20.1;

NOTE: Threads complying with AS 1722.1 are not interchangeable with threads complying with ANSI/ASME B1.20.1 and vice versa.

- (c) jointing compounds shall be resistant to anhydrous ammonia; and
- (d) gaskets shall comply with AS 1210 and shall not contain any copper-bearing material.

Compression fittings may be used for joints in pipework 12 mm or less internal diameter.

Jointing materials containing asbestos should be avoided.

2.9.3 Pipe runs

All pipelines shall be designed, fabricated and installed in accordance with AS 4041. All exposed pipework shall be adequately protected from physical damage. Tanks forming part of a temporary system shall not be coupled or interconnected by rigid piping.

2.9.4 Concealed piping

Where piping is placed in tunnels, ducts and similar enclosed spaces, provision shall be made for adequate ventilation and emergency exit. (See AS/NZS 2865.)

2.9.5 Pipework testing

All pipework shall be subject to an installation examination and test in accordance with AS 4037 or an equivalent Standard.

Where it is necessary to enter a confined space containing anhydrous ammonia piping an entry permit shall be issued and the requirements of AS/NZS 2865 shall be complied with.

2.9.6 Marking

All piping carrying anhydrous ammonia should be identified in accordance with AS 1345. Liquid and vapour lines shall be further identified so as to be readily distinguishable from each other.

2.10 LIQUID LOADING AND UNLOADING CONNECTIONS

2.10.1 General

Wherever possible, liquid loading and unloading connections should be made either with rigid steel piping in combination with one, two or three swivel joints, or with flexible steel pipe or hose. Rubber hose connections may be used for piping up to 50 mm internal diameter, where it is not practicable to use a more durable type of flexible pipe connection.

Where it is necessary to absorb vibration, or where rigid connections are impracticable, flexible steel piping, such as the expansion bellows type, may be used provided that its length is as short as practicable and in any case does not exceed 1 m.

Articulated pipelines shall be counter-balanced to permit free manipulation of the line, and shall be provided with a bleed valves.

2.10.2 Materials and construction

Swivel joint bodies shall be of forged steel, ductile iron, cast steel or stainless steel, and shall be tested for freedom from porosity and leaks at a pressure not less than 1.5 times the piping design pressure. The manufacturer shall provide material and test certificates, and shall certify and mark the joints as being suitable for anhydrous ammonia service.

The bodies of swivel joints shall be of either screwed or bolted construction. The screwed type shall be fitted with locking devices.

Welded-on type swivel joints are preferred although screwed or flange types may be used.

2.10.3 Installation testing

Swivel joints and flexible steel piping assemblies shall be tested to a pressure equal to 1.5 times the piping design pressure

2.11 FLEXIBLE STEEL HOSE

2.11.1 Design pressure

Flexible steel hose assemblies subject to container pressure shall be designed for a minimum design pressure of 2.4 MPa.

2.11.2 End connectors

Flexible steel hose end-connectors shall be forged steel welded-on flange connectors or forged steel welded-on screw connectors.

2.11.3 Installation testing

Flexible steel hose assemblies shall be tested for leaks after assembly with the hose end-connectors, at a pressure of 1.5 times the design pressure.

2.11.4 Marking

Flexible steel hose assemblies shall be marked with the date of original installation. The date of subsequent testing shall be recorded on a tag attached to the hose or valves.

2.12 RUBBER HOSE

2.12.1 Hose subject to container pressure

Any hose and hose assembly that is subject to container pressure whether for liquid or vapour service, shall comply with the following requirements:

- (a) The hose shall be a Type 2 hose in accordance with AS 2212, or shall comply with the requirements for anhydrous ammonia hose given in ANSI K61.1 where relevant for a hose under container pressure.

- (b) Any installation incorporating such a hose shall be tested for leaks at a pressure of 1.5 times the design pressure before being put into service.
- (c) Any coupling for connecting a transfer hose of this type shall have an Acme screw thread in accordance with ANSI/ASME B1.5.

NOTE: The following sizes of Acme thread are recommended:

For liquid service: 3¼ in or 1¾ in.

For vapour service: 2¼ in or 1¾ in.

2.12.2 Low pressure hose

Any hose or hose assembly located downstream of a pressure regulator and used open-ended shall be a Type 1 hose in accordance with AS 2212 or shall comply with ANSI K61.1 where relevant for low-pressure hose.

2.13 PUMPS

2.13.1 Design pressure

The design pressure of any pump shall be not less than the total discharge pressure or 1.73 MPa, whichever is the greater.

NOTE: This does not relate to the pressure differential that may be obtained with the pump.

2.13.2 Positive displacement pumps

Positive displacement pumps shall have a constant-differential bypass valve installed on the pump discharge, delivering through a line of sufficient size to carry the full capacity of the pump at the relief valve pressure setting to the pump supply tank or the suction side of the pump.

2.13.3 Centrifugal pumps

Centrifugal pumps shall have a line fitted with a shut off valve installed on the discharge side of the pump delivery to the vapour space of the pump supply tank.

2.13.4 Pressure gauge

A pressure gauge, with a minimum range from 0 to 2.5 MPa shall be installed on the discharge side of all pumps upstream of any pressure relief or shut off valves.

2.13.5 Shut off valve

Shut off valves should be installed as close as practicable to all pump suction and discharge connections. A bleed valve shall be also installed to permit release of pressure in the pump.

2.14 COMPRESSORS

2.14.1 General

The design pressure of any compressor shall be not less than the total discharge pressure or 1.73 MPa, whichever is the greater. Compressors shall be provided with means to minimize the entry of liquids.

NOTES:

- 1 The design pressure does not relate to the pressure differential that may be obtained within the compressor.
- 2 A drainable liquid trap of sufficient capacity is one means of providing protection against liquid entering the compressor.

2.14.2 Valves

Vapour piping shall contain shut off valves located as close as practicable to the compressor connections. A bleed valve shall be included to release pressure in the compressor.

A safety valve large enough to discharge the full capacity of the compressor shall be connected to the discharge before any shut off valve. The discharging pressure of this valve shall not exceed 2 MPa.

2.14.3 Pressure gauges

Compressors shall be provided with pressure gauges with a minimum range of 0 to 2.5 MPa at both the suction and discharge sides.

2.15 VAPORIZERS

2.15.1 Type

Vaporizers shall be indirect-fired.

2.15.2 Design

Vaporizers shall be designed and constructed in accordance with AS/NZS 1200, or an equivalent Standard. The design pressure on the ammonia side of any vaporizer shall be not less than that determined in accordance with Clause 3.2.1 or the design pressure of any tank or vessel to which the vaporizer is connected, whichever is the greater. Where steam or water is used as a source of heat, it should be supplied at a pressure below that of the ammonia that it heats.

2.15.3 Installation

Vaporizers may be connected to the liquid or the gas section of the storage tank, or both, provided that there is, in each connection to the storage tank, a manually operated valve which shall be capable of completely shutting off all gas or liquid flow from the storage tank to the vaporizer.

A safety valve with a discharge capacity determined in accordance with AS 1210 shall be fitted at or near the vapour outlet of a vaporizer.

A simplified equation derived from the general equation given in AS 1210 for the determination of discharge capacity is given in Appendix D.

Any direct-fired device that supplies the necessary heat to the heating medium shall be located not less than 15 m from any anhydrous ammonia storage tank.

2.15.4 Safety devices

Vaporizers shall be fitted with either—

- (a) a temperature operated or a pressure operated safety device, which shall be set to cut off the vaporizer source of heat at a tank pressure less than the relief valve setting, where the temperature of the heating medium may be such that an excessive pressure could be developed in the vaporizer; or
- (b) suitable automatic means for preventing any liquid from passing through the vaporizer to the ammonia gas discharge piping.

Vaporizers shall not be fitted with fusible plugs.

2.15.5 Marking

Vaporizers shall be marked in accordance with AS/NZS 1200.

2.16 EMERGENCY SHUT DOWN SYSTEM

In addition to the manual shut off valves specified in Clause 3.5, storage tanks with a capacity greater than 35 m³ shall be fitted with an emergency shut down (ESD) system.

The minimum requirements of the ESD system shall be as follows:

- (a) An actuated-fail-closed shut off valve shall be fitted to the liquid line downstream of the manual shut off valve fitted in accordance with Clause 3.5.
- (b) ESD stations shall be located at each loading bay or control panel and at the exit gates of the storage depot, or similar locations.
- (c) A link shall be provided so that in the event of activation of the ESD system, the internal self-closing (ISC) valve on any tanker or nurse tank greater than 11 m³ capacity shall close at the same time as the storage tank shut off valve.

The ESD system shall be designed to fail to a safe condition.

2.17 DRIVE-AWAY PROTECTION

When filling or discharging at static storage tanks, a drive-away protection system shall be fitted to road tank vehicles to ensure that they cannot be moved when transfer hoses or loading arms are connected.

The minimum requirement for drive-away protection shall be as follows:

- (a) Vehicles fitted with air-activated brakes shall incorporate a brake interlock system that prevents the spring brakes from being released while hoses or a loading arm are still attached.
- (b) Hoses and loading arms at static storage tanks used to transfer anhydrous ammonia to and from vehicles other than those covered by Item (a) shall be fitted with breakaway couplings. Fixed piping associated with breakaway couplings shall be supported to ensure the correct activation of the couplings.

2.18 SAFETY EQUIPMENT

Any safety equipment prescribed in this Standard for specific types of systems shall comply with the following requirements:

- (a) A face-shield shall provide protection to all the face but shall be worn only as secondary eye protection. Gas tight goggles or chemical goggles shall provide primary eye protection.
- (b) Chemical splash goggles shall be flexible fitting and designed to provide primary protection to the eyes and eye socket from the splash of hazardous liquids. Direct-vented goggles do not comply with this requirement.
- (c) A gas filter respirator shall have a half-face piece or a full-face piece and a filter contained in a renewable canister, sufficient to provide protection against low concentrations of anhydrous ammonia for a limited period. Gas tight goggles or chemical-splash goggles shall be used with a half-face piece respirator.
- (d) Gauntlet gloves shall have separate fingers and thumb, shall protect hands and forearms, and shall be made of rubber or plastic impervious to anhydrous ammonia.
- (e) Thermal gloves shall have sufficient insulation to prevent injury resulting from contact with components at a temperature of 0°C.
- (f) Protective clothing shall consist of normal work clothing that can be buttoned up at the wrist and throat to provide some skin protection in low ammonia concentrations.
- (g) A protective suit shall comply with AS 3765.1.

- (h) Self-contained breathing apparatus or rebreathing apparatus shall comprise a respirator which supplies the wearer with air or oxygen from containers carried by him and shall have an effective life of at least 25 min. Speech diaphragms shall be incorporated. Where required to be used on a vehicle, the apparatus shall be suitable for use when driving.
- (i) A safety shower or bath shall be either a shower having a spray fitting 2 m above the base, or a bath in which a person can be fully immersed. A shower unit shall be capable of delivering 75 L/m of water for at least 15 min.
- (j) An eye fountain shall be a fountain designed to effectively irrigate both eyes for a period of at least 30 min. An eye irrigator shall be an eyecup or other device to irrigate the eyes.
- (k) Rubber or plastic boots impervious to anhydrous ammonia shall be at least mid-calf length.

2.19 PERSONAL PROTECTION EQUIPMENT

Guidance on the selection of and specifications for personal protection equipment are given in the following Standards:

AS/NZS 1337 for eye protectors.

AS/NZS 1715 and AS/NZS 1716 for respiratory protection devices.

AS/NZS 1801 for protective helmets.

AS/NZS 2161 Part 2, 3 and 5 for protective gloves.

AS/NZS 2210 Parts 1 and 2 for protective footwear.

SECTION 3 TANK STORAGE

3.1 APPLICATION

Installations for the storage of anhydrous ammonia in tanks shall comply with the requirements of Section 2 and with this Section.

3.2 TANKS

3.2.1 General requirements

Tanks and supports shall comply with AS 1210 or other equivalent Standard, subject to the following qualifications:

- (a) The design pressure of tanks for other than refrigerated or insulated storage shall be not less than 1.73 MPa.

The design pressure of tanks located in areas where the temperature of the contents could exceed 46°C shall be greater than the estimated maximum vapour pressure. The estimated maximum vapour pressure shall be determined in accordance with AS 2872.

- (b) Welding procedures shall be qualified in accordance with AS/NZS 3992.
- (c) Carbon steel tanks shall be heat-treated after construction in accordance with AS 4458. (See also Appendix C.)
- (d) Heating coils shall not be installed in any storage tank.

3.2.2 Tank markings

Any anhydrous ammonia tank shall be marked in accordance with AS 1210 or the equivalent Standard to which it was manufactured.

Static storage tanks shall be placarded in accordance with NOHSC 1015 and NOHSC 2017.

Any tank openings except those for safety valves, pressure gauges and liquid level gauges shall be marked to indicate whether the openings connect with liquid or vapour spaces.

3.2.3 Tank painting

All uninsulated aboveground tanks shall have a reflective surface maintained in good condition. White is recommended for painted surfaces.

3.3 PRESSURE RELIEF VALVES

3.3.1 General

Each tank except a drum shall be provided with at least one safety valve, which shall be in direct communication with the vapour space of the tank when the tank is at rest in its normal operating position.

3.3.2 Set pressure

Safety valves shall be set to start to discharge in accordance with the requirements of AS 1210.

3.3.3 Locking or sealing

Safety valves shall be arranged so that the possibility of altering the setting is minimized. Where the pressure setting or adjustment is external, the safety valve shall be provided with a means of sealing the adjustment.

3.3.4 Discharge capacity

The aggregate discharge capacity of any safety valves shall be not less than that determined in accordance with AS 1210. A simplified equation derived from the general equation given in AS 1210 for the determination of discharge capacity is specified in Appendix D.

3.3.5 Reserve safety valves

Where additional safety valves are provided for servicing convenience, the valve system used to isolate any such devices shall be designed so that it is not at any time possible to operate the system with less aggregate pressure relief capacity than that required under Clause 3.3.4.

3.4 EXCESS FLOW VALVES AND NON RETURN VALVES

3.4.1 General

Every vapour or liquid opening in a tank except refrigerated storage tanks with a design pressure less than 20 kPa and drums shall be provided with an internal excess flow valve, or where flow is inward only, with an internal non return valve, except that excess flow valves or non-return valves are not required on the following:

- (a) Openings to which safety valves are fitted.
- (b) Plugged openings.
- (c) Openings not greater than 1.4 mm diameter.
- (d) Vapour bleed and liquid withdrawal openings of applicator tanks of 1 m³ capacity or less which are mounted on farm vehicles and used for the application of anhydrous ammonia, provided that the controlling orifice is not greater than 11 mm diameter and the valve is a hand-operated (attached hand wheel or equivalent) shut off valve (see Note 1).

Tanks with a capacity of less than 7.5 m³ may be fitted with a combination positive shut off valve and excess flow valve.

NOTES:

- 1 To assist in filling applicator tanks it is permissible to bleed vapours to the open air, provided that the foregoing requirements are complied with.
- 2 For installation in an opening designed for inward flow only, a non-return valve is preferred to an excess flow valve since it gives more positive protection.

3.4.2 Multiple-tank systems

Where two or more tanks have common loading or unloading connections, the common liquid and vapour lines shall be fitted with excess flow valves, unless the common line has flow capacity in excess of, the combined flow capacities of the individual tank lines, in which case the excess flow valve in the tank shall suffice.

3.5 MANUAL SHUT OFF VALVES

All connections to tanks shall have manual shut off valves located as close as practicable to the tank except in the following cases:

- (a) Safety relief valves.
- (b) Openings protected by a 1.4 mm diameter controlling-orifice.
- (c) Plugged openings.
- (d) Where the filling connection is mounted directly on to a tank of less than 7.5 m³ capacity, an external shut off valve need not be fitted, provided that the opening is fitted with either—
 - (i) a combination non-return valve and excess flow valve; or
 - (ii) one double or two single non-return valves.

- (e) Where an internal quick closing remotely controlled shut off valve is fitted on a rail tank vehicle or a road tank vehicle.

3.6 VAPOUR RETURN VALVE

Any tank of capacity 1 m³ or more shall be equipped with a vapour return valve.

3.7 LIQUID LEVEL GAUGES

3.7.1 General

Any tank that is to be filled on a volumetric basis shall be fitted with not less than one fixed liquid level gauge, and not less than one variable liquid level gauge. It shall be possible to use the fixed liquid level gauge to check the variable liquid level gauge.

3.7.2 Fixed liquid level gauges

One fixed liquid level gauge shall indicate the standard filling level. This gauge shall be located at the standard filling level unless any dip tube or extension used to permit another location is attached in such a manner that it cannot be inadvertently detached. A marking reading 'SFL...%' shall be provided on or near this gauge.

3.7.3 Standard filling level

The standard filling level shall indicate the liquid level for 85 percent of the container's volume for tanks up to 5 m³ total capacity, and 87 percent for tanks exceeding 5 m³ total capacity.

3.7.4 Variable level gauges

Any variable-level gauge on the tank shall be designed and installed so as to permit the reading of the liquid level in the tank to an accuracy of ± 1 percent between 80 percent and 98 percent of the tank's capacity.

NOTES:

- 1 Readings below this level are usually desirable to indicate the tank content.
- 2 Variable-level gauges will not provide an accurate indication of the filling level and it is recommended that a fixed-level gauge be used to determine the limit of filling.

3.7.5 Visual gauges

Visual gauge glasses mounted externally on a tank shall be fitted with spring-loaded excess flow valves, and shall be shielded against the direct rays of the sun.

A visual gauge glass shall not be a tubular type.

NOTE: The use of magnetic or float type gauges is recommended.

3.8 PRESSURE GAUGES

3.8.1 General

All tanks except drums shall be provided with not less than one pressure gauge with a minimum range of 0 to 2.5 MPa.

3.8.2 Position

Pressure gauges shall be connected to the vapour space of the tank with an opening not greater than 1.4 mm diameter unless provided with an excess flow valve.

3.9 TEMPERATURE GAUGES

3.9.1 General

Temperature gauges shall be installed on all tanks which are not filled by mass and which may be filled to a level in excess of 85 percent of the capacity of the tank.

The temperature gauge shall be fitted with a dial indicating a temperature range from at least -30°C to $+60^{\circ}\text{C}$.

3.9.2 Position

The sensing device of temperature gauges shall be installed in pockets and located so that it is submerged below the level of the ammonia liquid when the tank is filled to more than 60 percent of its capacity.

3.10 TANK LOCATION

3.10.1 General

The location of any tank shall be chosen to comply with the following requirements:

- (a) No tank shall be within a building except a building specially constructed as a tank shelter.
- (b) The location shall be subject to applicable statutory requirements.

3.10.2 Separation of tank from surroundings

A tank shall be located so as to comply with the following requirements:

- (a) Separation distances shall be not less than those specified in Table 3.1.
The distances specified may be reduced subject to an acceptable risk assessment.
- (b) Where exposure to adjacent property, where topographical conditions or unavailability of water supply warrant, the regulatory authority may alter distances, impose restrictions on individual tank capacity and total storage capacity, or require other reasonable protective measures such as catchpits or diversion kerbs.
- (c) Where the separation distance is no longer observed, then either the tank shall be moved to a location such that the distance is observed, or the tank shall not be further used for the storage of anhydrous ammonia.

3.10.3 Adjacent ammonia tanks

Tanks shall be separated from each other by distances sufficient to provide access for maintenance, inspection and emergencies.

3.10.4 Tanks near flammable and combustible liquid storages

Anhydrous ammonia tanks shall not be sited in compounds for the storage of flammable liquids. Where installed in an area in proximity to combustible liquid storage, suitable means shall be taken, such as by diversion kerbs or grading, to prevent accumulation of such liquid under the tank containing anhydrous ammonia.

NOTE: Exact definitions of flammable and combustible liquids are given in AS 1940 and the ADG Code.

3.10.5 Housekeeping

Combustible materials shall not be allowed to accumulate around and under anhydrous ammonia storage tanks. Where appropriate firebreaks should be provided.