IS 4544 (2000): Ammonia - Code of Safety [CHD 8: Occupational Safety, Health and Chemical Hazards]

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भारतीय मानक

आमोनिया — सुरक्षा संहिता

(पहला पुनरीक्षण)

Indian Standard

AMMONIA — CODE OF SAFETY

(First Revision)

ICS 71.060;13.300

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

***September* 2000** **Price Group 5**

Chemical Hazards Sectional Committee, CHD 7

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Chemical Hazards Sectional Committee had been approved by the Chemical Division Council.

The standard was originally published in 1968. Due to the technological changes since last thirty years committee felt a need to revise the standard. In this revision more information has been incorporated under general properties and threshold limit has been changed according to the latest available data. Some important practices have also been incorporated in this revision under the clauses, like handling of cylinders, unloading of tank, storage, personal protective equipment and repair of tanks.

There is no ISO standard on the subject.

The elimination of accidents is vital to public interest. Accidents produce economic and social loss, and impair individual or group productivity. Realization of this loss has led the authorities to devote a good deal of attention to safety education. In any programme of safety education, preparation of code of safety is an essential part.

Ammonia is mainly used in the manufacture of fertilizer and as refrigerant. It is also used as detergent; for removing stains, in bleaching and calico printing; and for extracting plant colours (cochineal, archil, etc) and alkaloids. Its other uses are in the manufacture of nitric acid; in rubber vulcanization, water treatment, nitriding of steel, oil refining, extracting certain metals from ores, solvent and reaction medium in organic synthesis, yeast nutrient, sulphite paper pulp process, and explosives.

The filling, transport and importation of liquid ammonia or compressed ammonia gas in cylinders is governed by the *Gas Cylinder Rules,* 1981.

The manufacture of ammonia involves handling of flammable and corrosive gases under high pressures. Apart from general precautions, some typical precautions are required to be taken and this code of safety lays special emphasis on these points.

The composition of the technical committee responsible for formulation of the standard is given in Annex A.

AMENDMENT NO. 1 AUGUST 2007
TO
IS 4544 : 2000 AMMONIA — CODE OF SAFETY

(First Revision)

(Page 2, *clause* **5.1.3**, *last sentence)* — Substitute the following for the existing:

'Threshold limit value and STEL value of ammonia are as follows:

i) ACGIH Threshold Limit Value (TLV-TWA) - 25 ppm
ii) ACGIH Short Term Exposure Limit (STEL)- 35 ppm

NOTES

1 ACGIH (TLV-TWA) - The TWA concentration for a conventional 8 h work day and 40 h work week, to which it is believed that nearly all workers may be repeatedly exposed, day after day for lifetime without adverse effect.

2 ACGIH (TLV-STEL) indicates Short Term Exposure Limit. A 15 minutes TWA exposure that should not be exceeded at any time during a work day, even if the 8 h TWA is within the TLV-TWA. Exposures above the TLV-TWA up to the TLV-STEL should be less than four times per day, and there should be at least 60 minutes between successive exposures in this range.'

(Page 2, *clause* **5.2**) — Add the following at the end of 'text':

i) Lower Explosive Limit (LEL) = 16% (*v/v*)
ii) Upper Explosive Limit (UEL) = 25% (*v/v*)

(CHD 8)

Reprography Unit, BIS, New Delhi, India

Indian Standard

AMMONIA — CODE OF SAFETY
(First Revision)

1 SCOPE

This standard prescribes a code of safety concerning the hazards related to ammonia. It also describes the properties and essential information for safe handling and use of ammonia.

2 REFERENCES

The Indian Standards listed below contain provisions which through reference in this text, constitute provisions of this Indian Standard. At the time of publication, the editions indicated were valid. All standards are subject to revisions, and parties to agreements based on this Indian Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
1260 (Part 1) : 1973	Pictorial marking for handling and labelling of goods : Part 1 Dangerous good (*first revision*)
4155 : 1966	Glossary of terms relating to chemical and radiation hazards and hazardous chemicals

3 TERMINOLOGY

For the purpose of this standard, definition of terms given in IS 4155 shall apply.

4 GENERAL PROPERTIES

4.1 General Information

4.1.1 *Common Name* : Ammonia

4.1.2 *Synonyms* : Anhydrous ammonia, Ammonia gas. Liquid ammonia

4.1.3 *Chemical Name* : Ammonia

4.1.4 *Chemical Formula* : NH_3

4.1.5 *Molecular Mass* : 17.03

4.1.6 *U N Number* : 1005

4.1.7 *CAS No* : 7664-41-7

4.2 Physical Properties

4.2.1 *Physical State* : liquefied Compressed Gas

4.2.2 *Boiling Point* : (-) 33.35°C

4.2.3 *Colour* : Colourless

4.2.4 *Odour* : Pungent

4.2.5 *Melting Point* : (-)77.7°C

4.2.6 *Vapour Density* : 0.597 (at 0°C and 1 atm) (air=1)

4.2.7 *Specific Gravity* : 0.682 [at(-)33.3°C] (water = 1)

4.2.8 *Auto Ignition Temperature* : 651°C

4.2.9 *Minimum Ignition Energy* : 100 mJ

4.3 Chemical Properties

4.3.1 *Corrosivity* : Corrosive to copper, copper alloys and galvanized surfaces

4.3.2 *Light Sensitivity* : No

4.3.3 At 450-500°C it begins to decompose to form nitrogen and hydrogen.

5 HAZARDS ASSOCIATED WITH AMMONIA

5.1 Health Hazards

5.1.1 *General*

Anhydrous ammonia is a strongly irritant chemical for the skin, eyes and respiratory tract. The liquid produces severe burns. The gas has a characteristic sharp penetrating odour. In sufficient concentrations, it produces painful irritation. Because of the unpleasant odour and prompt irritation, it is unlikely that anyone would voluntarily remain in an atmosphere seriously contaminated with ammonia. However, serious injury may result if escape is not possible.

5.1.2 *Acute Toxicity*

5.1.2.1 *Systemic effects*

Ammonia is not a systemic poison.

5.1.2.2 *Local effects*

Inhalation of high concentrations produces violent coughing due to its local action on the respiratory tract. If rapid escape is not possible, severe lung irritation, pulmonary edema and death can result. Lower concentrations cause eye irritation, pulmonary edema and bronchitis. Table 1 shows effects of various concentrations of gas in air. Swallowing of the liquid results in severe corrosive action on the mouth, throat and stomach. Exposure to high gas concentrations may cause temporary blindness and severe eye damage. Direct contact of the eyes with liquid anhydrous ammonia will produce serious eye burns.

Table 1 Effects of Various Concentrations of Ammonia in Air

(*Clause* 5.1.2.2)

Vapour Concentration (ppm)	General Effect	Exposure Period
(1)	(2)	(3)
1-5	Odour detectable by most person	Prolonged repeated exposure produces no injury
25	No adverse effect for average worker	Maximum allowable concentration for 8 hour working exposure
35	No adverse effect for erage worker	Exposure should not be longer than 15 minutes and should not occur more than four times per day
400 to 700	Nose and throat irritation Eye irritation with tearing	Infrequent short (1/2 hour) exposure ordinarily produces no serious effect
2 000 to 3 000	Conculsive coughing Severe eye irritation	No permissible exposure. May be fatal after short exposure
5 000 to 10 000	Respirator spasm. Rapid asphyxia	No permissible exposure. Rapidly fatal

Liquid anhydrous ammonia produces skin burn on contact.

5.1.3 *Chronic Toxicity*

Chronic irritation to the eyes, nose and upper respiratory tract may result from repeated exposure to the vapours. A threshold limit value of 25 ppm in air has been set as the maximum safe concentration for daily 8 hour exposure.

5.2 Fire and Explosion Hazards

Ammonia is capable of forming flammable mixtures with air within certain limits (16 to 25 percent by volume). The presence of oil, or a mixture of ammonia with other combustible materials, will increase the fire hazard. The explosive range of ammonia is broadened by admixture of oxygen replacing air, and by temperature and pressure higher than atmospheric pressure. Contact of ammonia with certain other chemicals, including mercury, chlorine, iodine, bromine, calcium, silver oxide, and hypochlorite, may form explosive compounds. Mercury instruments employed in anhydrous ammonia service should never be connected in such a manner as to permit contact of the mercury with liquid or gaseous anhydrous ammonia.

6 HANDLING AND STORAGE

6.1 Handling of Cylinder

6.1.1 Before filling the cylinder with ammonia check and confirm for its validity. It shall have valid test certificate from the competent authorities.

6.1.2 Cylinders should never be subjected to rough handling or to abnormal mechanical shock, such as dropping and bumping.

6.1.3 Do not use rope slings for unloading. When handling by crane or derrick, a suitable platform, cradle or boat should be used. Do not use hooks, tongs or similar fastening devices.

6.1.4 Do not use electric magnets for unloading or handling.

6.1.5 Avoid dragging or sliding cylinders. It is safer to move the bottle type cylinders even short distances by using a suitable truck rather than by tilting or rolling them on their bottom edges.

6.1.6 Use a rack or chain to hold cylinders in place when hooked up for discharging.

6.1.7 Do not place or handle cylinders where they might form part of an electrical circuit. Contact with third rails or trolley wires shall be avoided.

6.1.8 Do not remove valve protection until ready to withdraw ammonia from the cylinder.

6.1.9 Do not temper with numbers, markings, or test dates stamped on cylinders.

6.1.10 Cylinders for ammonia or any other compressed gas, whether full or empty, should never be used as rollers for moving heavy or bulky articles.

6.2 Emptying of Cylinders

6.2.1 The tube type cylinder is normally used in the horizontal position. Two general types of valves are supplied. Depending on which type is involved, either the valve outlet or the valve stem is at an angle with the longitudinal axis of the cylinder. It is the position of this valve outlet or stem which determines whether liquid or gaseous ammonia will be discharged from the cylinder.

When the valve outlet or stem is on top, the dip-pipe on the inside of the cylinder is under the liquid, and therefore, liquid anhydrous ammonia will be discharged. To discharge gaseous ammonia, the cylinder is turned so that the valve outlet or stem points

downward. Follow instructions of ammonia manufacturer concerned.

6.2.2 The bottle type or vertical cylinder will discharge ammonia as a gas when placed in an upright or vertical position. Due to liquid ammonia expansion, a bottle type cylinder may, under certain elevated temperature conditions, discharge a small amount of liquid when the valve is opened, and it is recommended that bottle type cylinders be allowed to reach room temperature before the valve is opened. To discharge liquid anhydrous ammonia, this type of cylinder shall be placed in horizontal position with the valve outlet pointed up.

6.2.3 The rate at which gaseous ammonia may be discharged from either type cylinder depends upon the temperature of the surrounding atmosphere and the surface area of the liquid ammonia.

6.2.4 When the cylinder is empty, disconnect it, insert the valve plug and replace the cylinder protective cap.

6.2.5 If a bottle type cylinder has frozen during discharge, never use a pry under the valve end to loosen the cylinder. Use water to loosen the cylinder or wait for it to thaw out.

6.2.6 Store empty cylinders separate from filled cylinders and fasten an EMPTY tag on cylinders immediately upon emptying. Close valve, replace plug or nut on valve outlet, and secure valve protecting cap snugly.

6.3 Unloading of Tank

6.3.1 Unloading operations should be conducted by carefully instructed, reliable employees under adequate supervision. They should be provided with proper personal protective equipment.

6.3.2 See that train or engine crew accurately spots the car at the unloading line. The unloading track should be level.

6.3.3 Only licensed tanks/ tankers are to be used for transporting ammonia.

6.3.4 All tanks/tankers should have excess flow check value as per the current rule in force.

6.3.5 Brakes shall be set and wheels blocked on all cars being unloaded. It is considered good practice that derails be placed at one or both ends of the unloading track approximately one car length from the car being unloaded, unless the car is protected by a closed and locked switch or gate.

6.3.6 Metal caution signs shall be so placed on the track or car as to give necessary warning to persons approaching car from open end or ends of siding. These signs shall not be removed until the car has been unloaded and all fittings disconnected. Signs should prominently display the words: 'STOP - TANK CAR CONNECTED'.

6.3.7 Anhydrous ammonia is unloaded by creating a pressure differential between the tank car and the storage tank. This may be accomplished by means of a compressor, with the suction side connected to the top of the storage tank and the discharge side to the gas line on the tank car. Unloading compressor should provide discharge pressure high alarm trip and safety valve in its discharge line.

6.3.8 The connection between the liquid line on the tank car and the unloading line to the storage tank should have a remote operated isolation valve, an excess How check valve and can be made by an anhydrous ammonia hose equipped with high pressure screw couplings. This will take care of any accidental leak as well as provide flexibility in spotting the car.

6.3.9 Bleed off pressure on flexible lines or connections at car through vent valve before disconnecting hose or transfer lines.

6.3.10 There should be provisions for high level alarm in storage tank set to operate at a level which gives time for effective action and also for two independent level indicating devices one of which can be a float-and-tape type or a float guided on a stainless steel tube containing a magnetic follower.

6.4 Return of Tank Cars

As soon as the tank cars are completely unloaded all valves shall be made tight, the unloading connections removed, and all other closures made tight. Before releasing empty tank cars, the dome cover should be closed tightly.

6.5 Indoor Storage

6.5.1 If anhydrous ammonia shall be stored inside; store in a fire resistant structure, away from steam pipes and heating devices. Storage should be dry and cool. Avoid mechanical damage or overheating of storage tanks and cylinders.

6.5.2 Suitable safety device like pressure control relieving system must be there to avoid excess pressurization. Safety valve on ammonia storage tanks are to be designed for fire conditions.

6.5.3 Ventilation should be provided through the structure in such a manner that full advantage of natural ventilation may be obtained. If natural ventilation is not sufficient, then storage area should be equipped with suitable type of mechanical ventilation.

CAUTION: Avoid pocketing of ammonia gas under floors, roofs, and similar structures.

6.5.4 The vents from the storage tanks, relief valve must lead to a safe location to avoid any unwanted ammonia contamination in the working area.

6.5.5 Locations used for inside storage of anhydrous ammonia shall be cut off from other occupancies and the building to be protected with automatic sprinklers, vapour tight electrical equipment, good natural ventilation, good floor drainage and adequate exposition venting.

6.5.6 There should be provision of diagonally opposite emergency exits of each corner of the building and emergency push button at each exit which should sound alarm as part of warning system. Source of water should be available in vicinity for dealing with small spill and leaks. Fire hydrants should be located within 25 m of storage.

6.6 Outdoor Storage

6.6.1 Outside storage tanks may be located at least 15 m away from buildings or adjacent to blank masonry building walls. The location should be away from any flammable liquid storage. Dyke of adequate size should be constructed around the storage tank

6.7 Bulk Storage (Non-Refrigerated)

6.7.1 Anhydrous ammonia vappurizes at atmospheric temperature and pressure and for that reason shall be stored in gas-tight containers under pressure. Storage tank if kept outside should have arrangement for protection from sun.

6.7.2 In case of multiple storage facilities, a plan should be prepared for readily and definitely approaching all shut-off valves and valves used for isolating various parts of the storage facilities. This is imperative, otherwise a serious leak under certain weather conditions may blanket out completely the storage area and make approach impossible. Approach routes to these valves should be demarcated prominently.

6.7.3 Each storage area should be protected by at least one standard fire hydrant so located that a suitable hose stream may be brought to bear upon the storage for extinguishing a fire, or for the cooling effect in case of adjacent fires. This problem should be discussed beforehand with the fire department that would respond, so that a minimum delay will ensure in case fire exposes the storage. Isolated storage areas are recommended, in so far as may be practical, with respect to adjacent buildings and consistent with adequate safety. Adequate supply of fire extinguishers of the CO_2 or BCF vapour type should be made at strategic points.

6.7.4 Fn laying out new storage facilities or studying existing storage, consult suppliers of ammonia and of equipment and comply with all local, state or other regulations which apply.

6.7.5 Storage tank should be designed for a minimum of 15.5 bar absolute and maximum temperature of -10°C (preferably - 33°C). Each storage tank shall be equipped with relief valve(s). Two relief valves may be mounted on a 3 way hand valve to provide means for repair of faulty valve while protecting the tank. Inlet to relief valve should be designed or protected so that internal fittings such as level floats do not block it, which may get accidentally detached. Vent pipes from the valves should terminate upward. Suitable provision should be made to prevent water, ice, or snow from entering the vents. A drain should also be provided at the bottom of vent pipe. They should be so arranged that in case of a release through the safety devices, the escaping ammonia will not enter working areas, collect under roofs, contact sources of ignition, or endanger workmen.

6.7.6 If gauge glasses are used, they should be provided with excess flow check valves. The gauge glasses should not be longer than 120 cm and not more than 60 cm between supports. If gauge glasses are less than 25 mm, excess flow check valves may not be necessary. The gauge glasses should be protected by suitable guards to prevent breaking on external impact.

6.7.7 Arrangement for personnel water drench facilities should be made to provide immediate access to affected personnel.

7 LABELLING

7.1 Tankers or large consignments or smaller containers shall carry an identifying label or stencil depicting the symbol given in Fig. 2 of IS 1260 (Part 1) and the following information shall also be given in the lower half of the label.

AMMONIA, ANHYDROUS

WARNING ! Hazardous liquid and gas under pressure

Liquid Causes Burns
Gas Extremely Irritating

Do not breathe gas.

Do not get in eyes, on skin, on clothing.

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. Call a physician at once in case of burns, especially to the eyes, nose and throat, or if the patient is unconscious.

Keep cylinders away from heat and sun. Do not store with flammable or explosive materials.

Never drop cylinders.

Be sure connections are tight. Use no oil or lubricants on valves.

Never refill cylinders.

Keep the cylinders up-right (vertical) with its valve at the top and secure it properly.

8 PREVENTIVE MEASURES

8.1 Employee Education and Training

8.1.1 Safety in handling ammonia depends, to a great extent, upon the effectiveness of employee education, proper safety instructions, intelligent supervision and the use of safe equipment.

8.1.2 The education and training of employees to work safely and to use the personal protective equipment or other safeguards provided for them is the responsibility of supervision. Workers should be thoroughly informed of the hazards that may result from improper handling of ammonia. Each employees should be fully informed as to what to do in an emergency.

8.1.3 Employee education and training should include the following:

a) Instruction and periodic drill or quiz regarding the locations, purpose and use of respiratory protective devices and other personal protective equipment and action to be taken during emergency.

b) Instruction and periodic drill or quiz regarding the locations of safety showers, eye baths, bubbler drenching fountains, or the closest source of water for use in emergencies.

c) Instructions to avoid all unnecessary inhalation of vapours of ammonia and all direct contact with the liquid.

d) Instruction and periodic drill or quiz regarding the location, purpose and the use of emergency fire fighting equipment. Instruction to strictly prohibit smoking in storage area.

e) Instructions to report to the proper authority all equipment failures and any unusual odour of ammonia.

8.2 Personal Hygiene

8.2.1 Emergency showers and eye baths should be placed at convenient locations wherever anhydrous ammonia is used in quantity. Every employee should understand that direct contact with the chemical requires the instant application of large amounts of water to the affected area. These safety showers should be tested periodically for their proper functioning.

8.2.2 Skin, eye and respiratory protective equipment will often be necessary.

8.3. Physical Examinations

8.3.1 *Preplacement Examinations*

Most employees may be assigned to processes in which the use of anhydrous ammonia is carefully controlled. Under some circumstances the physician carrying out preplacement examinations may wish to exclude from exposure people with the following disabilities:

a) Those with only one functioning eye;

b) Those with severe faulty vision; and

c) Those with chronic diseases of the nose, throat or lung.

8.3.2 *Periodic Health Examination*

Usually periodic health examinations will not be conducted solely by reason of the employee exposure to ammonia.

8.4 Personal Protective Equipment

8.4.1 *Availability and Use*

While personal protective equipment is not an adequate substitute for good, safe working conditions, adequate ventilation, and intelligent conduct on the part of employees working with ammonia, it is, in many instances, the only practical means of protecting the worker, particularly in emergency situations. One should keep firmly in mind that personal protective equipment protects only the worker wearing it, and other unprotected workers in the area may be exposed to danger.

8.4.1.1 The correct usage of personal protective equipment requires the education of the workers in proper employment of the equipment available to him. Under conditions which are sufficiently hazardous to require personal protective equipment, its use should be supervised and the type of protective equipment selected should be capable of control over any potential hazards.

8.4.2 *Eye Protection*

Gas-tight chemical goggles or full face mask should be worn when handling ammonia where leaks or spills may occur. Water wash or water sprays should be available in areas where ammonia leaks, spills or splashes may be encountered.

8.4.3 *Respiratory Protection*

Severe exposure to ammonia may occur in tanks during equipment cleaning and repairs, when decontaminating areas following spills, or in case of failure of piping or equipment. Employees who may be subject to such exposures should be provide with proper respiratory protection and trained in its use and care. Available types are described below.

NOTE — Respiratory protective equipment shall be carefully maintained, inspected, cleaned and sterilized at regular intervals, and always before and after use by another person.

8.4.3.1 *Self-contained breathing apparatus*

It permits the wearer to carry a supply of oxygen or air compressed in the cylinder (the self-generating

type produces oxyge.n chemically) and allows considerable mobility. The length of time a self-contained breathing apparatus provides protection varies according to the amount of air, oxygen or regenerating material carried.

Compressed oxygen should not be used where there is danger of contact with flammable liquids or vapours, especially in confined spaces such as tanks or pits. A special type of self-contained breathing apparatus may be used which is provided with a small cylinder of compressed air for escape but is supplied with air through an air line for normal work purposes.

8.4.3.2 *Positive pressure hose masks*

These are supplied by blowers and require no internal lubrication. The wearer shall be able to use the same route for exit as for entrance and shall take precautions to keep the hose line free of entanglement. The air blower shall be placed in an area free of contaminants.

8.4.3.3 *Air-line masks*

These are supplied with clean compressed air, are suitable for use only where conditions will permit safe escape in case of failure of the compressed air supply. These masks are usually supplied with air piped to the area from a compressor. It is extremely important that the air supply is taken from a safe source, and that is not contaminated by oil decomposition from inadequate cooling at the compressor. The safer method is to use a separate compressor of the type not requiring internal lubrication. Pressure reducing and relief valves as well as suitable traps and filters, shall be installed at all mask stations.

8.4.3.4 *Chemical cartridge respirators*

These may be used to avoid inhaling disagreeable but relatively harmless concentrations of ammonia vapour. These respirators, however, are not recommended for protection where toxic quantities of ammonia may be encountered. While using cartridge care must be taken to check the oxygen content in the area. It should be more than 16.5 percent (*v/v*) and chemical cartridges whose life is over, must not be available for use

CAUTION : **Filter type respirators do not offer protection against gases and are unsuitable for use when working with ammonia.**

8.4.4 *Head Protection*

Where there is no danger from falling objects, safety or 'hard* hats are considered unnecessary, soft brimmed hat or caps should be worn to give protection against liquid leaks and splashes.

8.4.5 *Foot Protection*

Rubber boots or safety-toed rubber booties should be used as required. Rubber boots should be thoroughly cleaned and ventilated after contamination.

8.4.6 *Body, Skin and Hand Protection*

Rubber or other protective gloves should be worn where any danger of contact with ammonia may occur. Impermeable wears may also be used.

8.4.6.1 For the protection of the skin, cotton shirt, trousers and underwear should be worn (cotton resists alkalis better than wool).

8.4.6.2 In case of emergency, a rubber apron or rubber coat may provide sufficient protection, but in areas of high ammonia concentration a complete gas suit should be worn.

8.4.6.3 For optimum protection of the body, the collar should be kept buttoned, glove (gauntlets) should be tucked inside of sleeves, and trouser legs should be left outside of boots.

It is also suggested to have a valcro type tight fitting strap to have the legs and arm areas tight enough to avoid ammonia gas entry into the protective suit.

8.4.6.4 In area of high ammonia concentration, ammonia may be absorbed by perspiration on the body even though appropriate protective clothing is worn. Severe discomfort may be minimized or prevented by the application of protective oil to such body areas in addition to the wearing of protective clothing.

8.5 Spills and Leaks

8.5.1 Leaks of ammonia should be searched for, preferably with hydrochloric acid solution or with either chlorine gas or sulphur dioxide gas using a small cylinder of the compressed gas. A white cloud is produced in the presence of ammonia. Because of the fire risk, sulphur candles should not be used.

8.5.2 If leaks or spills occur, only properly protected personnel should remain in the area. In cases where leaks cannot be valved off, use large volumes of water sprayed directly on the leak and maintain contact until the contents have been discharged and the tank is empty. Leaking cylinders should be removed to the outdoors or to an isolated, well-ventilated area and the contents transferred to other suitable containers. All spills should be flushed away promptly with water.

8.5.3 In handling or operating any type of ammonia system, always be sure that all valve connections and pipe lines are in proper order and condition before starting the operation. Keep compressors and motors clean and in good condition.

8.5.4 During cold weather keep all steam traps warm, whether or not tanks are in service.

8.5.5 Never, under any circumstances, close all valves on a full line of liquid ammonia unless protected by pressure relief or liquid expansion device.

9 FIRST-AID

9.1 *General Principles*

After severe exposure to ammonia gas, it is important to move the patient from the contaminated area promptly. In case of contact of the liquid with the eyes or skin, immediate flushing with large quantities of running water is imperative. In all cases of serious injury, call a physician at once giving him a complete account of the accident.

9.2 Contact with Skin and Mucous Membranes

Speed in removing ammonia from contact with the patient and in moving the patient to an uncontaminated atmosphere is of primary importance.

If skin contact is extensive and emergency showers available, the employee should get under the shower immediately. Contaminated clothing and shoes should be removed under the shower. In other instances Hushing with large amounts of running water should be continued for at least 15 minutes.

9.2.1 Under no condition should salves or ointments be applied to the skin or mucous membrane burns during the 24-hour period following the injury. Subsequent medical treatment is otherwise the same as for thermal burns.

9.3 *Contact with the Eyes*

If even small quantities of ammonia enter the eyes, they should be irrigated immediately and copiously with water for a minimum of 15 minutes. The eyelids should be held apart during the irrigation to ensure the contact of water with the tissues of the eye surface and lids. A physician should be called at the earlier possible moment. After the first 15 minutes period of irrigation, if a physician is not available, the irrigation should continue for a second period of 15 minutes. It is then permissible as a first-aid measure to instill 2 or 3 drops of 0.5 percent pontocaine solution or an equally effective aqueous topical anesthetic. No oils or oily ointment should be instilled unless ordered by a physician. The employee should be sent to a physician, preferably an eye specialist, as soon as possible.

9.4 *Ingestion*

If liquid anhydrous ammonia has been swallowed, call a physician immediately. If the patient is conscious and able, he should drink large amounts of water to dilute the chemical. Do not induce vomiting if the patient is in shock extreme pain or is unconscious. If vomiting begins, place the patient face down with head lower than hips, this prevents vomitus from entering the lungs and causing further injury.

9.5 *Inhalation*

Exposed persons should be removed at once to an uncontaminated area. If the exposure has been to minor concentrations for a limited time, usually no treatment will be required.

9.5.1 When there is severe exposure to higher concentrations, and if oxygen apparatus is available, oxygen may be administered but only by a person authorized for such duty by a physician. If the patient is not breathing, an effective means of artificial respiration should be initiated immediately. Call a physician.

9.5.2 The patient should be kept comfortably warm but not too hot and should be kept at rest.

9.5.3 Never attempt to give anything by mouth to an unconscious patient.

10 CLEANING AND REPAIRS

10.1 Preparation of Tanks and Equipment

10.1.1 Tank and equipment cleaning and repairing should be done under the direction of thoroughly trained personnel who are fully familiar with all of the hazards and the safeguards necessary for the safe performance of the work.

10.1.2 In addition to the precautions generally recommended for tank work, such as procurement of written approval of supervision, testing for oxygen content, use of rescue harness or life belt and life line, provision of grounded equipment in good condition for portable lights and power tools and stationing of thoroughly trained 'watchers' outside and tank entrance, additional precautions are recommended as follows:

a) Make sure that all pressure has been relieved from tank. Use of compressor is frequently made to remove bulk of gas remaining after the liquid has been removed.

b) Pressurize and depressurize the tank with air till ammonia content inside the tank becomes nil. After stopping the compressor, slowly vent the tank. Make sure that any gas escaping does not enter working area or expose other person.

c) Fill tank completely with water and drain out. Repeat if any ammonia gas remains.

d) Keep adequate vents in open condition to avoid vacuum formation during filling the tank with water.

e) If oil is found in the tank and requires to be removed, it should be done by steaming and draining and not by the use of solvents.

f) Provide adequate fresh air supply.

g) Use proper personal protective equipment.

h) Flush all lines completely with water until no ammonia remains.

j) Blank off lines; do not depend on shut-off valves.

10.2 Entering Tank

10.2.1 No one should enter a tank or confined space until a work permit has been signed by an authorized person, indicating that the area has been tested and found to be safe. Furthermore, no workman should enter a tank or vessel that does not have a manhole opening large enough to admit a person wearing his safety harness, life line and emergency respiratory equipment. It should be ascertained that the tank or vessel can be left through the original entrance.

10.2.2 One man on the outside of the tank should keep the men in the tank under observation and another man should be available nearby to aid in rescue if any of the men in the tank are overcome.

10.2.3 A supplied-air respirator or self-contained breathing apparatus, together with rescue harness and life line should always be located outside the tank entrance for rescue purposes, regardless of the type of respiratory equipment or air supply which is provided for employees inside the tank.

10.2.4 If a tank cleaner or repairman is overcome, he should be removed to fresh air immediately, artificial respiration should be applied if breathing has stopped, and a physician summoned at once.

10.3 Repair Work

10.3.1 No welding and cutting of any type should be conducted on tanks or lines until they are completely free of ammonia and certified by competent person as well as safety work permit issued.

10.3.2 Before refilling the tank with anhydrous ammonia, the tank should be thoroughly dry and vented to safe location.

11 WASTE DISPOSAL

11.1 Waste disposal of ammonia and materials containing ammonia depends to a great extent upon local conditions. Be sure that all central, state, and local regulations regarding health and pollution are followed.

11.2 If not prohibited, waste may be disposed of by diluting with large quantities of water and washing into sewers.

ANNEX A

(Foreword)

COMMITTEE COMPOSITION

Chemical Hazards Sectional Committee, CHD 7

Chairman	*Representing*
DR K.V. RAGHAVAN	Indian Institute of Chemical Technology, Hyderabad
Members	
DR B. N. RATHI	Bhabha Atomic Research Centre, Mumbai
DR B.V. BAPAT SHRI M. B. SURVE *(Alternate)*	National Organic Chemical Industries Limited, Mumbai
DR A. BHASKAR SHRI A. JHAVAR (*Alternate)*	Hindustan Lever Limited, Mumbai
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SHRI V. H. CHUDAMANI SHRI A. G. SESHAN *(Alternate)*	Hindustan Organic Chemicals Limited, Rasayani
SHRI S. S. GAUTAM DR BRU MOHAN *(Alternate)*	Directorate General of Factory Advice Service & Labour Institute, Mumbai
SHRI P. K. GHOSH	Atomic Energy Regulatory Board, Mumbai
SHRI Y. R. JAISHIMA SHRI R. VENUGOPAL *(Alternate)*	Ministry of Defence (DGOF), Calcutta
SHRI P. M. KARIA SHRI MOHAN PATIL *(Alternate)*	Excel Industries Limited, Mumbai
SHRI R. P. KHANNA SHRI K. N. PATH *(Alternate)*	Ministry of Defence (DGQA), New Delhi
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SHRI A. K. MEHRA	SIEL Chemical Complex, Punjab
DR H. MUKHERJEE	Department of Explosives, Nagpur
DR D. J. PARIKH DR T. S. PATEL *(Alternate)*	National Institute of Occupational Health, Ahemdabad
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SHRIMATI MANJU VERMA	Central Warehousing Corporation, New Delhi
SHRIMATI SUNITA	Development Commissioner, Small Scale Industries, New Delhi
SHRI V. N. DAS	Indian Chemical Manufacturers' Association, Calcutta
DR P. N. RAO SHRI B.B. PATIL *(Alternate)*	National Safety Council, Mumbai
REPRESENTATIVE	Oil Industries Safety Directorate, Mumbai
SHRI J. N. SHARMA	Indian Petrochemical Corporation Limited, Vadodara
SHRI K. R. SHARMA	Indian Drugs and Pharmaceuticals Limited, Virbhadra
DR M. SENGUPTA DR (SHRIMATI) INDRANI CHANDRA SEKARAN *(Alternate)*	Ministry of Environment & Forests, New Delhi
SHRI M. P. SINGH SHRI N.C. TEWARI *(Alternate)*	Department of Industrial Policy and Promotion, New Delhi
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SHRI LAJINDER SINGH, Director (Chem)	Directorate General, BIS *(Ex-officio Member)*

Member-Secretary
SHRI N. K. PAL
Addl Director (Chem), BIS

Toxic/Carcinogenic Substances Subcommittee, CHD 7:1

Convener

SHRI A. K. MEHRA	Shriram Food & Fertilizers Industries, New Delhi

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