Anhydrous Ammonia-Storage and handling

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In order to keep abreast of progress in industry, Kenya Standards shall be regularly reviewed. Suggestions for improvements to published standards, addressed to the Managing Director, Kenya Bureau of Standards, are welcome.

Anhydrous Ammonia-Storage and handling

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Foreword

This Kenya Standard was prepared by the Technical Committee on Transport of dangerous goods under the guidance of the Standards Projects Committee, and it is in accordance with the procedures of the Kenya Bureau of Standards.
During the preparation of this standard, reference was made to the following documents:

The objective of this Standard is to provide distributors and users with procedures for the safe storage and handling of anhydrous ammonia.

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

Acknowledgement is hereby made for the assistance derived from these sources.

SAS/NZS 2022:2003

1.1 Scope

This Kenya Standard 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 Normative references

1.3 Definitions

For the purpose of this Standard, the definitions given 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 tank, cylinder or drum)

The total volume, of the space enclosed within the tank or cylinder, expressed in litres or cubic metres. ·
NOTES:
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 l 5°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.

e) Water bodies, National park·

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'-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 1000 L water capacity without safety devices except for fusible plugs,

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 SYSTEMS AND REQUIREMENTS 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

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 arid 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 ELECTRIC EQUIPMENT AND WIRING

Electrical equipment and wiring for use in anhydrous ammonia installations shall be installed and maintained
.
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

2.71 General

Any valve, fitting or accessory used for anhydrous ammonia service shall comply with 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 l73 MPa, whichever is the greatest.

2. 72 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 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
Clause3.4.
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 I 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. Vapor 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 I5 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 relevant standard, and the design pressure, except for vapour lines from refrigerated storage tanks with design pressures less than I 00 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 relevant standard. (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 relevant standards as appropriate for the sealing arrangements or flanged, provided that-

(a) where the nominal bore of the pipe exceeds 50mm 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 relevant standard.

(c) jointing compounds shall be resistant to anhydrous ammonia; and

(d)gaskets shall comply with and shall relevant standard 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 relevant standard. 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.

2.9.5 Pipework testing

All pipework shall be subject to an installation examination and test in accordance with
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 standards shall be complied with.

2.9.6 Marking

All piping carrying anhydrous ammonia should be identified in accordance with relevant standard. 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 I 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 althouglfs9rewed or flange types may be used.

2.10.3 Installation testing

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

2.11 FLEXIBLE STEEL HOSE

2.11.l Design pressure

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

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.l 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 relevant standard or shall comply with the requirements for anhydrous ammonia hose given in relevant standard where relevant for a hose under container pressure.

{b)Any installation incorporating such a hose shall be tested for leaks at a pressure of I5 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 relevant standard
NOTE: The following sizes of Acme thread are recommended:

For liquid service: 3 1/4. in or 13/4 in.
For vapour service: 21/4. in or 13/4 in.

2.12.2 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 an
equivalent Standard. The design pressure on the ammonia side of' any vaporizer shall be not less than that determined in accordance with Clause 32.1 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 relevant standard shall be fitted at or near the vapour outlet of a vaporizer.

A simplified equation derived from general equation given for the determination of discharge capacity given in Annex C.
Any direct-fired device that supplies the necessary heat to the heating medium shall be located not less than 15 m for 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 vapour 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 Marking

Vaporizers shall be marked in accordance with relevant standard.

2.16 EMERGENCY SHUT DOWN SYSTEM

In addition to the manual shut off valves specified in Clause 35, storage tanks with a capacity greater than 35 m3 shall be fitted with an emergency shut down (BSD) 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 BSD system, the internal self-closing (ISC) valve on any tanker or nurse tank greater than 11m3' 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 riot 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 relevant standard

(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 of water for at least 15 min.

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: for eye protectors, for respiratory protector (on devices, for protective helmets, for protective gloves, for protective footwear (refer to normative references)

SECTION 3: TANK STORAGE

3.1 APPLICATION

Installations for the storage of anhydrous ammonia m 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 equivalent international 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 relevant standard.
(b) Welding procedures shall be qualified in accordance with relevant standard

(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 every storage tank.

3.2.2 Tank markings

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

Static storage tanks shall be placarded.in accordance with Any tank openings except those of' 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 m 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 Relevant international standard.

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 relevant standard. A simplified equation derived from the general equation given in relevant standard 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 Jess 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 I 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 line 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 connection 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 75 m3 capacity, an external shut off valve need not be fitted, provided that the opening is fitted with either-s-

(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 I 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. H 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 ~fr accuracy of ±1 percent between 80 percent and
98 percent of the tank's capacity.

NOTES:
I. 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-jewel 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°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. I.

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 catch pits or diversion kerns

(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.thetank 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.

TABLE 3.1

LOCATION OF STORAGE TANKS

	Minimum distances from storage tanks, m

Capacity of tank ml	To highway or main railway*	To place of public assembly, residential buildings and factoriesƚ	To institution, hospital and similar establishments
>2 ≤7	15	60	90
>7 ≤100	15	120	180
>100 ≤ 400	15	150	240
>400	15	180	300

*The actual rail track, and not the boundary of the right-of-way.
ƚFor the purpose of this Standard, factories are defined as stores, warehouses and buildings in which persons are employed for the purpose of any trade or business, excepting buildings used specifically for the storage and handling of anhydrous ammonia and associated activities·
Within adequately fenced industrial sites that have good and continuous security and supervision, the distances given in Column 3 may be reduced within the premises up to a factor of 4 with the approval of the regulatory authority. ·

3.10.6 Chlorine storage

Anhydrous ammonia tanks shall be separated from chlorine storage areas by a vapour path of not less than 10 m.·
NOTE: Chlorine can react with ammonia to form nitrogen trichloride, which is spontaneously explosive. In the presence of moisture and excess's ammonia, ammonium chloride is formed.

3.10.7 Potable water supply

Any static tank shall be not less than I $'m from a well or other potable water collection point.

3.11 INSTALLATION

3.11.1 Foundations and supports

Substantial foundations with reinforced concrete footings shall be provided for any permanent installation. In addition-

(a) the foundation and supporting structure shall be designed in accordance with equivalent standards to support the total. Mass when full of water;

(b) the lowest point of the tank shall be not less than 450 mm above the ground;

(c) any tanks that are interconnected in any way shall be supported so that their maximum liquid levels are in the same horizontal plane, unless the piping and valve system is capable of preventing uncontrolled levelling of the liquid; and

(d)protection against flotation or other water damage shall be provided wherever high floodwater could occur.

3.11.2; Temporary installations

Where it is required to install a static storage tank on temporary foundations that are not in accordance with Clause 3.11. I then -
(a) support made up from sound hardwood slabs or other appropriate methods shall be used;

(b) a level base for the temporary supports shall be prepared on a natural surface, on slightly excavated ground, or on ground which has been built up with a suitable filling material fully compacted; and

(c) the base pad shall be of sufficient size for the tank so as to adequately support the tank with all valves accessible.

3.11.3 Tank protection

Fenders or their equivalent shall be installed around any tank and associated fittings which may be liable to damage from manoeuvring vehicles or which is not fenced in accordance with Items 3.11.4 (a) or (b).

Where a tank is within 30 m of the track of a main railway or the edge of a public road, the installation shall incorporate provisions to divert or otherwise prevent impact from a derailed rail vehicle or a runaway road vehicle. '.

3.11.4 Security of tanks

Any above-ground storage tank or tanks for anhydrous ammonia shall-.

(a) be surrounded by a chain wire fence which complies with Clause 311.6; or

(b) for a tank in which all valves except the safety valves are grouped together at one end, such valves shall be located within an enclosure; or

(c) be provided with locks on all valves, other than safety valves, in any case where the opening of the valve could lead to the escape of ammonia.

Where a tank is on premises that are already completely enclosed by fencing complying with Clause 3.10.6, then additional fencing around the-tank is not required.

3.11.5 Restrictions for lockable valves

Locking of valves as a substitute for placing a fence about a tank may be used only-

(a) at remotely located tanks where the tank is sited in excess of 2 km from habitation and public roads; ·

(b) where a fence around the tank is not required because the premises are completely surrounded by a fence complying with Clause 311.6; or

(c) where the capacity of the tank; is: less than 60 m3 capacity.

3.11.6 Security fence construction

Any security fence required under Clause 3.11.4 shall be at least a chain wire fence of strong construction, not less than 1.8 m high. In addition-

(a) a fully-surrounded fence shall be at least 1.5 m from the tank, and shall be provided with an outdoor opening gate at opposite ends of the enclosure; or

(b) a partial fence surrounding valves only shall be installed so that access between the fence and the tank is not possible, and not less than one gate, 2 m wide, that allows easy access 'to the valves, shall be provided.

3.12 SAFETY EQUIPMENT

3.12.1 Suitability
Any Safety equipment required by the Clauses 3.12.2 to 3.12.4 shall comply with Clause 2.18.

3.12.2 Isolated tanks

Any storage tank that is 800 m or more from protected places shall be provided with at least the following:
(a) One gas filter respirator.

(b) One pair of gauntlet gloves.

(c) A combined face shield and goggles or a pair of goggles and a face shield to be worn over the goggles.

(d) One 20 L container of water.
NOTE: Where a reticulated water supply is available, it is recommended that a bath sufficient to immerse fully a person, a safety shower or a tap with a fixed hose be provided.

(e) An eye fountain or eye irrigator.

(f) One self-contained breathing apparatus for tanks with a capacity greater than 60 m3.
(See Clause 710.3 for requirements when transferring anhydrous ammonia).

3.12.3 Tanks near protected places

In addition to the safety equipment specified in Clause 3.12.2, the following shall be provided at any facility containing a storage tank that is less than 800 m from a protected place:
(a) Self-contained breathing apparatus.
(b) A protective suit and hood made from material impervious to anhydrous ammonia and in one piece with all air gaps effectively sealed.

3.12.4 Location of safety equipment
Any specified safety equipment shall be located at a prominent and suitable place considering the dominant prevailing wind direction and other geographical features, except for an installation which is more than 2 km from habitation or public roads and provided
that-.
(a) regulatory authority approval for the· storage of the equipment elsewhere has been obtained;

(b) a sign is displayed prominently on the site advising of the location of the equipment;

and

(c) the safety equipment is taken to the installation whenever persons are required to enter the site.

SECTION 4 TANKS FOR TRANSPORTATION

4.1 APPLICATION

Tanks intended for the transportation of anhydrous ammonia shall comply with the requirements of Section 2, Section 3 and with this Section.

4.2 GENERAL

4.2.1 Protection of hoses

When carried provision shall be made on all vehicles for the storage and protection during transit of all hose assemblies used in transfer operations and other loose assemblies.

4.2.2 Vapour return valve

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

4.3 ROAD AND RAIL TANK VEHICLES

4.3.1 Road tank vehicles

Any road tank vehicle intended for the transport of anhydrous ammonia on public roads shall comply with the requirements of AS 2809, Parts J, 3 and 4, or the requirements of the relevant motor vehicle registration authority, and; the ADG Code.

4.3.2 Rail tank vehicles

Any rail tank vehicle shall comply with~

(a) those requirements of this Standard relating to design and construction of tanks and components.

4.4 SKID TANKS, NURSE TANK AND APPLICATOR TANKS

4.4.1 Secure mountings

Any transportable tank and flow control devices shall be securely fastened to the vehicle during transport in accordance with the ADR.

4.4.2 Valves and accessories

Each skid tank, nurse tank and applicator tank shall be fitted with the following valves and accessories:

(a) A fixed liquid level gauge.

(b) A filling connection, which shall be fitted with a positive shut off valve in conjunction with either a non-return valve or an internal excess flow valve.

(c) 'where a flow control valve is connected directly to the skid, nurse or applicator tank, flexible connection shall be fitted between the flow control valve and the remainder of the liquid discharge system. Where the flow valve is not so installed, a flexible connection shall be fitted between the flow control valve and the tank shut off valve. (See Section 2.)
NOTE: An excess flow valve, unless in the liquid discharge line, is not required provided that the controlling orifice between the contents of the tank and the outlet of the shut off valve (see Clause 3.4.1) does not exceed 11 mm diameter.

4.4.3 Fusible plugs

Drums shall be fitted with at least one fusible plug which shall be vapour-tight at 54°C and which will release at a temperature not greater than 79°C.

4.4.4 Safety equipment

The safety equipment specified in the ADR shall be carried in any vehicle transporting a skid tank, nurse tank or application tank. In addition, 20 L of water in a suitable container and an eye irrigator shall be provided.

4.5 PLACARDING

Transport tanks shall be placarded in accordance with the ADR.

SECTION 5 CYLINDERS AND CYLINDER SYSTEMS

5.1 APPLICATION

Installations for the storage and handling of anhydrous ammonia in cylinders and drums shall comply with the requirements of Section 2 where applicable and with this Section.

5.2 EQUIPMENT

5.2.1 Cylinders

Any cylinder used for anhydrous ammonia shall comply with KS… and shall be marked in accordance with KS….

5.2.2 Valves

Cylinder valves shall be steel or stainless steel.

5.3 STORAGE AND HANDLING

5.3.1 General

The storage and handling of ammonia in cylinders shall be in accordance with Clauses 5.3.2 to 5.3.5 inclusive and with the relevant requirements-of KS-storage and handling of gases in cylinders where ammonia is stored with other gases. ·

5.3.2 Ventilation

Any enclosed area in which anhydrous ammonia is used shall be ventilated to atmosphere by either of the following means:

(a) The area shall be open to outside atmosphere on at least two sides.

(b)A mechanical ventilation system with a supply from outside the enclosed area shall be provided, and arranged so that in the event of airflow failure, the supply of ammonia is shut off. ·

5.3.3 Adjacent hazards-
Cylinders shall not be fitted with flammable or oxidizing materials, or within 10 m of a chlorine installation. ·

5.3.4 Cylinders in use

Where the capacity any single gas cylinder or multiple cylinder installation is greater than 2 L, the installation shall be located outside the building so that no cylinder is closer than 2 m to: any fire escape exit. The installation area shall comply with the following requirements

(a) The area immediately about the cylinder shall be paved with concrete or equivalent material.

(b) The cylinder shall be chained or bracketed to a wall or secure post. (c) The piping from the cylinder shall not be under tension or strain

(d) The cylinder and piping shall be protected from manoeuvring vehicles.

(e) Placarding in accordance with NOHSC 1015 and NOHSC 2017 shall be provided.

The cylinder should be shaded from the direct rays of the sun, and should be located away from other sources of heat, e.g. boilers, steam and hot water pipes.

5.3.5 Storage of cylinders not in use

Any storage for cylinders that are not in use or are empty shall• (a) be open on two sides or the equivalent; (b) have a hardwood or concrete floor;

(c) be surrounded by a fence or otherwise secured against unauthorized access; and

(d) be marked in accordance with Clause 5.3.4.

Where fitted the roof of a storage area shall be made of non-combustible material or with hardwood framing with non-combustible cladding.

5.3.6 Minor storage

Storage of anhydrous ammonia in cylinders in quantities not exceeding 500 L shall be classified as minor storage and the relevant requirements given in ks-storage and handling of gases in cylinders shall be observed.

5.4 INSPECTION AND TESTING

Cylinders shall be inspected and tested in accordance with international standards.

5.5 FILLING CYLINDERS

Cylinder shall be filled only by mass and the filling and inspection procedures shall be in accordance with international standards.

5.6 CYLINDER HANDLING AND TRANSPORT

5.6.1 Handling

Cylinders shall be handled carefully arid: shall not be allowed to fall, or be subjected to undue shock.

5.6.2 Transport

Vehicles used for the transport of anhydrous ammonia in cylinders shall comply with the requirements of the international standards and shall be ventilated. When loaded for transport cylinders shall be secured to prevent dislodgment and damage and valves shall not overhang the edge of any truck tray.
NOTE: Guidance on securing cylinders for transport is provided in the Load Restraint Guide.

5. 7 SAFETY EQUIPMENT

The following personal protective equipment as appropriate shall be provided when storing and handling anhydrous ammonia cylinders:

(a)General requirements

(i) eye protection
(ii) safety footwear
(iii) protective gloves
(iv) full cover overalls.

(b) Additional requirements for greater than minor storage (see Clause 5.3.6) •

(i) one gas filter respirator; and

(ii) a combined face shield and goggles or a pair of goggles and a face shield to be worn over goggles.

Where quantities exceeding minor storage are located near a sensitive protected place, the provision of self-contained breathing apparatus should be considered based on a risk assessment.

SECTION 6 REFRIGERATED STORAGE

6.1 APPLICATION OF SECTION

This Section applies to systems using tanks for the storage of anhydrous ammonia under refrigerated conditions. Refrigerated storage systems shall comply with the relevant requirements of Sections 2 and 3 and this Section.

6.2 TANK CONSTRUCTION

6.2.1 Design pressure of 100 kPa and below

Tanks for design pressures of I 00 kPa and below shall be constructed and designed in accordance with the applicable requirements of API 620 including Appendix Q therefore, an equivalent Standard, together with any modifications or amendments to suit local conditions and the requirement of the regulation authority.

6.2.2 Design pressure above 100 kPa

Tanks for design pressures above I 00 kPa shall be constructed and designed in accordance with Clause 2.2 and the materials shall be selected from those listed in API 620, Tables
2.02, R.2.1 and R.2.4, together with any modifications or amendments to suit local conditions and the requirements of the regulatory Authority.

6.2.3 Materials

Where austenitic steels or non-ferrous materials are used, the relevant requirements of an international standards shall be used as a guide in the selection of those materials for use at the design temperature.

6.2.4 Marking

Each tank shall be marked in accordance with Clause 3.2.2 and, in addition, with the following:

(a) The capacity in litres cubic metres, or tonnes.

(b)The minimum design temperature.

(c) The maximum design pressure.

(d)The maximum allowable water level to which the tank may be filled for test purposes.

(e)The density of the product in kilograms per litre for which the tank was designed.

(f) Maximum level to which the tank may be filled with liquid anhydrous ammonia.

6.2.5 Secondary containment

Refrigerated; ammonia storage tanks greater than 1200 m3 capacity shall have secondary containment-facilities (double integrity type tanks) in the form of a wall or outer tank located dose to the wall of the inner tank and capable of containing ammonia leakage from the inner tank.

6.3 LOCATION AND INSTALLATION

6.3.1 General

The location of any refrigerated tank shall comply with Clause 3.10.
NOTE: The regulatory authority may alter the distances specified depending on the type and design of the tanks.

6.3.2 Foundations

Tanks shall be supported on suitable non-combustible foundations that have been designed to accommodate the type of tank being used and to minimize differential settlement.

6.3.3 Soil freezing

Tanks for product storage at less than 0°C shall be supported in such a way as will prevent, or heat shall be supplied so as to prevent, the effects of freezing and consequent frost heaving induced by the product storage temperature. The soil temperature beneath the tank shall be maintained at not less than 0°C.

6.3.4 Insulation

Refrigerated tanks and pipelines that are insulated shall be covered with a material of suitable quality and thickness for the temperatures encountered. Insulation shall be suitably supported and protected against the weather and a suitable vapour barrier shall also be provided to prevent growth of ice under the insulation. Weatherproofing and insulation material shall be of a type, which will not support flame propagation.

6.3.5 Compounds

Refrigerated tanks other than double integrity type tanks shall be provided with compounds having a capacity of 100 percent of the largest tank plus 10 percent of the total capacity of all storage tanks within the area. Compounds may make use of natural topography.
Where provision is made for draining rainwater from compounds, the drains shall be kept closed and shall be operated so that when in use they will not permit tank contents to enter natural water courses, public sewers or public drains; Where drainage from the compound is controlled by pumps, the pumps shall be non-self-starting.

6.3.6 Bunds
Bunds shall be of earth, steel, concrete or solid masonry designed to be liquid-tight and to withstand a full hydraulic head and the low temperature, and constructed so as to provide the required protection. Earthen bunds shall have a flat section at the top not less than 600 mm wide. The slope shall be consistent with the angle of repose of the material of which the catchpits are constructed, ·

6.4 FILLING AND DISCHARGING VALVES

6.4.1 Use of non-return valves and shut off valves
Where operating conditions' make it feasible, an internal non return valve shall be installed on the filling connection and a remotely operated shut off valve shall be installed on discharge connections located below the maximum liquid level close to or inside the tank.

Where the same pipeline is used for filling and discharging and it is not possible to install a non-return valve, an emergency shut down (ESD) system complying with the requirements
of Clause 2. I5 shall be fitted.
A remote shut off valve, designed to fail to a safe condition shall be installed on every pipeline that, penetrates the secondary containment system below the liquid level. Where possible, the shut off valve should be fitted within the containment system.
The shutoff valves shall be activated from appropriate locations.

6.4.2 Use of excess flow valves

Any excess flow valve, which may become inoperative under the conditions, shall not be used.
Where the design pressure is less than 20 kPa, an emergency shut down (ESD) system complying with the requirements of Clause 2.16 shall be fitted.
NOTE: The installation of excess flow valves is not recommended as the pressure differential developed may not be sufficient to activate the valve

6.5 PRESSURE RELIEF

6.5.1 Total relieving capacity

The total relieving capacity requirements of any tank shall be provided by safety valves except for the variation permitted in Clause 6.5.2. The total capacity provided shall be the larger required by the following:

(a) Possible refrigeration system upset, such as-

(i) cooling water failure;

(ii) power failure;

(iii) instrument air or instrument failure;

(iv) mechanical failure of any equipment;

(v) excessive pumping rates; or

(vi) rapid barometric pressure drops such as would be experienced during a cyclone.

(b) Fire exposure determined·.

6.5.2 Safety hatch

Where the relieving capacity required under Item 6.5.l(b) is greater than that required by
Item 6.5. l(a), the additional capacity may be provided by a safety hatch which shall be set to operate at 125 percent of the design pressure and ·be capable of discharging the additional volume of gas. The safety hatch shall not be considered as providing any of the capacity
required in Item 6.5.l(a).

6.5.3 Vent lines

Where vent lines are installed to direct the vapours from the safety valve, the back pressure under full relieving conditions shall not-exceed 50 percent of the start-to-discharge pressure for pressure balanced valves or 10 percent of the start-to-discharge pressure for conventional valves. The vent lines shaft be installed to prevent accumulation of liquid in the lines.

6.5.4 Weather protection

The valves or valve installation' shall be protected against the weather

6.5.5 Vacuum breakers

Atmospheric storage shall be provided with vacuum breakers. Ammonia gas, nitrogen, or other inert gas maybe introduced as the vapour replacement medium to break the vacuum.

The capacity off the vacuum breaker shall be not less than the maximum combined volumetric capacity of the refrigeration compressors or the combined volumetric capacity of all discharge pumps whichever is the greater.

6.6 REFRIGERATION SYSTEMS

6.6. Design

Any refrigeration system shall comply with equivalent international standards.

6.6.2 Emergency power

An emergency source of power of sufficient capacity to handle the sum of the loads determined in accordance with Items 6.6.3(a) and (b) shall be provided unless water scrubbing, a flare with ignition for operation during a site power failure or other facilities are available to safely dispose of vented vapours while the refrigeration system is not operating.

6.6.3 Refrigeration load

The total refrigeration load shall be computed as the sum of the following:

(a) Load imposed by the heat flow into the tank caused by the temperature differential between design ambient temperature and storage temperature.

(b) Load imposed by heat flow into the tank caused by maximum sun radiation.

(c) Maximum load imposed by filling the tank with anhydrous ammonia warmer than the design storage temperature.

d) Liquefaction vapour displaced during filling operations where there is no vapour return line back to the filling source.
NOTE: More than one storage tank may be handled by the same refrigeration system provided that the vapour spaces are interconnected and the tanks have the same design pressures.

6.6.4 Control system

The refrigeration system shall be provided with an automatic control system, which shall•

(a) start or stop refrigeration in accordance with the load, as indicated by tank vapour pressure;

(b) record vapour pressure in the tank, and sound an alarm if maximum or minimum limits are passed;

(c) respond to excess discharge pressure from condenser system, caused by cooling•
medium failure, sound an alarm and shut off the refrigeration system;

(d) record fill level, and sound an alarm if maximum or minimum limits are passed; and

(e) be capable of controlling any alternative plant provided.

6.6.5 Compressors

Not less than two compressors shall. be provided for each refrigeration system, in accordance with the following requirements:
(a) Each compressor shall be sized to operate with a suction pressure at least 10 percent below the minimum setting of the safety valve(s) on the storage tank and shall withstand a suction pressure at least equal to 120 percent of the tank design pressure.
NOTE: Discharge pressure will be governed by condensing conditions.

(b)The number and sizes of compressors for the holding refrigeration load, i.e. the sum of the loads calculated in Item 6.6.3(a) and (b), shall be such that, in the event of failure of any,one of these compressors, the combined capacity of the remainder shall be sufficient to handle that load.
NOTE: Compressors required for the filling refrigeration load, i.e. the load calculated as in Item 6.6) (c)~'may be used as standby units for the holding refrigeration compressors.

(c) Each compressor shall have an individual driving unit.

(d) Where, required for compressor protection, an entrainment separator incorporating a drain and a level gauge shall be provided in the suction line of each compressor.

(e) An oil separator incorporating a drain and a level gauge shall be installed in the discharge line of an oil lubricated compressor.

6.6.6 Condensers

The condenser system shall be cooled by air or water or both. The condenser shall be designed for a pressure not Jess than 1.73 MPa. Provision shall be made for purging non condensable gases or vapours either manually or automatically.

6.6.7 Receiver and liquid drain

A receiver shall be provided with a liquid level control to discharge the liquid ammonia to storage. The receiver shall be designed for a pressure not less than l. 73 MP and shall be equipped with the necessary connections, safety valves and gauging devices

SECTION 7 OPERATIONS

7.1 APPLICATION

The procedures for the operation of a system for the storage and handling of anhydrous ammonia shall comply with the requirements of this Section.

7.2 ESTABLISHMENT OF PROCEDURES

7.2.1 Procedures required

It shall be the responsibility of the occupier of the system to develop and implement procedures appropriate to the system as follows:

(a) Site plan or plans indicating plant, main pipework or routes, switchboards of sub stations, emergency stop valves or actuating devices, and other significant components of the system depending on the intended use of the plan.

(b) Operating procedures, covering all aspects of the day-to-day operation of the facility.

(c) Maintenance procedures, covering regular testing inspection and monitoring of the Equipment

(d) Emergency procedures, covering action to be taken in the event of spillage, accident, equipment failure or other abnormalities emergencies.

(e) Construction procedures, covering new facilities and modification of existing plant.

NOTES:
1 Many states have occupational health and safety legislation in place. The legislation generally provides for consultative mechanisms at workplaces to enable management and workers to be jointly involved in the development of procedures and work practices.

2 Guidance on quality management systems is given in the ISO 9000.

7.2.2 Promulgation of procedures"

The procedures shall be documented in notices, manuals or other recorded instructions as appropriate to the particular installation, on view or readily available on-site.

7.2.3 Review and up keep of procedures

The procedures shall be modified when necessary because of equipment or organizational changes and shall otherwise be reviewed at least every two years.

7.2.4 Operating procedures

The operating procedures shall provide, where appropriate, for the following:

(a) Any specific requirements detailed in Clauses 7.9 and 7.10

(d) · Liquid transfer procedures

(e) Monitoring of essential functions and components.

(f) Recognition of fault conditions.
(g) Control of hazards.

(h) Manufacturer's operating instructions for the equipment.

(i) Equipment not in use (e.g. isolation, deactivation and identification).

(j) Housekeeping site maintenance.

(k) Treatment of leakage, spillage and clean-up.

(l) Maintaining clear spaces for access.

(m) Personnel safety.

(n) Work at height.

(o) Personal protective equipment.

(p) Security.

(q) Control of access and of movements and activities of people, equipment, and vehicles.

(r) Access to top of tank in the case of a refrigerated tank.

(s)Environmental monitoring.

(t) Operation of utilities.

7.2.5 Construction and maintenance procedures

The construction and maintenance procedures shall provide. Amongst other things, for the following where appropriate to the particular installation;

(a) Work authorization.

(b) Work in confined spaces.

(c) Testing of instrumentation and of protective devices, alarms and monitors.

(d) Gas freeing.

(e) Isolation and tagging.

(f) Control of contractors.

(g) Firefighting equipment.

(h) Pipelines.

(i) Storage tanks.

(j) Electrical equipment,

(k) Fences and security measures,

(l) Illumination.

(m) Needs of any other individual items or plant components, e.g. pumps and Compressor.

(n) Signs and notices.

7.2.6 Emergency' procedures

A documented emergency procedures plan shall be prepared, which shall make provisions for dealing -with, where appropriate, likely emergencies for the particular installation. Any such preplanning shall include the following:

(a) Hazard identification.

(b) List of contacts, emergency services and phone numbers

(c) Emergency operations flow chart and chain of command.

(d) Duty list.
(e) Capacity of resources, including any mutual aid (inter-company) arrangements.

(f) Cooperation with relevant authorities.

(g) Evacuation provisions and assembly points.

(h) First aid.

(i) Debriefing and internal/external reporting of incidents.

G) Vehicles on site. (k) Contractors.
(I) Access control. (m) Site plan.
(n) Spillage, clean up and decontamination.

NOTE: Action to clean up spillage or leakage should be initiated immediately.

(o) Any specific requirements of Clause 72.5.

(p) The availability of sufficient water to combat any emergency situation.

(q) Access to foam generators and foam suppliers that are compatible with ammonia.
NOTE: Following an incident, facility and emergency procedure should be reviewed as they relate to the incident.

7.3 PLACARDING
Stores shall be placarded in accordance with national regulations.

7.4 TRAINING OF PERSONNEL

7.4.1 Training

Training or instruction m established procedures shall be provided in accordance with Clauses 7.4.2 to 7.4.5.

Particular care should be taken to ensure. comprehension in the case of language difficulties.

7.4.2 Employees

Each employee shall be trained in such duties duties as have been individually assigned to that person. The training shall include the following, as appropriate:

(a) Procedures to be followed in the event of an incident (spillage, accident or fire)

(b) Layout of the installation

(c) Location of emergency equipment.

(d) Basic principles of spillage control and use of fire hose.

(e) Statutory regulations relevant to employees' tasks.

(f) Awareness of the properties, characteristics and hazards of ammonia.

(g) Corrective use of personnel protective equipment provided.

(h) Area of housekeeping.

(i) ·Safety rules of the installation, including any restrictions on movement, access or activities.

7.4.3 Contractors

Contractors and their staff shall be trained in the following, as appropriate to the specific task to be performed:

(a) Safety rules of the installation, including any restrictions on movement, access, activities and use of personnel protective equipment.

(b) Conditions and obligations associated with work permits and confined-space entry permits.

(c) Hazards likely to be encountered.

(d) Procedures to be followed in the event of an incident, e.g. spillage, accident or fire.

74.4 Visitors

Every person who enters premises where anhydrous ammonia is stored or used shall comply with all signage and notices for the site.

Every person entering restricted areas shall be instructed to comply with the relevant safety instructions.

7.4.5 Refresher training

Training procedures shall include provision for refresher training at sufficient intervals to ensure that capability is maintained.

7.5 WORK ACTIVITIES AND SUPERVISION

All activities within a restricted area shall be carried out by a competent person trained in the particular tasks to which they are assigned unless under the direct control of a supervisor. Any supervisor shall be experienced and knowledgeable in the regulations and Standards applicable to the activity.

7.6 COMPLIANCE WITH PROCEDURES

All persons shall comply with the procedures established for the particular installation and an audit system shall be established to ensure compliance.

7.7 RECORDS

Records shall be kept of the following.
(a) Training and retraining.

(b) Equipment tests required by this Standard and reference Standards.

(c) In-service inspections.
(d) Emergency drills
.
(e) Maintenance and-repairs.

(f) Significant spillage accident, injury, dangerous occurrence or other abnormal incident.

The records shall be kept for periods as required by the regulatory authority.
NOTE: Regulatory authorities generally require that any of a specified range of abnormal incidents are reported.

7.8 GENERAL PRECAUTIONS

7.8.1 Use of water in emergencies
Where water is used in an emergency, the following points shall be observed in its use:

(a Water shall be applied in sufficient quantity in the form of a fine spray or fog to reduce the concentration of ammonia gas in air.

(b) Water shall be used on liquid ammonia pools only if sufficient water is available.
NOTE: The volume of water used should be approximately 100 times the volume of the ammonia spill.

(c) Water shall be used to cool any anhydrous ammonia container exposed to fire and which cannot be removed from the vicinity of the fire.

(d) Water shall not be sprayed on anhydrous ammonia containers that are colder than the
. available water supply as the water will heat anhydrous ammonia and aggravate any gas leak.

(e) Anhydrous ammonia that is to be disposed of, e.g. as from a leaking container, shall be dissolved in water whose volume shall be at least I 0 times, and preferably 100 times, the liquid volume of the anhydrous ammonia. The ammonia shall be introduced as close as possible to the bottom of the water tank.
NOTE: When pools of liquid ammonia are present, the use of foam is recommended,

7.8.2 Stress corrosion

The following precautions shall be observed to prevent stress corrosion; which could occur under certain conditions: ·.

(a) Care shall be exercised to eliminate oxygen from ammonia storage tanks.

(b) Whenever a tank has been opened to the atmosphere, it shall be thoroughly purged with ammonia or an inert gas, but not with carbon dioxide (because of its affinity with ammonia), to eliminate all traces of contamination

(c) Ammonia tanks that are to remain out of service for a considerable period of time shall be maintained with a positive internal pressure of ammonia gas or a suitable inert gas. "

(d Anhydrous ammonia shall not be transported in tankers constructed of quenched and tempered steels unless the water content of the liquefied ammonia is not less than 0.2 percent. The marking of the shipping' paper '0.2% water' can be taken to indicate suitability for transport in such tankers.

7.9 INSPECTION AND TESTING

7.9.1 Tanks

All tanks shall be inspected in accordance with equivalent international standard
All tanks shall be examined externally prior to every filling.

7.9.2 Cylinders

Cylinders shall be inspected and tested in accordance with KS.

7.9.3 Rail tank vehicles

Rail tank vehicles ‘shall be externally examined by the filler prior to every filling and shall be inspected in accordance with equivalent international standard.

7.9.4 Road vehicles.

Road tank vehicles shall be examined externally by the filler prior to every filling and shall be inspected in accordance with equivalent international standard.

7.9.5 Safety and relief valves

Safety and relief valves installed in systems shall be inspected and tested in accordance with equivalent international standard.

7.9.6 Excess flow valves and non-return valves

Excess flow valves and non-return valves shall be inspected in accordance with
equivalent international standard.

7.9.7 Rigid piping and swivel joint assemblies

Rigid piping and swivel joint loading or unloading assemblies, in addition to being subjected to the installation test (see Clauses 2.9.5), shall thereafter be tested for leakage, at a pressure not less than 1.5 times the

piping design pressure, once every 5 years and whenever maintenance has been carried out, stamped with the date of the test.

7.9.8 Flexible steel hose

Flexible steel hose assemblies, in addition to being subjected to the installation test (see Clause 2.10.3), shall thereafter be inspected visually at every connection and be hydrostatically tested at a pressure not less than 2.4 MPa at intervals not more than 2 years or whenever repaired and stamped with the date of the test.

7.9.9 Hose

Hose assemblies, in addition to being subjected to the installation test (see Clause 2.11.3), shall thereafter be tested for leakage at a pressure of not less than 2.4 MPa at intervals not more than 12 months and whenever maintenance is carried out on the hose assembly and stamped with the date of the test.·

In addition, the hose shall be externally examined for damage· every time prior to use. All hose assemblies shall be destroyed at the first signs of any deterioration.

Hose assemblies shall be removed from service and destroyed not longer than 8 years from the date of manufacture.

7.9.10 Liquid level gauges

Liquid level gauges shall be examined during every tank filling, to ensure that they are operating.

Liquid level gauges shall be checked and calibrated when the tank is inspected internally.

7.9.11 Pressure gauges

Pressure gauges shall be maintained: within the limits of accuracy given in equivalent international standards, for industrial gauges and shall be inspected and calibrated as required
Pressure gauges shall be marked with the date of calibration.

7.9.12 Temperature gauges

Temperature gauges shalt, be maintained within the limits of accuracy required b and shall be inspected and calibrated as required by equivalent international standards. Temperature gauges shall be marked with the date of calibration

7.9.13 Emergency shut-down (ESD) systems

The operation of ESD systems shall be checked at least every 12 months or more frequently as required by the regulatory authority.

7.10 TRANSNFER OF ANHYDROUS AMMONIA

7.10.1· General

Tanks shall not be filled with anhydrous ammonia unless they are in good condition and comply with the relevant requirements of this Standard. Where transfer of anhydrous ammonia is to be effected on the consumer's premises, the consumer shall be notified of the time that delivery will be made. No delivery shall be made at night unless adequate lighting is provided at the location.

7.10.2 Attendant

At least one trained person shall remain in attendance from the time the connections are made until they are finally disconnected, and two persons shall be in attendance where the transfer takes place in a built-up area with public access or within 15 m of any protected place, other than in buildings on the premises where the transfer takes place.

7.10.3 Protective equipment

Proper clothing, gauntlet gloves and chemical splash goggles shall be worn as a minimum during the making and braking of transfer connections. The chemical splash goggles shall be worn at all times, and a canister type respirator shall be 'at the ready' during the transfer operation. A self-contained breathing apparatus shall also be available at any depot.

7.10.4 Precautions against movement

Before connections are made to a road or rail tank vehicle or to a nurse tank or other container mounted on a road or rail vehicle, the vehicle should be located on level ground and the brakes shall be applied. Where interlocking brakes are not fitted chocks shall be placed at the front and rear wheels.
NOTE: It is important that transport vehicles be positioned such that in the event of an emergency the vehicle can be towed straight out without need for reversing or turning.

7.10.5 Bleed valves

Where bleed valves are fitted to relieve pressure, the (bleed valves shall be opened before the tanker and storage tank pipework terminal caps ‘are removed

7.10.6 Liquid level

During transfer, the driver of the transporting/vehicle and the filler shall regularly check the liquid level gauges of the storage tank and transport tank. If any variable-level gauge or temperature gauge is unserviceable, the. check of contents level shall be by means of the fixed-level gauge or weighing methods.

7.10.7 Mass filling ratio

The mass filling ratio for the tank shall not be exceeded. The appropriate procedure described in Appendix D shall be followed.
NOTE: If the filling volume in litres or cubic metres is required, it may be calculated using the liquid density values listed in-Annex A.

7.10.8 Filling refrigerated tanks

The filling ratio for the tank shall be such that the tank will not be full of liquid at a liquid temperature corresponding to the vapour pressure at the start-to-discharge pressure setting of the pressure-relief valve.

7.11 LEAK DETECTION AND LOCATION

7.11.1 General

If the leak occurs in a congested area or where atmosphere dissipation is not feasible, the Ammonia should be absorbed in water (see Clause 7.8.1).

7.11.2 Location and leaks

The exact location of leaks may be detected by allowing the fumes from an open bottle of hydrochloric acid to come in contact with the ammonia vapour, which will produce a dense white fog. Moist phenolphthalein or litmus paper, which will change colour in ammonia vapour, may also be used. The use of sulphur tapers is not recommended.
A small leak in anhydrous ammonia valves, connections or feed lines may be readily detected by odour.

7.12 REPAIRS

7.12.1 Personnel

Only competent persons shall attempt to stop an ammonia leak, make repairs, alter or open connections in any anhydrous ammonia system

7.12.2 Protective equipment

If there is any doubt concerning the seriousness of the leak, an approved respiratory protective device should be worn.

7.12.3 Purging

An anhydrous ammonia system shall be drained and purged of all vapour prior to commencement of any repair.

7.12.4 Welded repairs

Repairs involving welding on a container shall not be made until has been declared gas-free after testing, or has been completely filled with water. Any purging water shall be completely drained and the area to be welded shall be completely dry before welding.

Any welded repair shall be stress-relieved, unless specifically exempted by means of vessel inspection in accordance with equivalent international standard in the case of a minor repair.

7.12.5 Repairs to rail tank vehicles

Any repairs to rail tank vehicles shall be in accordance with equivalent international standard and the requirements of the rail system concerned.

SECTION 8 EMERGENCY MANAGEMENT

8.1 APPLICATION

The emergency management for any installation for the storage and handling of anhydrous ammonia shall comply with the requirements of this Section.

8.2 PLANNING FOR EMERGENCIES

8.2.1 Design of premises

The likelihood of any incident occurring in an area used for the, storage and handling of ammonia can be reduced by good design and layout, sound engineering, good operating practices, and proper instruction and training of personnel in the performance of their duties.

The following should be considered in the design and layout of any facility used for the storage and handling of ammonia:

(a) Sufficient space between bund walls, storage areas and other structures to allow access for maintenance and emergencies.

(b) Means for reducing emission of vapours to, the outside atmosphere.

(c) Alarms connected directly to the fire brigade or to a 24 h monitoring service.

(d) Water supplies.

(e) Fire protection equipment. (see section 9)

(f) Means of evacuation and assembly points.

(g) Protection for personnel responding-to an emergency.

(h) Access routes for fire brigade: appliances and other emergency vehicles.

(i)Provision for the containment pf leaks, spills and run-off of firefighting water.

(j) Provision for the display emergency plan (see Clause 8.2.2) and the emergency procedures (see Clause 7.2.6).

The regulatory authority the fire authority and other emergency service agencies should be consulted with respect to these matters.

8.2.2 Emergency plan

8.2.2.1 General.

A detailed plan, for combating emergencies that could occur on the premises shall be prepared. Such a plan should be developed in consultation with the emergency service agencies and the regulatory authority. The emergency, plan shall-

(a) take into account any potential for the occurrence of fire, explosion, earthquake, reaction or release of ammonia or other dangerous goods stored on the premises;

(b) be appropriate to the size and complexity of the installation; and

(c) be regularly appraised and updated. (See Clause 8.2.2.4.)

Plant personnel should be familiar with the contents of the emergency plan.

Emergency service agencies may require a copy of the emergency plant to be kept at the entrance to the premises.

8.2.2.2 Premises emergency plan

The emergency plan for use by plant personnel shall set out the procedures to be followed by the occupier's personnel in an emergency. It shall include, as appropriate-

(a) actions to be taken in the event of a fire, spill, explosion, leak or other emergency, including fire-fighting actions, alarm activation, evacuation procedure, shutdown procedures, the establishment of emergency control centres, and mutual aid arrangements (e.g. cooperation with relevant authorities, the use of equipment on neighbouring premises);

(b) a list of contact telephone numbers for emergency services, e.g, fire brigade, ambulance, police, regulatory authorities, local hospital and appropriate technical advisor, the criteria for contacting them and the procedures to 'ensure that they are alerted promptly;

(c) evacuation procedures and the implementation of a warden system;

(d) the establishment of nominated assembly areas, away 'from the incident area and emergency services operations;

(e) training of personnel in carrying out the plan (which may involve the local fire brigade); and

(f) the location of material safety data sheets (MSDSs).

The emergency plan shall be reviewed and updated regularly (see Clause 8.2.2.4).

8.2.2.3 Plan for the use by emergency services ·

A second emergency plan may be required for the surrounding area, to assist the emergency services in carrying out their duties expediently and efficiently. Such a plan shall be kept in a location to the satisfaction of the local emergency services organization such as the State Emergency Services or the fire authority. NOTE: The information that should be 'provided for the emergency services in this emergency plan is described in Appendix F.

8.2.2.4 Review of emergency plan

The emergency plan shall be kept up-to-date and reviewed and revised, where necessary, whenever-

(a) a new type of dangerous goods is introduced to the premises;

(b) the quantity of dangerous goods being kept is changed;

(c) a change is made: the way the dangerous goods are stored or handled;

(d) a change is made in a process or procedure, which might result in a change of risk;

(e) new information regarding the hazardous properties of a substance is established; or

(f) problems are encountered during training or after an incident.
The plan shall be reviewed and revised periodically.

8.3 MANIFEST

Unless otherwise approved by the regulatory authority, a manifest shall be provided and maintained as recommended in NOHSC 3010.

8.4 PLACARDING

8.4.1 Placarding of stores

Every installation in which dangerous goods are kept shall be placarded in accordance with NOHSC 1015 and NOHSC 2017, except that, where those requirements conflict with the requirements of the relevant state or territory regulation, the requirements of the regulation shall prevail.

8.4.2 Safety information

Where required by the relevant regulatory authority, safety information, intended principally for the emergency services, shall be displayed at approved locations. The following information shall be provided:

(a) The location of the emergency plan (see Clause 8.2.2). (b) The location of the manifest (see Clause 83).

(c) The location of personal protective equipment.

(d) The locations of the controls for essential (e.g. electricity and water) and their distribution.

(e) The location and description of dangerous goods befog stored.
NOTE: A pictorial layout of the site or building may also be required on the safety information board. ··"·

8.5 MANAGEMENT OF LEAKS AND SPILLS·.

Every endeavour shall be made to prevent leaks or spills, and to control them if they do occur. Clean-up action shall be initiated immediately.

Leaked or spilled ammonia shall be disposed of in accordance with the procedure established in accordance with Clauses 7.2 .6 and 7.8.1.

When controlling or dispersing leaked or spilled ammonia, the following shall be considered:

(a) Shutting off all sources· of ignition.

(b) Working up wind. Increasing ventilation.

(c) Clearing the area of unprotected personnel.

(e) Wearing appropriate protection equipment to prevent skin and eye contamination and inhalation, of vap ours.

(f) Notifying emergency services when contamination of drains, sewers or waterways occur,

(g) Increasing ventilation and allowing gas from small leaks to vent to a safe area.

(h) using fire hoses with fog nozzles to disperse gas from large leaks down wind.

(i) No spraying water directly onto a leaking ammonia container.

(j) Using sand or soil to contain liquid.

(k) Allowing small liquid spills to evaporate.

(l) Covering large liquid spills with 150 mm of protein or other suitable high-expansion foam.

(m) Preventing liquid ammonia from entering drains and large masses of water.

At every occurrence of a leak or spill, the emergency plan shall be implemented and consideration should be given to notifying the emergency service agencies.
NOTE: Emergency services should be notified when-
(a) the spill has spread, or has the potential to spread, beyond the boundary of the installation;

(b) it is beyond the resources of the occupiers to clean up the spill or leak effectively and safely;

(c) the protective equipment is inadequate for dealing with the situation;

(d) staff are not experienced in dealing with the situation; or

(e) staff and the public are, or could potentially be, placed at risk.

SECTION 9 FIRE PROTECTION

9.1 APPLICATION

The fire protection facilities for any installation for the storage and handling of anhydrous ammonia shall comply with requirements of this Section.

9.2 GENERAL CONSIDERATIONS

9.2.1 General

The fire protection provisions for any installation are intended, to fulfil the following functions:

(a) Firefighting to control and extinguish any fire that may occur.

(b) Heat protection, to prevent exposure to the heat from a nearby fire.

(c Vapour dispersal.

The advice of a suitably qualified consultant in consultation with the appropriate fire authority should be sought on fire protection and prevention measures, and the adequacy and suitability of firefighting equipment. Where appropriate, a risk assessment and a fire safety study should be undertaken.
Fire protection systems shall be appropriate to the hazards and should consider the storage configuration, the location and the adjoining activities and materials.

The fire protection and prevention measures and firefighting equipment shall be at least that specified in the Kenya fire safety act.
NOTE: Ammonia vapour in air is flammable within the limits given in Table Al, so an installation should be assessed for potential classification as a hazardous area and appropriate precautions should be taken regarding ignition sources, particularly electrical equipment.

9.2.2 Hazards

Anhydrous ammonia can, present the following during a fire:

(a) Cylinders can rupture 'catastrophically.

(b)Localised heating of tanks may cause rupture.

(c) Ruptured cylinders and tanks may become projectiles. Released ammonia may ignite.

(e) Released ammonia will present a toxic, corrosive and freezing hazard to persons.

(f) Smoke, and water run-off from a fire within an installation for the storage and handling of ammonia may present toxic and corrosive hazards to persons and the environment.

(g Liquid anhydrous ammonia will release large volumes of gas relative to the volume of liquid.

9.2.3 Design and compatibility

9.2.3.1 General

The design of the fire protection system shall give consideration to the optimization and adaptability of the equipment so that it may be effective in any one of a variety of events. It may be an independent system or integrated with other fire protection covering the installation and adjoining installation.

The materials and equipment provided in the fire protection system shall be suitable for the conditions of use and compatible with anhydrous ammonia and the other goods stored in the installation.

Any firefighting appliances, equipment, components, hoses, connections, booster connections and the like shall be compatible with that of the relevant fire authority at essential interfaces.

9.2.3.2 Heat protection

Storage facilities for anhydrous ammonia may require heat protection due to the potential explosive rupture of a container. One or more of the following means can provide heat protection:

(a) Sufficient separation from the potential heat source to render thermal protection unnecessary.

(b) The use of radiation barriers.

(c) The use of cooling water, which may be by means of-
(i) fixed or traversing monitors;
(ii) fixed sprinkler or deluge systems:
(iii) fire hydrants equipped with hoses; or
(iv) fire hose reels.

9.2.4 Control of run off

A plan shall be in place to ensure that contaminated water cannot enter surface or ground water. Where liquids are the principal firefighting and cooling media, water retention facilities shall be provided with sufficient capacity to contain the water that may be generated.

Procedures for blocking of drains:6ff drains and the prevention of contamination of watercourses shall be included in the emergency plan (see Clause 8.2.2).

9.2.5 Location firefighting equipment

Firefighting equipment should be located in conspicuous positions and be accessible for immediate use:

9.2.6 Protection of firefighting equipment

Any/firefighting equipment that is susceptible to corrosion or degradation by weather, ultraviolet light, fumes and the like should be located in a sheltered position or in a protective enclosure.

9.2.7 Protection from adjacent fire exposure

Protection from adjacent potential fire exposure shall be provided. Such protection can be provided by-

(a) sufficient separation from the potential heat source;

(b) the use of thermal barriers; or

(c) the use of cooling water by means of-
(i) fixed or traversing monitors;
(ii) fixed sprinkler or deluge systems;

(iii) fire hydrants equipped with hoses; or

(iv) fire hose reels.

9.3 FIXED FIRE PROTECTION AND DETECTION SYSTEMS

Any fixed fire protection and detection systems shall comply with the appropriate Standards listed in Table 91.

TABLE 9.1

ST AND ARDS FOR FIXED FIRE PROTECTION AND DETECTION SYSTEMS.

System	**Standard**
Automatic fire detection Automatic sprinkler installations Manual alarm installations Fire hose reel installations Fire hydrant installations Manual alarm call points Pump sets Low expansion foam Medium and high expansion foam Dry chemical extinguishing system Gaseous fire extinguishing systems Fire hose reelsninstallation	

9.4 FIRE ALARM SYSTEMS,

Where a fire alarm system 'is installed, it shall comply with relevant national regulations.

9.5 FIRE EXTINGUISHERS

9.5.1 General
Fire extinguishers shall comply with the appropriate Standard listed in Table 9.2 and installed and located in accordance with national regulation, and adjacent to the relevant area of risk (see also, Clause 9.2.5)
The following shall be considered when selecting fire extinguishers:

(a) Suitability for use with anhydrous ammonia.

(b) Suitability for use on electrical equipment within the installation.

(c) Compatibility of extinguishers, which are liable to be used together in an emergency.

TABLE 9.2

STANDARDS FOR PORTABLE FIRE EXTINGUISHERS

Type of portable fire extinguisher	Standard
Water type **Foam type** **Dry powder type** **Carbon dioxide type** **Classification of fire extinguisher** **Wheeled fire extinguishers**	

9.5.2 Maintenance

All fire extinguishers shall be maintained in accordance with relevant requirements given in AS 1851.1.

9.6 HOSE REELS

9.6.1 General

Hose reels complying with equivalent international standard shall be provided in accordance with the requirements given in Table 9.3.

9.6.2 Location

In an area where hose reels are required -

(a) hose reels shall be installed with a maximum hose length of 36 m and fog spray nozzles;

(b) hose reels shall be installed in such a way that they are accessible to all personnel in that area and in locations satisfactory to the local fire authority; and

(c) sufficient hose reels shall be provided so that the nozzle end of a fully extended fire hose fitted to the reel and laid out to avoid any physical barriers can reach every part of the installation.
In circumstances where hose reels are required, hydrant hose systems may be substituted for hose reels' subject to the availability of trained staff capable of using the equipment.

9.7 FIRE HYDRANTS

9.7.1 General

Where a fire hydrant system is installed, the following requirements shall apply:

(a) The hydrant system shall be designed and installed in accordance with Relevant international standard.

(b)For each hydrant, at least one hose and hose fitting, as well as one fog spray nozzle shall be provided. Where practicable there should be at least two fire hydrants located remote from each other.

9.7.2 Location

Hydrants shall be located so that each area requiring protection is within 30 m of, but not less than 10 m from a hydrant under any fire or adverse wind conditions.
NOTE: For design purposes, 'adverse wind conditions' are taken as requiring at least 50 percent more water than the quantity calculated as being required at the installation.

The following points shall be considered in determining the suitability of a hydrant for providing cover:

(a) Clear access to and around every hydrant.

(b) Freedom from obstruction caused by parking, loading and unloading of vehicles.

(c) The location of fire hydrants installed by the water supply authority in nearby public thoroughfares.

(d) Protection of hydrants and hydrant pipe work from fire or mechanical damage.

9.7.3 Maintenance

Fire hydrants and hoses shall be maintained in accordance with equivalent international standards.

9.8 MONITORS

Where monitors are installed, they shall comply with the following requirements:

(a) Cooling monitors shall be capable of applying the required quantity of water under adverse wind conditions.

(b) The means for manually starting and stopping flow and for controlling the direction if the monitor is adjustable shall be operable from a safe position.
NOTES:

1 For design purposes, 'adverse wind conditions' are taken as requiring at least 50 percent more water than the quantity calculated for the area.
2 It is considered that, to provide significant' cooling in adverse wind conditions, monitors would need to be so close to the area that any design that relies on manual adjustment of direction or spray pattern could be inoperable because of proximity to the heat source.

9.9 SPRINKLER SYSTEMS

9.9.1 General

Where fire sprinkler systems are required, they shall be installed and located in accordance with appropriate Standard. Such systems shall comprise-

(a) individual-activation sprinklers;

(b) deluge sprinklers;
(c) foam sprinklers;
a combination of the systems above.

9.9.2 Maintenance

Sprinkler system shall be maintained in accordance with equivalent international standard.

9.10 WATER SUPPLY

The water supply for firefighting shall comply with the following requirements:
(a) The water pressure, flow and water reserves shall be sufficient for the needs of the installation and for any possible simultaneous needs of nearby buildings or facilities for firefighting water.
NOTE: Where an assessment of the site indicates that operation of the whole water system at one time is unlikely, an appropriate factor may be applied.

(b) Where the necessary flow cannot be maintained by the system, provision shall be made for boosting. Where supply conditions are inadequate for boosting, astatic water supply system shall be provided.
NOTE: The required water should be provided by a reticulated system where practicable.

(c) A static water supply system shall be capable of providing not less than 2 h of running time for the whole system as determined under Item (a) above or 30 min if suppling only a hose reel system.
NOTE: Return water or additional make-up water may be taken into account in the calculation of reserves and a bore or dam may be utilized if sufficiently reliable in terms of availability

9.11 FIRE PROTECTION REQUIREMENTS

The minimum fire protection to be provided at a system for the storage and handling of anhydrous ammonia shall be as follows:

(a) Where a permanent reticulated water supply is available as listed in Table 9.3 or as required by the regulatory authority.

(b) Where a permanent reticulated water supply is not available; as required by the regulatory authority.

Where the term 'fire extinguisher' is used in Table 9.3 without further qualification it shall mean a water type fire extinguisher with a rating of not less than 2A in accordance with equivalent international standard and a capacity of not less than 9 kg

TABLE 9.3.

MINIMUM FIRE PROTECTION REQUIREMENTSFOR AN ANHYDROUS AMMONIA SYSTEM

Aggregate capacity, rn^3	Requirements
≥0.5 ≤ 2	(a) At least two fire extinguishers
> 2≤12.	(b) At least one hose reel and fire extinguisher
>12 ≤ 60	c) At least one hose reel, as determined by coverage and fire extinguishers positioned to achieve a l 5 m maximum travel distance
>60 ≤100	(d} As for (c), plus at least one on-site hydrant system, or monitors, or a sprinkler system
> 100	(e) A risk and fire safety assessment to be undertaken

9.12 ACTION IN EVENT OF A FIRE

In event of a fire the procedures given in the emergency plan shall be followed (see Clause 8.2.2

(Informative)

Annex A

PROPERTIES OF ANHYDROUS AMMONIA

It is essential that all personnel engaged in the handling of anhydrous ammonia be aware of its properties and be trained thoroughly in safe practices for its storage and handling. The general characteristics of anhydrous ammonia are as follows:

(a) Anhydrous ammonia is ammonia gas in compressed and/or liquefied form. It is not to be confused with aqueous ammonia, which is a solution of ammonia gas in water.
(b) Ammonia gas is liquefied under moderate pressure, and on release of the pressure the liquid will readily revert to the gaseous phase. Advantage is taken of this characteristic to store and transport the gas under pressure as a liquid.

(c) At atmospheric temperatures and pressures, ammonia is-a pungent, colourless gas and its odour serves as its own warning agent. Since ammonia gas is lighter than air, adequate ventilation is the best means of preventing dangerous accumulation of gas.

(d) At atmospheric pressure, at a temperature below -33°C, pure anhydrous ammonia is a liquid. As its temperature is increased, its vapour pressure is increased and the volume of a given mass of liquid is increased.

(e) The vapour pressure and the specific volume of anhydrous ammonia at various temperatures are given in Table A3.·.

(d) Ammonia vapour in air is explosive within the limits given in Table A2.

(f) Ammonia will form explosive compounds when in contact with such substances as silver, mercury, chlorine, iodine, bromine, calcium, and hypochlorite's.

(g) Ammonia containing water will not corrode iron or steel, but even if minute quantities of water are present it will rapidly react with zinc, tin, copper and copper base alloys such as brass and bronze. A number of other metals will also react with ammonia in varying degrees. Thus, amongst other things, galvanized pipes and fittings, and many non-ferrous metals commonly used in gauges and similar accessories, are unsuitable for ammonia service.

(h) Ammonia may cause rapid deterioration of some elastomeric materials such as fluoro polymers or fluoroelastomers used as seals and gaskets.

NOTE: 'Viton is a common fluoro elastomer.

(i) Anhydrous ammonia is considered a hazardous liquid, as on exposure to heat it will expand greatly and, depending upon the temperature it could rupture the container with explosive force and release its contents

(j) Ammonia may cause varying degrees of irritation to the skin or mucous membranes. It can temporarily damage the visual and respiratory systems, and in sufficient concentration permanent damage or death will occur.

(k)Ammonia gas will dissolve in moisture on the skin and cause a painful burning sensation. In liquid form ammonia can severely damage the skin. Should anhydrous ammonia come into contact with the body it should immediately be flushed with copious quantities of water.

(l) Particular care is necessary during maintenance operations, and it is important to observe the threshold limit value (TLV, formerly known as MAC). See Table Al for the effects of various concentrations for various exposure times.

TABLE Al

HEALTH HAZARDS

Vapour concentration p.p.m V/V	General effect	Exposure period
25*	Odour, detectable by most persons	Maximum for 8 h working period
100	No adverse effect for average worker	Deliberate exposure for long periods not permitted
400	Immediate nose and throat irritation	No serious effect after 30 min to l h
700	Immediate eye irritation	No serious Effect after 30 min to l h
1700	Convulsive coughing	Could be fatal after 30 min

	Severe eye, nose and throat irritation	
2000 TO 5000	Convulsive coughing Severe eye, nose and throat irritation	Could be fatal after 15 min
50000 to 10000	Respiratory spasm Rapid asphyxia	Fatal within minutes
This is the present threshold limit value.(TLV)		

TABLE A2
PHYSICALPROPERTIES

PROPERTY	VALUE
Boiling point at I 01.325 kPa	-33.35°C
Freezing point	-77.70°C
Critical temperature	132.40°C
Critical pressure	11.425 MPa
Latent heat at 101.325kPa and -33 to 35°C	1370.76 kJ/kg
Liquid density	See Table A3
Vapour pressure	See Table A3
Vapour density	See Table A3
Flammable limits (percentage by volume in air)	16 percent to 2 5 percent
Auto-Ignition temperature	651°C

TABLE A3

RELATIONSHIP BETWEEN TEMPERATURE, VAPOUR PRESSURE AND DENSITY

Temperature oc	**Vapour pressure(gauge) kPa**	**Liquid density kg/m3**	**Saturated vapour density kg/m3**

50	-60.4	702	0.381
-45	-46.7	696	0.500
-40	-29.5	690	0.645.
-35	- 8.1	684	0.823
-30	18.2	678	1.038
-25	50.3	671	1.297
-20	88.9	665	1.604
-15	135	659	1.966
-10	189.6	652	2.390
-5	253.6	645	2.883
0	328.1	639	3.452
5	313.3	632	4.108
10	513.7	625	4.859
15	627.0	618	5.718
20	755.9	610	6.694
25	901.4	603	7.795
30	1065.2	595	9.034
35	1248.6	588	10.431
40	1453. 1	580	12.005
45	1680.1	571	13.774
50	1931.3	563	15.756

Annex B

STRESS CORROSION CRACKING

BI INTRODUCTION

The stress corrosion cracking of carbon steel in the presence of ammonia is a significant risk to the integrity of ammonia storage tanks and associated equipment and the possibility of it occurring should not be ignored. Stress corrosion cracking is major problem for ammonia producers, distributors and users and the adoption of effective risk control strategies throughout all stages of the life of the equipment is necessary to control the risk.

B2 FACTORS AFFECTING STRESS CORROSION CRACKING

Research and industrial experience has shown that stress corrosion cracking could be affected by the following:

(a) *Presence of oxygen* Stress corrosion cracking does not occur without the presence of oxygen. An oxygen content in anhydrous ammonia greater than I part per million considerably increases the risk and severity of stress corrosion cracking.

(b) *Local str*ess level High local stress level increase the risk of stress corrosion cracking. Stress corrosion cracking often occurs in welds and the beat affected zone due to the presence of high local stresses, Local stress is affected by steel yield strength, weld material properties, welding procedure, post weld stress relief, local structural stress concentrations are strikes, grinding and other local damage.

A strength threshold below which stress corrosion cracking does not occur has not been identified. However, steels <with a yield strength less than 300 MPa are considered to be low risk.

(c) *Water content* A concentration of 0.2% in liquid ammonia has been shown to tend to inhibit stress corrosion cracking. However, the addition of water may not protect the vapour space of tanks when condensation of pure ammonia can occur.

(d) *Temperature* The risk of stress corrosion cracking and the severity of cracking are much less at -33˚c than at ambient temperature. However, the occurrence of stress corrosion cracking 11:_t refrigerated storage conditions has been reported.

B3 RISK CONTROL STRATEGIES

Based on the factors which influence stress corrosion cracking given in Paragraph C2 the following measures are recommended for reducing the risk of stress corrosion cracking at each stage of the life of the equipment:

(a) *Design*

(i) Specify low yield strength steels.

(ii) Design to reduce stress concentrations particularly at welds.

(iii) Use fracture mechanics analysis to establish allowable crack sizes or demonstrate 'leak before break'.

(iv) Select refrigerated storage for large tanks that cannot be stress relieved.

(v) Incorporate secondary containment facilities to handle possible leaks.

(b) *Construction*

(i) Undertake post weld stress relief.

(ii) Control welding to reduce weld yield strength and residual stresses.

(iii) Dress welds to reduce surface stress and hardness (specially applicable to quenched and tempered steels).

(iv) Control weld grinding using soft grinding wheels that cut but do not smear.

(v) Control and repair arc strikes.

(vi) Eliminate hard stamping of plates.

(c) *Testing*

(i) Undertake hydrostatic pressure testing (hydrostatic pressure testing assists m the relief of residual stresses).

(ii) Check weld hardness.

(d) *Commissioning*

(i) Purge with inert gas or ammonia to exclude oxygen before filling.

(ii) Add water to increase water content at initial fill.

(e) *Operation*

(i) Maintain water content.

(ii) Maintain low oxygen content.

(iii) Maintain systems and establish procedures to monitor and provide early detection of leaks.

(f) *Inspection*

(i) Establish inspection periods and procedures using experience and risk based inspection

(ii) Use wet fluorescent magnetic particle techniques to detect cracking.

(g) *Repair*

(i) Grind out cracks using controlled processes that minimize local hardness.

(ii) Use low strength electrodes for weld build-up repairs.

(iii) Where post weId heat treatment is not practicable, shot peening of the repaired area should be considered as an option.

Whilst it is usually not possible to eliminate totally the risks associated with stress corrosion cracking the adopo0ption of a number of the above measures as far as practicable can often provide satisfactory control of the overall risk. It should be noted that road tank vehicles which' are often fabricated from higher strength steels to reduce weight need careful attention.

ANNEX C
CAPACITY OF SAFETY VALVES

Cl PRESSURE TANKS AND VAPORIZERS

The required minimum discharge capacity for safety valves to used on uninsulated tanks and vaporizers shall be determined from the equation:

$Q_a = 4.39A^{0.82}$…….. Cl

where

Q_a-required flow capacity of the valve, in cubic metres per minute of free air, i.e.at l5°C and 101.5 kPa (absolute) ·

A-external area of the tank or vaporizer adjacent to the maximum feasible wetted area below 75 m height above any potential sizeable source of flame or heat, in square metres.
NOTE: The source of flame or heat usually refers to ground level but may be at any level at which a sizeable fire could be sustained.

Where the surface area is not stamped on the nameplate or where the marking is not legible, the total surface area can be calculated by one of the following equations:

(a) Cylindrical vessels with hemispherical heads:

Area = overall length x outside diameter x π:

l(b) Cylindrical vessel with semi-ellipsoidal heads:

Area= (overall length+ 0.3 outside diameter) x outside diameter x π

(c) Spherical tank: Area= (outside diameter)2 x π

Table C l gives the result of calculations of flow rate for a range of surface areas, using Equation C l.

TABLE Cl
RATE OF DISCHARGE FOR SAFETY VALVES

Surface area m^2	Flow rate m^3/min	Surface area m^2	Flow rate m3/min	Surface area m^2	Flow rate m3/min
5	16	20	51	100	192
6	19	21	53	150	267
7	21	22	55	200	338
8	24	23	57	250	406
9	26	24	59	300	471
10	29	25	61	400	597
11	31	30	71	500	717
12	34	35	81	600	832
13	36	40	90	700	944
14	38	45	100	800	1053
15	40	50	109	900	1160
16	42	60	126	1000	1265
17	45	70	143		
18	47	80	160		
19	49	90	176		

ANNEX D

TANK FILLING LEVEL

INTRODUCTION

An anhydrous ammonia container should never be allowed to become liquid-full, because if the contents subsequently warm up, the resulting liquid expansion will cause liquid to discharge from the safety valve and may subject the container to hydrostatic pressure. Therefore, it is necessary to stop filling before the tank space is completely filled, and the ullage space which is left should be sufficient to allow for the expected fluctuations of liquid temperature, and consequently of liquid level. This Annex-describes alternative methods of calculating filling levels that will ensure that normal-variations are catered for so that a vapour space will remain above the liquid surface in all but the most abnormal circumstances. It deals only with tanks, for although the same principles are relevant for cylinders.

The starting point for the determination of the filling level is an assumption of the temperature likely to be reached in the liquid when a container stands in the sun. Heating is caused by conduction from the ambient air according to its temperature, and by solar radiation. Experiments in various locations have established that the temperature will stabilize at a value which will vary according, to 'two features of the tank itself, firstly the heat sink effect due to its size, and secondly but a lesser extent its aspect ratio. Both of these features are a function of the ratio between the volume (V) and the surface area (A), and this VIA ratio has become the basis for determining the maximum likely temperature of the tank contents.

Theoretically, each tank has an individual V/A ratio, so that each will reach an individual temperature; therefore, each tank should have an individual filling ratio. However, it is considered that this degree of complexity is not justified, so as simple convention has been adopted to the effect that tanks up to 5 m3 capacity may reach 55°C, but tanks over 5 m3 are not likely to exceed 46°C. Filling ratios have been calculated to leave a small ullage of one or two percent when the liquid is at these temperatures.

A tank may be filled by mass following a mass-filling ratio technique, or by volume by applying a volume-filling. Percentage method. The former is generally considered to be the more exact; even, temperature is not a factor, so that temperature observations and corrections are not necessary. However, weighing is

rarely a practical technique for stationary tanks, so filling is normally controlled by observation of the level of the liquid surface, i.e. the filling level.

Two techniques: of filling level control are available. The simpler is to fill to the standard filling level as indicated be the fixed liquid level gauge. This level is chosen on the assumption that the liquid temperature at the time of filling is 5°C. The method requires no measurements or calculations, and is therefore relatively simple, but there is a penalty in that the method is fairly conservative. In many conditions, the tank could in fact be safely filled to a higher level.

For those who wish to go to the additional trouble, a more complex procedure is available, which permits filling to the maximum filling level provided that the exact liquid temperature is known.

The procedures described in this Standard apply to uninsulated and unshaded tanks exposed to normal weather cycles. It is recognized that in a specific installation some or all of these conditions may not apply, but any variation to filling ratios should be negotiated individually with the regulatory authority.

D2 DETERMINATION OF STANDARD FILLING LEVEL D2

D2.1.1 Application
The standard filling level gives the location point for the fixed liquid level gauge, necessary for the filling procedures outlined in Paragraphs E4 and ES.

D2.2 Principle

The standard liquid level is calculated on the basis that a liquid at 5°C is loaded into a tank and then allowed to warm to either 46°C or 55°C (according to size), at which temperature the tank is one or two percent less than completely filled. It is considered that temperatures outside this range are unlikely to occur in practice.

D2.3 Procedure

The procedure shall be as follows:

(a) Calculate the volume filling percentage from the following equation:

$V = R / D \times 10^5$ …… D 1

where

V = volume-filling percentage.

R= mass-filling ratio for the size of the tank, i.e. 0.538 if the tank is less than 5 m3 or 0.553. if 5 m3 or more

D= liquid density at 5°c; in kilograms per cubic metre.
=632

(b) Calculate the location of liquid surface from V and the tank diameter, by geometric methods.

D3 PROCEDURE FILLING BY WEIGHT
D3.1 Application

Since it is not normally practicable to provide weighing facilities for a fixed stationary tank, filling by weight.is generally useable only for cylinders, or for portable tanks, or for tankers if they can be filled on a weighbridge, or cross-checked on a weighbridge after filling by volumetric monitoring.

D3.2 Filling procedure

The mass-filling ratio R (see Paragraph D2.3) is multiplied by the actual capacity of the

tank' and (added to the tare of the empty tank or tanker, to give the total mass. Filling shall not continue past this point.
NOTE: Filling may be controlled by a mass flow meter after the determination of initial tank I contents by other means.

D4 PROCEDURE-FILLING BY VOLUME-STANDARD LIQUID LEVEL METHOD

D4.1 Application

The standard liquid level method may be used for any cylinder, tank or tanker, which is not filled by mass, provided that the liquid being transferred is not unusually cold, i.e. below 5°C. No other checks are necessary.

D4.2 Filling procedure

Fill the tank to the standard filling level indicated by the fixed liquid level gauge. A

A variable liquid level gauge may be used to monitor the rising liquid level. during filling but it shall not be used as the final arbiter of when to stop filling.

D5 FILLING BY VOLUME-TEMPERATURE CORRECTION METHOD

D5.1 Application
The temperature correction method may be used to fill above the standard liquid level to the maximum filling level provided that certain additional information is obtained. A variable liquid level gauge and a liquid-temperature gauge are necessary.

D5.2 Determination of maximum permitted level

The following information shall be obtained:
(a) The size of the tank, i.e. whether it is above or below 5 m3. capacity, and the associated mass filling ratio (see Paragraph D2.3).

(b) The temperature of the liquid as it is filled into the tank.
The volume-filling percentage maybe calculated from the following equation:

$v = R/D\_ \times 10^5$

where... E2

V= volume filling percentage

R =mass-filling ratio

D =density. of the liquid at the actual temperature when loaded (see Table A3).

No further calculation is necessary since the volume filling percentage is read directly off the variable liquid-level gauge.

D6 FILLING ROCEDURE

The method of controlling filling shall be as follows:

(a) F-ill to the' standard filling level as in Paragraph D4. As filling proceeds, monitor the temperature and determine the value of V (see Paragraph D5.2).

(b) As the liquid level approaches the fixed liquid level gauge point, prepare to start using the variable liquid gauge.

(c) As the liquid level reached the standard filling level as indicated by the fixed liquid level gauge, check the calibration of the variable level gauge.

Continue filling until the calculated maximum filling level, corrected for any gauge error, has been reached.

ANNEX E

INFORMATION TO BE PROVIDED TO EMERGENCY SERVICES

The information provided to the emergency services should include the following:

(a) A site plan, which should indicate-

(i) the direction of north;

(ii) the boundaries of the premises and the names of adjacent streets; ·

(iii) the location and identification of all buildings and external stores at the premises;

(iv) vehicular entry points, and vehicular access within the site;

(v) the location of dangerous goods;

(vi) the fire service layout;

(vii) the location of the drainage system, including isolation valves;

(viii) the location of alarm points; and
/-0-//
(ix) the location of venting arrangements for location where anhydrous ammonia may become trapped where the wind direction may force the vapour into adjacent enclosed structures.

A copy of the current manifest listing quantities, classes, UN numbers, product and names of the dangerous goods being stored and the location of dangerous goods within the premises.
A list of names and telephone paper numbers (including at-work and after-hours)
of personnel within the occupier organization who can provide specialist advice or assistance in an emergency,

Details of the evacuation system at the site, including-

(i) the type of alarm and its means of actuation;

(ii) the locations' of assembly areas; and

(iii) a means by which the emergency services can identify members of the warden structure, for the premises

(e) Material safety data sheets (MSDSs) for all the dangerous goods on the site.

(f) Details.of chemicals that can react with ammonia and which are located close to the area where ammonia may be released.