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COLORADO DEPARTMENT OF AGRICULTURE

Inspection and Consumer Services Division

Storage and Handling of Anhydrous Ammonia

8 CCR 1202-5

Pursuant to the authority conferred in the Commissioner of Agriculture by the Anhydrous Ammonia Act, Title 35, Article 13, C.R.S. 1973, as amended, the following standards, rules and regulations are hereby adopted, effective on and after May 13, 1968. These regulations were updated and revised through an administrative hearing held on August 20, 1973. The regulations were officially adopted on September 14, 1973.

1. Standards provided for in ANSI Standard K61.1-1972, as revised from ANSI Standard K61.1-1966 and as recommended and published by the American National Standards Institute, Inc. setting forth minimum general safety standards covering the design, construction, location, installation, and operation of equipment for storage, handling, transportation by tank truck or tank trailer, and utilization of anhydrous ammonia fertilizer. These standards shall be supplemented by rules and regulations contained herein.

2. The authority having jurisdiction as used in these regulations shall mean the Colorado Commissioner of Agriculture.

3. The Commissioner shall have the power to grant exemption from application of these rules on request in writing, doing so when such request shows that compliance with the rules could cause unnecessary hardship to the petitioner, provided that such requests shall not be granted where the requested use would constitute a distinct hazard to life or adjoining property.

4. Nothing in these regulations shall prevent the continued operation of anhydrous ammonia facilities in existence prior to May 13, 1968 unless it shall be determined that such continued operation without modification could result in a distinct hazard to life or adjoining property.

1. INTRODUCTION

1.1 Scope

1.1.1 This standard is intended to apply to the design, construction, location, installation, and operation of anhydrous ammonia systems including refrigerated ammonia storage systems.

1.1.2 This standard does not apply to:

(a) Ammonia, manufacturing plants.

(b) Refrigeration plants where ammonia is used solely as a refrigerant. Such systems are covered in American National Standard Safety Code for Mechanical Refrigeration, B-9,I.[†] The provisions of ANSI B-9.1 are not appropriate to refrigerated ammonia storage systems as covered in this standard.

(c) Ammonia transportation pipelines.

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†See Appendix C for availability.

1.2 General

1.2.1 Where the provisions of these standards impose undue hardship or where the literal adherence to the provision fails to provide adequate safety in the opinion of the authority having jurisdiction, the authority having jurisdiction may permit deviation from the standards.

1.2.2 The term "anhydrous ammonia" as used in this standard refers to the compound, formed by a COMBINATION ~~comh nation~~ of two gaseous elements, nitrogen and hydrogen, in the proportion of one part nitrogen to three parts hydrogen by volume. Anhydrous ammonia may be in either gaseous or liquid form. It is not to be confused with aqua ammonia which is a solution of ammonia gas in water. Whenever the term "ammonia" appears in this standard, it is understood to mean anhydrous ammonia.

1.2.3 It is important that personnel understand the properties of this gas and that they be thoroughly trained in safe practices for its storage and handling. Some of the important physical properties of ammonia are listed in 1.2.5.

1.2.4 Gaseous ammonia liquefies under pressure at ambient temperature. Advantage of this characteristic is taken by industry and for convenience this commodity is usually shipped and stored under pressure as a liquid. When refrigerated to or below its normal boiling point (-28º F) it may be shipped and stored as a liquid at atmospheric pressure.

1.2.5 Physical Properties of Ammonia:

Molecular symbol	NH4
Molecular weight	17.082
Boiling point at one atmosphere*	-28º F
Melting point at one atmosphere	-107.9º F
Critical temperature	271.4º F
Critical pressure	1657 psia.
Latent heat at -28º F and one atmosphere	589.3 Btu per pound
Relative density of vapor compared to dry air at 32º F and one atmosphere	0.5970
Vapor density at -28º F and one atmosphere	0.05555 lb. per CU ~~ca~~. ft
Specific gravity of liquid at -28º F compared to water at 39.2º F	0.6819
Liquid density at -28º F and one atmosphere	42.57 1b. per CU ~~co~~, ft
Specific volume of vapor at 32º F and one atmosphere	20.78 CU ~~ca~~. ft per pound
Flammable limits by volume in air at atmospheric pressure	16% to 25%
Ignition Temperature (in a standard quartz container)	1562 F
Specific Heat, Gas, 15º C, one atm at constant pressure, C_p	0.5232 Btu/LB. ºF ~~Db. degree F.~~
at constant volume, C_v	0.3995 Btu/lb. º ~~degree~~ F

*One atmosphere = 14.7 psis.

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1.2.6 Experience has shown that ammonia is extremely hard to ignite and under normal conditions is a very stable compound. It takes temperatures of 840-980° F to cause it to dissociate slightly at atmospheric pressure. The flammable limits at atmospheric pressure are 16% to 25% by volume of ammonia in air. Experiments conducted by a nationally recognized laboratory indicated that an ammonia-air mixture in a standard quartz test container does not ignite below 1562° F. Ammonia is classified by the United States Department of Transportation and the United States Coast Guard as a non-flammable compressed gas for the purpose of transportation.

1.2.7 Ammonia should be handled only by properly trained personnel. In no case shall ammonia be used in conjunction with chemicals unless the possible reactions have first been adequately investigated. Under some circumstances ammonia and ammonium compounds can form explosive products with other chemicals. For additional information refer to NFPA 491M "Manual on Hazardous Chemical Reactions"* and CG-388, the "Chemical Data Guide for Bulk Shipment by Water" (1969 Edition).

*See Appendix C for availability.

1.2.8 Ammonia gas irritates the skin and mucous membrane. At 50 ppm its odor is detectable by most people. The maximum allowable concentration for an 8 hour working exposure is specified as 50 ppm by the American Conference of Government Industrial Hygienists. Because it serves as its own warning agent, no person will voluntarily remain in concentrations which are hazardous. At 5000 ppm it is rapidly fatal. Since ammonia gas is lighter than air, adequate ventilation is the best means of preventing any accumulation.

1.2.9 The common metals are not attacked by dry ammonia. Zinc, copper and copper base alloys such as brass are subject to rapid destructive action by ammonia in the presence of water.

1.3 Definitions

For the purposes of this standard the terms listed below shall be construed to have the meanings indicated.

1.3.1 "Approved" as used in these standards means:

(a) Listed by a recognized testing laboratory, or

(b) Recommended by the manufacturer as suitable for use with anhydrous ammonia and so marked, or

(c) Accepted by the authority having jurisdiction.

1.3.2 **"APPURTENANCE"** ~~**"Appurutenance"**~~ refers to all devices such as safety relief devices, liquid level **GAUGING** ~~gaging~~ devices, valves, pressure **GAUGES** ~~**gages**~~, fittings, metering or dispensing devices.

1.3.3 "Capacity" refers to the total volume of the container measured in U.S. gallons, unless otherwise specified.

1.3.4 "Cylinder" means a container of 1000 pounds water capacity or less constructed in accordance with United States Department of Transportation Specifications.

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1.3.5 The "Code" refers to the Unfired Pressure Vessel Code of the American Society of Mechanical Engineers (Section VIII of the ASME Boiler Construction Code), 1952, 1956, 1959, 1962, 1965, 1968 and 1971 editions, the joint code of the American Petroleum Institute and the American Society of Mechanical Engineers (API-ASME Code) 1951 edition, and subsequent amendments to or later editions of the same, as adopted.

1.3.6 "Container" includes all vessels, tanks, cylinders or spheres used for transportation, storage or application of anhydrous ammonia.

1.3.7 "Design Pressure" is identical to the term "Maximum Allowable Working Pressure" used in the Code.

1.3.8 An "Implement of Husbandry" is a farm wagon-type tank vehicle of not over 3000 gallons capacity, used as a field storage "nurse tank" supplying the fertilizer to a field applicator and moved on highways only for bringing the fertilizer from a local source of supply to farms or fields or from one farm or field to another.

1.3.9 "Filling Density" means the per cent ratio of the weight of the gas in a container to the weight of water at 60° F that the container will hold. ~~One lb. H2O = 27.737 cu. in. at 60 F.~~ For determining the water capacity of the tank in pounds, the weight of a gallon (231 cubic inches) of water at 60° F in air shall be 8.32828 pounds.

1.3.10 "Gas" refers to anhydrous ammonia in either the gaseous or liquefied state.

1.3.11 "Gas Mask" refers to gas masks approved by the Bureau of Mines. See American National Standard for Respiratory Protection, Z88.2.*

*See Appendix C for availability.

1.3.12 "DOT Regulations" refer to Hazardous Materials Regulations of the Department of Transportation (Title 49-Transportation, Code of Federal Regulations, Parts 171 to 190), including Specifications for Shipping Containers.

1.3.13 "Systems" as used in these standards refers to an assembly of equipment consisting essentially of the container or CONTAINERS ~~containers~~, appurtenances, pumps, compressors, and interconnecting; piping.

1.3.14 The abbreviations "psig" and "psia" refer to pounds per square inch GAUGE ~~gage~~ and pounds per square inch absolute, respectively.

1.3.15 The terms "charging" and "filling" are used interchangeably and have the same meaning.

1.3.16 "Trailer" as used in these standards refers to every vehicle designed for carrying PERSONS ~~parsons~~ or property and for being drawn by a motor vehicle and so constructed that no part of its weight except the towing device rests upon the towing vehicle.

1.3.17 "Tank Motor Vehicle" means any motor vehicle designed or used for the transportation of anhydrous ammonia in any tank designed to be permanently attached to any motor vehicle or any container not permanently attached to any motor vehicle which by reason of its size, construction or attachment to any motor vehicle must be loaded and/or unloaded without being removed from the motor vehicle.

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1.3.18 "Semi-trailer" refers to every vehicle designed for carrying persons or property and for being drawn by a motor vehicle and so constructed that some part of its weight and that of its load rests upon or is carried by another vehicle.

1.3.19 "Safety Relief Valve" refers to an automatic spring loaded or equivalent type pressure activated device for gas or vapor service characterized by pop action upon opening, sometimes referred to as a pop valve.*

1.3.20 "Hydrostatic Relief Valve" refers to an automatic pressure activated valve for liquid service characterized by throttle or slow weep opening (non-pop action).*

1.4 Use of WATER ~~water~~ in Emergencies

1.4.1 THE ~~the~~ concentration of ammonia vapor in air can effectively be reduced by the use of adequate volumes of water applied through spray or fog nozzles.

1.4.2 Water should be used on liquid ammonia spills only if sufficient water is available. For the purpose of this section, sufficient water may be taken to be 100 parts of water to one part of ammonia.

1.4.3 If an ammonia container is exposed to fire and cannot be removed, water should be used to cool it.

1.4.4 Under some circumstances ammonia in a container is colder than the available water supply. Under these circumstances water should not be sprayed on the container walls since it would heat the ammonia and aggravate any gas leak.

1.4.5 If it is found necessary to dispose of ammonia, as from a leaking container, liquid ammonia should be discharged into a vessel containing water sufficient to absorb it. Sufficient water may be taken to be ten parts of water per part ammonia. The ammonia should be injected into the water as near the bottom of the vessel as practical.

2. BASIC RULES

This Section applies to all sections of this standard unless otherwise noted.

2.1 Approval of Equipment

2.1.1 The appurtenances of each system or the system shall be approved.

2.2 Requirements for New Construction and Original Test of Containers (Including Skid Containers), Other Than Refrigerated Storage Tanks

(See Exception in Paragraph 4.1.3)

2.2.1 Containers used with systems covered in Sections 3, 6, 7 and 8 shall be constructed and tested in accordance with the 1971 edition (and subsequent amendments thereto) of the Unfired Pressure Vessel Code of the ASME except that construction under Table UW 12 at a basic joint efficiency of under 80% is not authorized.

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2.2.1.1 Containers built according to the Code do not have to comply with paragraphs UG 125 through UG 128 inclusive, and paragraphs UG 132 and UG 133.

2.2.2 Containers exceeding 36 inches in diameter or 250 gallons capacity shall be constructed to comply with one or more of the following additional requirements:

2.2.2.1 Containers shall be stress relieved after fabrication in accordance with the Code, or

2.2.2.2 Cold formed heads, when used shall be stress relieved, or

2.2.2.3 Hot formed heads shall be used.

2.2.3 Welding to the shell, head, or any other part of the container subject to internal pressure shall be done in compliance with the Code under which the container was fabricated. Other welding: is permitted only on saddle plates, lugs, or brackets attached to the container by the container manufacturer.

2.2.4 All containers, except refrigerated storage tanks with a design pressure of less than 15 psig and containers constructed in accordance with Specifications of the DOT, shall be inspected by a person having a current certificate of competency from the National Board of Boiler and Pressure Vessel Inspectors.

2.2.5 The provisions of **2.2.1** ~~2.2.1~~ shall not be construed as prohibiting the continued use or reinstallation of containers constructed and maintained in accordance with the 1949, 1950, 1952, 1956, 1959, 1962, 1965 and 1968 editions of the Unfired Pressure Vessel Code of the ASME or any revisions thereof in effect at the time of fabrication.

2.3 Markings on Non-Refrigerated Containers and Systems Other Than DOT Containers

2.3.1 System nameplates, when required, shall be permanently attached to the system so as to be readily accessible for inspection and shall include markings as prescribed in 2.3.2.

2.3.2 Each container or system covered in Sections 3, 6, 7 and 8 shall be marked as specified in the following:

(a) With a marking identifying compliance with the rules of the Code under which the container-is constructed.

(b) With a notation on the container and system nameplate when the system is designed for underground installation.

(c) With the name and address of the supplier of the container or the trade name of the container and with the date of fabrication.

(d) With the water capacity of the container in pounds at 60° F or gallons, U.S. Standard.

(e) With the design pressure in pounds per square inch **GAUGE** ~~gage~~.

(f) With the wall thickness of the shell and heads.

(g) With marking indicating the maximum level to which the container may be filled with liquid anhydrous ammonia at temperatures between 20° F and 100° F except on containers provided with fixed maximum level indicators, such as fixed length dip tubes, or containers that are filled by weight Markings shall be in increments of not more than 20° F.

(h) With the outside surface area in square feet.

(i) With minimum temperature in Fahrenheit for which the container is designed.

(j) Marking specified on container shall be on the container itself or on a nameplate permanently affixed thereto.

2.3.3 All main operating valves on permanently installed containers having a capacity of over three thousand water gallons shall be identified to show whether the valve is in liquid or vapor service. The recommended method of identification may be legend or color code as specified in 2.3.3.1 or 2.3.3.2.

2.3.3.1 Legend: The legend LIQUID (or LIQUID VALVE)-, VAPOR (or VAPOR VALVE), as appropriate, shall be placed on or within twelve inches of the valve by means of a stencil tag, or decal.

2.3.3.2 Color Code: Liquid valves shall be painted orange and vapor valves shall be painted yellow. The legend ORANGE-LIQUID, YELLOW-VAPOR shall be displayed in one or more conspicuous places at each permanent storage location. The legend shall have letters at least two inches high and shall be placed against a contrasting Background. This is in accordance with American National Standard A13.1 "Schemes for Identification of Piping Systems"-1956, Page 5.

2.4 Marking Refrigerated Containers

(See Section 4.3, Marking Refrigerated Containers)

2.5 Location of Containers

2.5.1 Consideration shall be given to the physiological effects of ammonia as well as to adjacent fire hazards in selecting the location for a storage container. Containers shall be located outside of buildings or in buildings or sections thereof especially approved for this purpose.

2.5.2 Containers shall be located at least 50 feet from a dug well or other sources of potable water supply, unless the container is a part of a water treatment installation.

2.5.3 The location of permanent storage containers shall be outside densely populated areas.

2.5.4 Container locations shall comply with the following table:

NORMAL ~~Nominal~~ Capacity of Container (Gallons)	Minimum Distances (feet) from Container to:

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	Line of Adjoining Property Which may be Built Upon, Highways & Mainline of Railroad	Place of Public Assembly	Institution Occupancy
Over 500 to 2,000	25	150	250
Over 2,000 to 30,000	50	300	500
Over 30,000 to 100,000	50	450	750
Over 100,000	50	600	1,000
Location approval required from Department within 30 days from notification.			

2.5.5 Storage areas shall be kept free of readily ignitable materials such as waste, weeds and long dry grass.

2.6 Container Appurtenances

2.6.1 All appurtenances shall be designed for not less than the maximum working pressure of that portion of the system on which they are installed. All appurtenances shall be fabricated from materials proved suitable for anhydrous ammonia service.

2.6.2 All connections to containers except safety relief devices, GAUGING ~~gaging~~ devices, or those fitted with a No. 54 drill size orifice shall have shut-off valves located as close to the container as practicable.

2.6.3 Excess flow valves where required by these standards shall close automatically at the rated flows of vapor or liquid as specified by the manufacturer. The connections and line including valves and fittings being protected by an excess flow valve shall have a greater capacity than the rated flow of the excess flow valve.

2.6.4 Liquid level GAUGING ~~gaging~~ devices that require bleeding of the product to the atmosphere and which are so constructed that outward flow will not exceed that passed by a No. 54 drill size opening need not be equipped with excess flow valves.

2.6.5 Openings from container or through fittings attached directly on container to which pressure gage connections are made need not be equipped with excess flow valves if such openings are not larger than No. 54 drill size.

2.6.6 Excess flow and back pressure check valves where required by these standards shall be located inside of the container or at a point outside as close as practicable to where the line enters the container. In the latter case, installation shall be made in such manner that any undue stress beyond the excess flow or back pressure check valve will not cause breakage between the container and the valve.

2.6.7 Excess flow valves shall be designed with a by-pass, not to exceed a No. 60 drill size opening to allow equalization of pressures.

2.6.8 Shut-off valves provided with an excess flow valve shall be designed for proper installation in a container connection so that the excess flow valve WILL ~~win~~ close should the SHUT ~~shot~~-off valve break.

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2.6.9 All excess flow valves shall be plainly and permanently marked with the name or trade-mark of the manufacturer, the catalog number, and the rated capacity.

2.7 Piping, Tubing and Fittings

2.7.1 ALL ~~An~~ piping, tubing and fittings shall be made of material suitable for anhydrous ammonia service.

2.7.2 All piping, tubing and fittings shall be designed for a pressure not less than the maximum pressure to which they may be subjected in service.

2.7.3 All piping shall be well supported and provision shall be made for EXPANSION ~~expanation~~ and contraction. All refrigeration system piping shall conform to the Refrigeration Piping Code (ANSI B31.5), a Section of the American Standard Code for Pressure Piping, AS ~~at~~ it applies to ammonia.

2.7.4 Piping used on non-refrigerated systems shall be at least ASTM A-53 Grade B Electric Resistance Welded and Electric Flash Welded Pipe or equal. Such pipe shall be at least Schedule 40 when joints are welded, or welded and flanged. Such pipe shall be at least Schedule 80 when joints are threaded. Brass, copper, or galvanized steel pipe or tubing shall not be used.

2.7.5 All metal flexible connections for permanent installations shall have a minimum working pressure of 250 psig (safety factor of 4). For temporary installations, hose meeting the requirement of 2.8 may be used.

2.7.6 Cast iron fittings shall not be used but this shall not prohibit the use of fittings made specifically for ammonia service of malleable or nodular iron such as Specification ASTM A47 or ASTM A395.

2.7.7 Provisions shall be made for expansion, contraction, jarring, vibration, and for settling.

2.7.8 Adequate provisions shall be made to protect ALL ~~all~~ exposed piping from physical damage that might result from moving machinery, the presence of automobiles or trucks, or any other undue strain that may be placed upon the piping.

2.7.9 Joint compounds shall be resistant to ammonia.

2.7.10 After assembly, all piping and tubing shall be tested and proved to be free from leaks at a pressure not less than the normal operating pressure of the system.

2.8 Hose Specification

2.8.1 Hose used in ammonia service and subject to container pressure shall conform to the joint Rubber Manufacturers Association and The Fertilizer Institute “Hose Specifications for Anhydrous Ammonia” (See Appendix B).

2.8.2 Hose subject to container pressure shall be designed for a minimum working pressure of 350 psig and a minimum burst pressure of 1750 psig. Hose assemblies, when made up, shall be capable of withstanding a test pressure of 500 psig.

2.8.3 Hose and hose connections located on the low pressure side of flow control or pressure reducing valves on devices discharging to atmospheric pressure shall be designed for the maximum low

side working pressure. All connections shall be designed, constructed, and installed so that there will be no leakage when connected.

2.8.4 Where liquid transfer hose is not drained of liquid upon completion of transfer operations, such hose shall be equipped with an approved shut-off valve at the discharge end. Provision shall be made to prevent excessive hydrostatic pressure in the hose. (See paragraph 2.9.10).

2.8.5 On all hose one-half inch O.D. and larger, used for the transfer of anhydrous ammonia liquid or vapor, there shall be etched, cast, or impressed at five-foot intervals the following information:

"Anhydrous Ammonia" xxx psig (Maximum working pressure) Manufacturer's Name or Trademark Year of Manufacture

2.9 Safety Relief Devices

2.9.1 Every container used in systems covered by Sections 3, 6, 7 and 8 shall be provided with one or more safety relief valves of the spring-loaded or equivalent type. The discharge from safety relief valves shall be vented away from the container, upward and unobstructed to the atmosphere. All safety relief valve discharge openings shall have suitable raincaps that will allow free discharge of the vapor and prevent the entrance of water. Provision shall be made for draining condensate which may accumulate. The rate of the discharge shall be in accordance with the provisions of Appendix A.

2.9.2 Container safety relief valves shall be set to start-to-discharge as follows, with relations to the design pressure of the container:

Containers	Minimum	Maximum*
ASME-U-68, U-69	110%	125%
ASME-U-200, U-201	95%	100%
ASME 1952, 1956, 1959 1962. 1965, 1968 or 1971	95%	100%
API-ASME	95%	100%
U.S. Coast Guard	[As required by USCG regulations]	
DOT	[As required by DOT regulations]	

2.9.3 Safety relief devices used in systems covered by Sections 3, 6, 7 and 8 shall be constructed to discharge at not less than the rates required in 2.9.1 before the pressure is in excess of 120% (not including the 10% tolerance referred to in 2.9.2) of the maximum permitted start-to-discharge pressure setting of the device.

2.9.4 Safety relief valves shall be so arranged that the possibility of tampering will be minimized. If the pressure setting adjustment is external, the relief valves shall be provided with means for sealing the adjustment.

2.9.5 Shut-off valves shall not be installed between the safety relief valves and the containers or systems described in Sections 3, 6, 7 and 8, except that a shut-off valve may be used where the arrangement of this valve is such as always to afford required capacity flow through the relief valves.

NOTE: The above exception is made to cover such cases as a threeway valve installed under two safety relief valves, each of which has the required rate of discharge and is so installed as to allow either of the safety relief valves to be closed off, but does not allow both safety valves to be

closed off at the same time. Another exception to this may be where two separate relief valves are installed with individual shut-off valves. In this case, the two shut-off valve stems shall be mechanically interconnected in a manner which will allow full required flow of one safety relief valve at all times. Still another exception is a safety relief valve manifold which allows one valve of two, three, four or more to be closed off and the remaining valve or valves will provide not less than the rate of discharge shown on the manifold nameplate.

2.9.6 Safety relief valves shall have direct communication with the vapor space of the container.

2.9.7 Each safety relief valve used with systems described in Sections 3, 4, 6, 7 and 8 shall be plainly and permanently marked as follows:

(a) With the letters “AA” or the symbol “NHS”.

(b) The pressure in pounds per square inch GAUGE ~~gage~~ (psig) at which the valve is set to start-to-discharge,

(c) The rate of discharge of the valve in cubic feet per minute of air at 60º F and atmospheric pressure (14.7 psia).

(d) The manufacturer's name and catalog number.

For example, a safety relief valve marked AA-250-4200 (air) would mean that this valve is suitable for use on an anhydrous ammonia container; that it is set to start-to-discharge at 250 psig; and that its rate of discharge (see Sections 2.9.1, 2.9.2, and 2.9.3) is 4200 cubic feet per minute of air.

2.9.8 The flow capacity of the safety relief valve shall not be restricted by any connection to it on either the upstream or downstream side.

2.9.9 The manufacturer or supplier of a safety relief valve manifold SHALL ~~snail~~ publish complete data showing the flow rating through the combined assembly of the manifold with safety relief valves installed. The manifold flow rating shall be determined by testing the MANIFOLD ~~manifoid~~ with all but one valve discharging. If one or more openings have restrictions not present in the remaining openings, the restricted opening or openings or those having the lowest flow shall be used to establish the flow rate marked on the manifold nameplate. The marking shall be similar to that required in 2.9.7 for individual valves.

2.9.10 A hydrostatic relief valve shall be installed between each pair of valves in the liquid ammonia piping or hose where liquid may be trapped so as to RELEASE ~~relieve~~ into the atmosphere at a safe location.

2.9.11 Discharge from safety relief devices shall not terminate in or beneath any building.

2.10 Safety

See CGA Pamphlet G-2, TFI Operational Safety Manual M-2 and MCA Safety Data Sheet SD-8 (See Appendix C for availability.)

2.10.1 Personnel required to handle ammonia shall be trained in safe operating practices and the proper action to take in the event of emergencies. Personnel shall be instructed to use the equipment listed in 2.10.3 in the event of an emergency.

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2.10.2 If a leak occurs in an ammonia~~,~~ system, the personnel trained for and designated to act in such emergencies shall:

(a) See that persons not required to deal with an emergency are evacuated from the CONTAMINATED ~~contamiuated~~ area.

(b) Put on a suitable gas mask.

(c) Wear gauntlet type plastic or rubber gloves and wear plastic or rubber suits in heavily contaminated atmospheres.

(d) Shut off the appropriate valves.

2.10.3 All storage systems shall have on hand, as a minimum, the following equipment for emergency and rescue purposes:

*(a) One full face gas mask with anhydrous ammonia refill canisters.**

***(b) One pair of protective gloves.

***(c) One pair of protective boots.

***(d) One protective slicker and/or protective pants and jacket.

(e) Easily accessible shower and/or at least 50 gallons of clean water in an open top container.

(f) Tight fitting vented goggles or one full face shield.

2.10.3.1 Where several persons are usually present, additional safety equipment may be desirable.

2.10.4 Each tank motor vehicle transporting anhydrous ammonia, except farm applicator vehicles, shall carry a container of at least five gallons of water and shall be equipped with a full face gas mask, a pair of tight-fitting goggles or one full face shield. The driver shall be instructed in their use and the proper action to take to provide for his safety.

2.10.5 If a leak occurs in transportation equipment and it is not practical to stop the leak, the driver should move the vehicle to an isolated location away from populated communities or heavily traveled highways.

2.10.6 If liquid ammonia contacts the skin or eyes, the affected area should be promptly and thoroughly flushed with water. Do not use neutralizing solutions or ointments on affected areas. A physician shall treat all cases of eye exposure to liquid ammonia.

*An ammonia canister is effective for short periods of time in light concentrations of ammonia vapor, generally 15 minutes in concentrations of 3% and will not protect breathing in HEAVIER ~~hearier~~ concentrations. If ammonia vapors are detected when mask is applied the concentration is too high for safety. The life of a canister in service is controlled by the percentage of vapors to which it is exposed. Canisters must not be opened until ready for use and should be DISCARDED ~~discarrage~~ after use. Unopened canisters may be guaranteed for as long as three years. All should be DATED ~~dared~~ when received because of this limited life. In addition *to* this protection, an independently supplied air mask of the type used by fire departments may be used for severe emergencies.

**This corresponds to 82% by volume at -28º F, 85% by volume at 5º F, 87.5% by volume at 30º F, and 90.6% by volume at 60º F.

***Gloves, boots, slickers, jackets and pants shall be made of rubber or other material impervious to ammonia.

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2.11 Filling Densities

(See Par. 1.3.9 page 8.)

2.11.1 The filling densities for nonrefrigerated containers shall not exceed the following:

	Aboveground	Underground
(1) Uninsulated	56%*	58%
(2) Insulated	57%	

(3) DOT containers shall be filled in accordance with DOT Regulations

2.11.2 The filling density for refrigerated storage tanks shall be such that the tanks will not be liquid full at a liquid temperature corresponding to the vapor pressure at the start-to-discharge pressure setting of the safety relief valve.

2.11.3 If containers are to be filled according to liquid level by any GAUGING ~~gaging~~ method other than a fixed length dip tube GAUGE ~~gage~~, each container should have a thermometer well so that the internal liquid temperature can be easily determined and the amount of liquid and vapor in the container corrected to a 60° F basis.

2.12 Transfer of Liquids

2.12.1 Anhydrous ammonia shall always be at a temperature suitable for the material of construction and design of the receiving containers. Ordinary steels are not suitable for refrigerated ammonia. See Appendix R of API Standard 620 “Recommended Rules for Design and Construction of Large Welded Low-Pressure Storage Tanks” for materials for low temperature service.

2.12.2 At least one attendant shall supervise the transfer of liquids from the time the connections are first made until they are finally disconnected.

2.12.3 Flammable gases or gases which will react with ammonia (such as air) shall not be used to unload tank cars or transport trucks.

2.12.4 Containers shall be charged or used only upon authorization of the owner.

2.12.5 Containers shall be GAUGED ~~gaged~~ and charged only in the open atmosphere or in buildings approved for that purpose.

2.12.6 Pumps used for transferring ammonia shall be recommended and labeled for ammonia service by the manufacturer.

2.12.6.1 Pumps shall be designed for at least 250 psig working pressure.

2.12.6.2 Positive displacement pumps shall have installed, off the discharge port, a constant differential relief valve discharging into the suction port of the pump through a line of sufficient size to carry the full capacity of the pump at relief valve setting, which setting and installation shall be according to pump manufacturer's recommendations.

2.12.6.3 On the discharge side of the pump, before the relief valve line, there shall be installed a pressure GAUGE ~~gage~~ graduated from 0 to 40C psig.

2.12.6.4 Plant piping shall contain shut-off valves located as close as practical to pump connections.

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2.12.7 Compressors used for transferring~~:~~ or refrigerating ammonia shall be recommended and labeled for ammonia service by the manufacturer.

2.12.7.1 Compressors, except those used for refrigeration, shall be designed for at least 250 psig working pressure. Crank cases of compressors not designed to withstand system pressure shall be protected with a suitable safety relief valve.

2.12.7.2 Plant: piping shall contain shut-off valves located as CLOSE ~~close~~ as practical to compressor connections.

2.12.7.3 A safety relief valve large enough to discharge the full capacity of the compressor shall be connected to the discharge before any shut-off valve.

2.12.7.4 Compressors shall have pressure GAUGES ~~gages~~ at suction and discharge graduated to at least one and one-half times the maximum pressure that can be developed.

2.12.7.5 Adequate means, such as drainable liquid trap, may be provided on the compressor suction to minimize the entry of liquid into the compressor.

2.12.7.6 Where necessary to prevent contamination, an oil separator shall be provided on the discharge side of the compressor.

2.12.8 Loading and unloading systems shall be protected by suitable devices to prevent emptying of the storage container or the container being loaded or unloaded in the event of severance of the HOSE ~~hoss~~. Backflow check valves or properly sized excess~~,~~ flow valves shall be installed where necessary to provide such protection. In the event that such valves are not practical, remotely operated shut-off valves may be installed.

2.12.9 Meters used for the measurement of liquid anhydrous ammonia shall be recommended and labeled for ammonia service by the manufacturer and MEET ~~meer~~ state Weights and Measures requirement**S**.

2.12.9.1 Liquid meters shall be designed for a minimum working pressure of 250 psig.

2.12.9.2 The metering system shall incorporate devices that will prevent the INADVERTENT ~~inadverent~~ measurement of vapor.

2.13 Tank Car Unloading Points and Operations

2.13.1 Provisions for unloading tank cars shall conform to the Regulations of the Department of Transportation.

2.13.2 Unloading operations shall be performed by reliable persons properly instructed and made responsible for careful compliance with all applicable procedures.

2.13.3 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 and shall be left up until after car is unloaded and disconnected from discharge connections. Signs shall be of metal or other suitable material, at least 12 by 15 inches in size and bear the words “STOP-Tank Car Connected” or “STOP-Men At Work” the word “STOP”, being in letters at least 4 inches high and the other words in letters at least 2 inches high. The letters shall be white on a blue background.

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2.13.4 The track of a tank car siding shall be substantially level

2.13.5 Brakes shall be set and wheels blocked on all cars being unloaded.

2.13.6 Tank cars of anhydrous ammonia shall be unloaded only at approved locations meeting the requirements of paragraphs 2.10.3 and 2.12.8.

2.14 Liquid Level GAUGING ~~Gaging~~ Device

2.14.1 Each container except those filled by weight shall be equipped with an approved liquid level GAUGING ~~gaging~~ device.

2.14.2 All GAUGING ~~gaging~~ devices shall be arranged so that the maximum liquid level to which the container is filled is readily determined. [See 2.3.2 (g)]

2.14.3 GAUGING ~~gaging~~ devices that require bleeding of the product to the atmosphere such as the rotary tube, fixed tube, and slip tube devices, shall be designed so that the maximum opening of the bleed valve is not larger than No. 54 ~~64~~ drill size unless provided with an excess flow valve. (This requirement does not apply to farm vehicles used for the application of ammonia, as covered in Section 8.)

2.14.4 GAUGING ~~gaging~~ devices shall have a design pressure equal to or greater than the design pressure of the container on which they are installed.

2.14.5 Fixed liquid level GAUGES ~~gages~~ shall be so designed that the maximum volume of the container filled by liquid shall not exceed 85% of its water capacity. The coupling into which the fixed liquid level GAUGE ~~gage~~ is threaded must be placed at the 85% level of the container. If located elsewhere, the dip tube of this GAUGE ~~gage~~ must be installed in such a manner that it can not be readily removed

NOTE: This does not apply to refrigerated storage.

2.14.6 GAUGE ~~Gage~~ glasses of the columnar type shall be restricted to stationary storage installations. They shall be equipped with shut-off valves having metallic hand wheels, with excess-flow valves, and with extra heavy glass adequately protected with a metal housing applied by the GAUGE ~~gage~~ manufacturer. They shall be shielded against the direct rays of the sun.

2.15 Painting of Containers

2.15.1 Aboveground uninsulated containers should have a reflective surface maintained in good condition. White is recommended for painted surfaces, but other light reflecting colors are acceptable.

2.16 Electrical Equipment and Wiring

2.16.1 Electrical equipment and wiring for use in ammonia installations shall be general purpose or weather resistant as appropriate.

2.16.2 Where concentrations of ammonia in air in excess of 13% by volume are likely to be encountered, electrical equipment and wiring shall be of a type specified by and be installed in accordance with National Electrical Code, NFPA 70 (ANSI-C1) , for Class I, Group D locations.

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3. SYSTEMS UTILIZING STATIONARY, PIER-MOUNTED OR SKID-MOUNTED ABOVEGROUND OR UNDERGROUND, NON-REFRIGERATED STORAGE

This section. applies to stationary, pier-mounted, skid-mounted, above ground or underground, non-refrigerated storage installations utilizing containers other than those constructed in accordance with Department of Transportation Specifications. ALL ~~all~~ Basic Rules of Section 2 apply to this section unless otherwise noted.

3.1 Design Pressure and Construction of Containers

3.1.1 The minimum design pressure for non-refrigerated aboveground containers shall be 250 psig. [See 2.2.1.1]

NOTE: U-68 and U-69 ASME Code containers with a design pressure of 200 psig are acceptable if recertified to 250 psig and equipped with safety relief valves set at 250 psig as permitted in 2.9.2.

3.2 Container Valves and Accessories, Filling and Discharge Connections

3.2.1 Each filling connection shall be provided with combination back-pressure check valve and excess flow valve; one double or two single back-pressure check valves; or a positive shut-off valve in conjunction with either an internal back-pressure check valve or an internal excess flow valve.

3.2.2 All vapor and liquid connections, except safety relief valves and those specifically exempt in Sections 2.6.4 and 2.6.5 shall be equipped with approved excess flow valves; or in lieu thereof, may be fitted with approved quick-closing internal valves which, except during operating periods, shall remain closed.

3.2.3 Each storage container shall be provided with a pressure GAUGE ~~gage~~ graduated from 0 to 400 psig. GAUGES ~~Gages~~ shall be designated for use in ammonia service.

3.2.4 All containers shall be equipped with an approved vapor return valve.

3.2.5 All containers shall be equipped with a fixed maximum liquid level GAUGE ~~gage~~.

3.3 Safety Relief Devices

3.3.1 Every container shall be provided with one or more safety relief valves of springloaded or equivalent type and shall comply with the following:

(a) The discharge from safety relief valves shall be directed away from the container upward and unobstructed to the open air. Vent pipes shall not be restrictive or smaller in size than the safety relief valve outlet connection. All safety relief valve discharges shall have suitable rain caps that will allow free discharge of the vapor and prevent the entrance of water. Suitable provision shall be made for draining condensate which may accumulate.

(b) If desired, vent pipes from two or more safety relief devices located on the same unit, or similar lines from two or more different units, may be run into A ~~&~~ common header, provided the cross-sectional area of such header is at least equal to the sum of the cross-sectional areas of the individual vent pipes.

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3.3.2 The rate of discharge of spring-loaded safety relief VALVES ~~valvas~~ installed on underground containers may be reduced to a minimum of 30 per cent of the rate of discharge specified in Appendix A. Containers so protected shall not be uncovered after installation until the liquid ammonia has been removed. Containers which may contain liquid ammonia before being installed underground and before being completely covered with earth are to be considered aboveground containers when determining the rate of discharge requirements of the safety relief valves.

3.3.3 On underground installations where there is a probability of the manhole or housing becoming flooded, the discharge from vent lines shall be located above the high water level. All manholes or housings shall be provided with ventilated louvres or their equivalent, the area of such openings equalling or exceeding combined discharge areas of safety relief valves and vent lines which discharge their content into the manhole housing.

3.4 Installation of Storage Containers

3.4.1 Containers installed aboveground shall be provided with ~~,~~ substantial reinforced concrete footings and foundations or structural steel supports mounted on reinforced concrete foundations. In either case, the reinforced concrete foundations or footings shall extend below the established frost line and shall be of sufficient width and thickness to support the total weight of the containers and contents adequately. The foundation shall maintain the lowest point of the tank at not less than 18 inches above the ground. Floating type foundations shall also be acceptable providing the foundations are designed to adequately support the tank, contents and pumping equipment. Crushed rock of adequate depth would be acceptable.

3.4.2 Horizontal aboveground containers shall be mounted on foundations in such a manner as to permit expansion and contraction. Every container shall be supported so as to prevent the concentration of excessive loads on the supporting portion of the shell. The bearing afforded by the saddles shall extend over at least one third of the circumference of the shell. Suitable means for preventing corrosion shall be provided on that portion of the container in contact with the foundations or saddles.

3.4.3 Containers buried underground shall be placed so that the top of the container is at least one foot below the surface of the ground. Should ground conditions make compliance with these requirements impracticable, precautions shall be taken to prevent physical damage to the container. It is not necessary to cover the portion of the container to which a manhole and other connections are affixed. When necessary to prevent floating, containers shall be securely anchored or weighted.

3.4.4 Underground containers shall be set on firm foundations (firm earth may be used) and surrounded with soft earth or sand well tamped in place. As a further means of resisting corrosion, the container, prior to being placed underground, shall be given a protective coating satisfactory to the authority having jurisdiction. Such protective coating shall be equivalent to hot dip galvanizing, or to two preliminary coatings of red lead followed by a heavy coating of coal tar or asphalt. The container thus coated shall be lowered into place in such a manner as to prevent abrasion or other damage to the coating.

3.4.5 Distance between aboveground and underground containers of over 1,200 gallons capacity shall be at least five feet

3.4.6 Secure anchorage or adequate pier height shall be provided against container flotation wherever sufficiently high flood water might occur.

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3.5 Reinstallation of Containers

3.5.1 Containers once installed underground shall not later be reinstalled aboveground or underground, unless they successfully withstand hydrostatic pressure retests at the pressure specified for the original hydrostatic test as required by the code under which the tank was constructed and show no evidence of serious CORROSION. ~~corrosior~~

3.5.2 Where containers are REINSTALLED ~~reinstailed~~ underground the corrosion resistant coating SHALL ~~snail~~ be put in good condition; see 3.4.4. Where containers are reinstalled aboveground, safety Relief devices or GAUGING ~~gaging~~ devices shall comply with 2.6 and 3.3 respectively for aboveground containers.

3.6 Marking of Containers

3.6.1 Each container or group of containers shall be marked on at least two sides with the words "Anhydrous Ammonia" in sharply contrasting colors with letters not less than four inches high.

3.7 Protection of Container Appurtenances

3.7.1 Valves and other appurtenances shall be protected against physical damage. Main container shut-off valves shall be kept closed and locked when the installation is unattended. If the facility is protected against tampering by fencing or other suitable means, valve locks are not required.

3.7.2 All connections to underground containers should be located within a substantial dome, housing or manhole fitted with a substantial removable cover. Appurtenances shall also be protected during the transit of containers intended for installation underground.

3.7.3 Storage containers need not be grounded.

3.8 Identification

3.8.1 A sign shall be displayed in a conspicuous place stating the name, address, and phone number of the nearest representative, agent, or owner of the storage system.

4. REFRIGERATED STORAGE

This section applies specifically to systems utilizing tanks for the storage of anhydrous ammonia under refrigerated conditions. All Basic Rules of Section 2 apply to this section unless inconsistent with the requirements of this section.

4.1 Design of Tanks

4.1.1 Tanks may be designed for any storage pressure desired as determined by economical design of the refrigerated system.

4.1.2 The design temperature shall be the minimum temperature to which the container will be refrigerated and shall be so designated.

4.1.3 Containers with a design pressure exceeding 15 psig shall be constructed in accordance with 2.2 and the material shall be selected from those listed in API Standard 620, Recommended Rules

for Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Tables 2.02, R.2.1, R.2.2, R.2.3 or R.2.4.

4.1.4 Tanks with a design pressure of 15 psig and less shall be constructed in accordance with the general requirements of API Standard 620, including Appendix R.

4.1.5 When austenitic steels or nonferrous materials are used, the ASME Code shall be used as a guide in selection of materials for use at the design temperature.

4.2 Installation of Storage Tanks

4.2.1 Tanks shall be supported on suitable non-combustible foundations designed to accommodate the type of tank being used.

4.2.2 Adequate protection against flotation or other water damage shall be provided wherever high flood water might occur.

4.2.3 Tanks for product storage at less than 32° F shall be supported in such a way, or heat shall be supplied, to prevent the effects of freezing and consequent frost heaving.

4.2.4 The area surrounding a refrigerated tank or group of tanks shall be provided with drainage, or shall be diked to prevent accidental discharge of liquid from spreading to uncontrolled areas.

4.2.5 When drainage is employed, a slope of not less than one percent shall be provided. The drainage system shall terminate in an impounding basin having a capacity as large as the largest tank served.

4.2.6 Provision shall be made for drainage of rain water from the diked or impounding area. Such drainage shall not permit the release of ammonia.

4.2.7 When a dike surrounding the tank is employed, the capacity of the diked enclosure shall be as large as the largest tank served.

4.2.8 The walls of a diked enclosure or the wall of an impounding basin used in a drainage system shall be of earth, steel or concrete designed to be liquid tight and to withstand the hydrostatic pressure and the temperature. Earth walls shall have a flat top at least 2 feet wide. The slope shall be stable and consistent with the angle of repose of the earth used.

4.2.9 The ground in an impounding basin or within a diked enclosure, should be graded so that small spills, or the early part of a large spill, will accumulate at ~~2~~ one side or corner contacting; a relatively small area of ground and exposing a relatively small surface area for heat gain. Shallow channels in the ground surface or low curbs of earth can help guide the liquid to these low areas without contacting a large ground area.

4.3 Marking Refrigerated Containers

4.3.1 Each refrigerated container shall be marked with a nameplate on the outer covering in an accessible place as specified in the following:

4.3.1.1 With the name and address of the builder and the date of fabrication.

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4.3.1.2 With the maximum volume or weight of the product whichever is MOST ~~moat~~ meaningful to user.

4.3.1.3 With the design pressure.

4.3.1.4 With the minimum temperature in degrees Fahrenheit for which the container was designed.

4.3.1.5 With the maximum allowable water level to which the container may be filled for the test purposes.

4.3.1.6 With the density of the product in pounds per cubic foot for which the container was designed.

4.3.1.7 With the maximum level to which the container may be filled with liquid anhydrous ammonia.

4.4 Tank Pipes and Discharge Pipes

4.4.1 Shut-off valves shall be:

(a) Provided for all connections except those with a No. 54 drill size restriction, plugs, safety-valves, thermometer wells, AND ~~end~~

(b) Located as close to the tank as practicable.

4.4.2 WHEN ~~Whew~~ operating conditions make it advisable, a check valve shall be installed on the fill connection and a remotely operated shut-off valve ~~or,,~~ ON other connections located below the maximum LIQUID ~~Liquid~~ level.

4.5 Safety Relief Device

4.5.1 Safety relief valves shall be set to start-to-discharge at a pressure not in excess of the design pressure of the tank and shall have a total relieving capacity sufficient to prevent a maximum pressure in a tank of more than 120% of the design pressure.

4.5.2 The total relieving capacity shall be the larger requirement of 4.5.2.1 or 4.5.2.2.

4.5.2.1 Possible refrigeration system upset such as (1) cooling water failure, (2) power failure, (3) instrument air or instrument failure, (4) mechanical failure of any equipment, (5) excessive pumping rates, (6) changing atmospheric conditions.

4.5.2.2 Either one of the following formulas for fire exposure, (1) for valve manufacturers who use weight of vapors to BE ~~bi~~ relieved as basis for classifying valves:

$$W = \frac{34{,}500\ F\ A^{0.82}}{L}$$

or (2) for valve manufacturers that classify valves on the basis of air flow:

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$$Qa = \frac{633{,}000\ F\ A^{0.82}}{L\ C} \sqrt{\frac{Z\ T}{M}}$$

Where W = weight of vapors to be relieved in pounds/hour at relieving condi tions;

Qa= air FLOW ~~now~~ in cubic feet per minute aT standard conditionS* (60° F and 14.7 psi);

F = fireproofing credit. Use F = 1.0 except when an approved fireproofing ma terial of recommended thickness iS used, then use F = 0.2.

A = total surface area in square feet uP to 25 feet above grade or to the equator of a sphere, whichever iS greater;

Z = compressibility factor of ammonia at relieving conditions (if not known use Z = 1.0);

T = temperature in degrees R (460 - temperature in degrees F of gas aT relieving conditions);

M = molecular weight = 17 for ammonia;

L = latent heat of ammonia at relieving conditions

C = constant based on relation of specific Heats.

(C may be obtained from the following table).

(If X is not known use C = 315).

K	C	K	C	K	C
1.00	315	1.26	343	1.52	366
1.02	318	1.28	345	1.54	368
1.04	320	1.30	347	1.56	369
1.06	322	1.32	349	1.58	371
1.08	324	1.34	351	1.60	372
1.10	327	1.36	352	1.62	374
1.12	329	1.38	354	1.64	376
1.14	331	1.4C	356	1.66	377
1.16	333	1.42	353	1.68	379
1.18	335	1.44	359	1.70	380
1.20	337	1.46	361	2.00	400
1.22	339	1.48	363	2.20	412
1.24	341	1.50	364		

Where K = Cp/Cv at atmospheric conditions

and Cp = Specific heat of vapor at constant pressure

Cv = Specific heat of vapor at constant volume

4.5.3 Shut-off valves of adequate flow capacity may be provided and used to facilitate inspection and repair of safety relief valves. When a shut-off valve is provided it shall be so arranged that it can be locked or sealed open, and it shall not be closed except by an authorized person who shall remain stationed there while the valve remains closed, and who shall again lock or seal the valve open when leaving the station.

4.5.4 Safety relief devices shall comply with the following:

4.5.4.1 If stacks are used they shall be suitably designed to prevent obstruction by rain, snow, ice or condensate. The outlet size shall not be smaller than the nominal size of the safety relief valve outlet connection.

4.5.4.2 Discharge lines may be used if desired. Multiple safety relief valves on the same storage unit may be run into a common discharge header. The discharge line and header shall be designed to accommodate the maximum flow and a back pressure not exceeding l0% of the design pressure of the storage container. This back pressure shall be included in the 120% total maximum pressure given in 4.5.1. No other container or system shall exhaust into this discharge line or header. The vent lines shall be installed to prevent accumulation of liquid in the lines.

4.5.5 Atmospheric storage shall be provided with vacuum breakers. Ammonia gas may be used to provide a pad.

4.6 Protection of Container Appurtenances

4.6.1 Refrigerated storage containers shall comply with the provisions of Paragraph 3.7.

4.7 Reinstallation of Containers

4.7.1 Containers of such size as to require field fabrication shall, when moved and reinstalled, be reconstructed and reinspected in complete accordance with the code under which they were constructed. The containers shall be subjected to a pressure retest, and if rerating is necessary, it shall be done in accordance with the applicable code pressures.

4.8 Damage from Vehicles

4.8.1 Precaution shall be taken to avoid any damage by trucks, tractors, or other vehicles.

4.9 Refrigeration Load and Equipment

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

4.9.1.1 Load imposed by heat flow into the container caused by the temperature differential between the ambient temperature and the design storage temperature.

4.9.1.2 Load imposed by heat flow into the tank caused by maximum sun radiation.

4.9.1.3 Maximum load imposed by filling: the tank with ammonia warmer than the design storage temperature.

4.9.2 More than one storage tank may be handled by the same refrigeration system.

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4.9.3 Compressors (See also 2.12.7)

4.9.3.1 A minimum of two compressors shall be provided, either of which is of sufficient size to handle the loads listed in Paragraph **4.9.1.1 AND 4.9.1.2. WHERE MORE THAN TWO COMPRESSORS ARE PROVIDED, MINIMUM STANDBY EQUIPMENT EQUAL TO THE LARGEST NORMALLY OPERATING EQUIPMENT SHALL BE INSTALLED. COMPRESSORS REQUIRED FOR 4.9.1.3 MAY BE USED AS STANDBY EQUIPMENT FOR COMPRESSORS REQUIRED IN 4.9.1.1 AND 4.9.1.2.**

~~**4.9.1.1 and 4.9.1.2. Where more than two compressors are provided, minimum standby equipment equal to the largest normally operating equipment shall be installed. Compressors required for 4.9.1.3 may be used as standby equipment for compressors required in 4.9.1.1 and 4.9.1.2.**~~

4.9.3.2 Compressors shall be sized to operate with a suction pressure at least 10% below the minimum setting of the safety relief valve(s) on the storage tank and shall withstand a suction pressure at least equal to 120% of the design pressure of the tank. Discharge pressure will be governed by condensing conditions.

4.9.4 Compressor Drives

4.9.4.1 Each compressor shall have its **INDIVIDUAL** ~~**in dividus**~~ driving unit.

4.9.4.2 Any standard drive consistent with good design may be used.

4.9.4.3 An emergency source of power of sufficient capacity to handle the loads listed in paragraphs 4.9.1.1 and 4.9.1.2 **SHALL** ~~**snail**~~ be provided, unless facilities are provided to safely dispose of vented vapors while the refrigeration system is not operating.

4.9.5 Automatic Control Equipment

4.9.5.1 The refrigeration system shall be arranged with suitable controls to govern the compressor operation in accordance with the load as evidenced by the pressure in the container (s).

4.9.5.2 An emergency alarm system shall be installed to function in the event the pressure in the container (s) rises to the maximum or falls to the minimum allowable operating pressure.

4.9.5.3 An emergency alarm and shut-off shall be located in the condenser system to respond to excess discharge pressure caused by failure of the cooling medium.

4.9.5.4 All automatic controls shall be installed in a manner to preclude operation of alternate compressors unless the controls will function with the alternate compressors.

4.9.6 Separators

4.9.6.1 An entrainment separator of suitable size and design pressure shall be installed in the compressor suction line. The separator shall be equipped with a drain and **GAUGING** ~~**gaging**~~ device.

4.9.6.2 An oil separator of suitable size shall be installed in the compressor discharge line. It shall be designed for at least 250 psig and shall be equipped with a GAUGING ~~gaging~~ device and drain valve.

4.9.7 Condensers

4.9.7.1 The condenser system may be cooled by air or water or both. The condenser shall be designed for at least 250 psig. Provision shall be made for purging non-CONDENSABLES ~~condensibles~~ either MANUALLY OR ~~manually~~ automatically.

4.9.8 Receiver and Liquid Drain

4.9.8.1 A receiver shall be provided which is equipped with an automatic float valve to discharge the ~~liquid~~ ~~liquia~~ ammonia to storage or with a high pressure liquid drain trap of suitable capacity. The receiver shall be designed for at least 250 PSIG ~~paig~~ operating pressure and be equipped with the necessary connections, safety relief valves and GAUGING ~~gaging~~ device.

4.9.9 Insulation

4.9.9.1 Refrigerated containers and pipe lines which 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. Weatherproofing shall be of a type which will not support flame propagation.

4.10 Safety Equipment

4.10.1 All refrigerated storage plants shall have on hand the minimum safety equipment required under paragraph 2.10.3.

5. SYSTEMS UTILIZING PORTABLE DOT CONTAINERS

This section applies specifically to systems utilizing cylinders, portable tanks (DOT-51), or "ton containers" (DOT-106A, DOT-110A), constructed in accordance with Department of Transportation Specifications. All Basic Rules of Section 2 apply to this section, unless otherwise noted.

5.1 Containers

5.1.1 Containers shall comply with Department of Transportation Specifications and shall be maintained, filled, packaged, marked, labeled and shipped to comply with current DOT Regulations and American National Standard Method of Marking Portable Compressed Gas Containers To Identify the Material Contained, Z48.1.*

5.1.2 Containers shall be stored in an area free from ignitable debris and in such manner as to prevent external corrosion. Storage may be indoors or outdoors.

5.1.3 Containers shall not be buried below ground.

5.1.4 Containers shall be set upon firm foundations or otherwise firmly secured. The possible effect of sending on the outlet piping shall be guarded against by a flexible connection or special FRAMING ~~froting~~.

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5.1.5 Containers shall be protected from heat sources such as radiant flame and steam pipes. Do not apply heat directly to containers to raise the pressure.

5.1.6 Containers shall be stored in such manner as to protect them from moving vehicles or external damage.

5.1.7 Any container which is designed to have a valve protection cap shall have the cap securely in place when the container is not in service.

5.2 Container Valves and Regulating Equipment

5.2.1 Container valves and pressure regulating equipment shall be protected against tampering when installed for use.

5.2.2 Container valves shall be protected while in transit, in storage, and while being moved into final utilizations, as follows:

(a) By setting them into a recess of the container, or

(b) By ventilated cap or collar, fastened to the container, capable of withstanding a blow from any direction equivalent to that of a 30-lb. weight dropped four feet. Construction must be such that a blow will not be transmitted to the valves or other connections.

5.2.3 When containers are not connected for service, the outlet valves shall be kept tightly closed even though containers are considered empty.

*See Appendix C for availability

5.3 Safety Relief Device**S***

5.3.1 Containers shall be provided with safety relief devices as required by Department of Transportation Regulations.

6. SYSTEMS MOUNTED ON TRUCKS, SEMI-TRAILERS, AND TRAILERS FOR TRANSPORTATION OF AMMONIA

This section applies specifically to systems mounted on trucks, semi-trailers and trailers (other than those covered under sections 7 and 8) used for the transportation of ammonia. All Basic Rules of Section 2 apply to this section unless otherwise noted. Systems for trucks and trailers for transportation of ***ANHYDROUS*** ~~***anhydroits***~~ *ammonia, in addition to complying with the requirements of these standards, shall also comply where required, with the requirements of the Department of Transportation and those of any other regulatory body which may apply.*

6.1 Design Pressure of Containers

6.1.1 Containers used in intrastate commerce shall be constructed in accordance with Paragraph 2.2 with a minimum design pressure of 250 psig. Containers used in interstate commerce shall meet DOT Regulations.

6.1.2 The shell or head thickness of any container shall not be less than ~~ft~~ **3/16** inch.

Editing comments: Changes to this rule are indicated in ~~strikethrough~~ for removal and SMALL CAP, DOUBLE UNDERLINE for additions. If you are able to view this document in color the changes are also indicated in red.

6.1.3 All container openings, except safety relief valves, liquid level GAUGING ~~gaging~~ devices and pressure GAUGES ~~gages~~, shall be labeled to designate whether they communicate with liquid or vapor space. Labels may be on valves.

6.1.4 Baffles are not required for cargo tanks.

6.2 Mounting Containers on Track

6.2.1 The means of attachment of any container to the cradle, frame or chassis of a vehicle shall be designed on a basis of two "g" loading in either direction, using a safety factor of not less than 4, based on the ultimate strength of the material used. For purposes of this requirement, two "g" of load support is equivalent to three times the static weight of the articles supported; two "g" of loading and bending, acceleration, and torsion is equivalent to twice the static weight support applied horizontally at the road surface.

6.2.2 "Hold-down" devices, when used, shall anchor the container to the cradle, frame or chassis in a suitable and safe manner that will not introduce undue concentration of stresses. These devices shall incorporate positive means for drawing the container down tight, and suitable stops or anchors shall be provided to prevent relative movement between container and framing due to stopping, starting or changes in direction.

6.2.3 Vehicles designed and constructed so that the cargo tanks constitute in whole or in part the stress member used in lieu of the frame shall be supported by external cradles suspending at least 120° of the shell circumference. The design calculation shall include beam stress, shear stress, torsion stress, bending moment and acceleration stress, in addition to those covered by the code under which the cargo tank was designed.

6.2.4 If a liquid withdrawal line is installed in the bottom of a container, the connections thereto, including hose, shall not be lower than the lowest horizontal edge of the trailer axle.

6.2.5 Provisions shall be made to secure both ends of the hose while in transit.

6.2.6 When the cradle and the container are not welded together, suitable material shall be used between them to ELIMINATE ~~alminate~~ metal-to-metal friction.

6.3 Container Appurtenance

6.3.1 Non-recessed container fittings and appurtenances shall be protected against physical damage by either: (1) a protected location, (2) the vehicle frame or bumper, or ~~f~~3) a protective housing. The protective housing, if used, shall comply with the requirements under which the containers are fabricated with respect to design and construction, and shall be designed to withstand static loadings in any direction equal to twice the weight of the container and attachments when filled with the lading using a safety factor of not less than 4, based on the ultimate strength of the material to be used. The protective housing if used shall be protected with a weather cover, if necessary, to insure proper operation of valves and safety relief devices.

6.3.2 All connections to containers, except filling connections (see 6.3.3), safety relief devices, and liquid level and pressure GAUGE ~~gage~~ connections, shall be provided with suitable automatic excess flow valves, or in lieu thereof, may be fitted with quick-dosing internal valves, which shall remain closed except during delivery operations. The control mechanism for such valves may be provided with a secondary control remote from the delivery connections and such control

mechanism shall be provided with a fusible section (melting point 208° F to 220° F) which WILL ~~win~~ permit the internal valve to close automatically in case of

6.3.3 Filling connections shall be provided with automatic back-pressure check valves, excess-flow check valves, or quick-dosing internal valves, to prevent back-flow in case the filling connection is broken. Where the filling and discharge connect to a common opening in the container shell and that opening is fitted with a quick-dosing internal valve as specified in 6.3.2, the automatic valve shall not be required.

6.3.4 All containers shall be equipped for spray loading (filling in the vapor space) or with an approved vapor return valve of adequate capacity.

6.3.5 All containers shall be equipped with a fixed maximum liquid level GAUGE ~~gage~~.

6.3.6 All containers shall be equipped with a pressure-indicating GAUGE ~~gage~~ having a dial graduated from 0-400 PSIG ~~paig~~.

6.4 Piping and Fittings

6.4.1 All piping, tubing and fittings shall be securely mounted and protected against physical damage.

6.4.2 Piping used on non-refrigerated systems shall be at least ASTM A-53 Grade B Electric Resistance Welded and Electric Flash Welded Pipe or equal. Such pipe shall be at least Schedule 40 when joints are welded, or welded and flanged. Such pipe shall be at least Schedule 80 when joints are threaded. Brass, copper, or galvanized steel pipe or tubing shall not be used.

6.4.3 The truck unloading line shall be provided with an excess flow valve at the hose connection unless an approved quick dosing internal valve is provided in the container unloading connection. (See 6.3.2)

6.5 Safety Relief Devices

6.5.1 The discharge from container safety relief valves shall be vented away from the container upward and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container; LOOSE ~~looss~~ fitting rain caps shall be used. Size of discharge lines from safety relief valves shall not be smaller than the nominal size of the safety relief valve outlet connection. Suitable provision shall be made for draining condensate which may accumulate in the discharge pipe.

6.6 Marking~~,~~ of Container

6.6.1 Every container, whether loaded or empty, shall be conspicuously and legibly marked on each side and rear thereof on a background of sharply contrasting color with the words "COMPRESSED GAS" in LETTERS ~~letters~~ at least four inches high; and with the words "ANHYDROUS AMMONIA" in letters at least four inches high; in compliance with Department of Transportation Regulations

6.7 Transfer of Liquids

6.7.1 The content of tank motor vehicle containers shall be determined by weight, or suitable metering device approved by Colorado Weights & Measures authority.

NOTE: If the content of a container is to be determined by liquid level measurement, the container shall have a thermometer well so that the internal liquid temperature can be easily determined. This volume when converted to weight shall not exceed the filling density specified by the Department of Transportation Regulations.

6.7.2 Pumps or compressors shall be designed and installed in accordance with paragraph 2.12 and protected against physical damage when mounted upon ammonia tank trucks and trailers.

6.7.3 Tank motor vehicles of greater than 3500 water gallons capacity shall be unloaded only at approved locations meeting the requirements of Paragraphs 2.10.3 and 2.12.8.

6.8 Trailers and Semi-Trailers

6.8.1 Trailers shall be firmly and securely attached to the vehicle drawing them by means of suitable drawbars, supplemented by suitable safety chain (or chains) or safety cables.

6.8.2 Every trailer and semi-trailer shall be equipped with an emergency braking system to be activated in the event of hitch failure.

6.8.3 Trailers shall be of a type of construction which will prevent the towed vehicle from whipping or swerving dangerously from side to side and which will cause it to follow substantially in the path of the towing vehicle.

6.8.4 Where a fifth wheel is employed on a semi-trailer, it shall be ruggedly designed, securely fastened to both units, and equipped with a positive locking mechanism which will prevent separation of the two units except by manual release.

6.8.5 Every trailer or semi-trailer shall be provided with side lights and a tail light.

6.9 Electrical Equipment and Lighting

6.9.1 Tank trucks, tank trailers, and tank semi-trailers, may not be equipped with any artificial light other than electric light. Electric lighting circuits shall have suitable overcurrent protection (fuses or automatic circuit breakers). The wiring shall have sufficient carrying capacity and mechanical strength, and shall be suitably secured, insulated and protected against physical damage.

6.10 Protection Against Collision

6.10.1 Each tank motor vehicle shall be provided with properly attached bumpers or chassis extensions arranged to protect the tank, piping, valves and fittings from physical damage in case of collision.

6.11 Chock Blocks

6.11.1 At least two chock blocks shall be provided. These blocks shall be placed to prevent rolling of the vehicle whenever it is parked during loading and unloading operations.

6.12 Portable Tanks (Including Skid Tanks)

6.12.1 When portable tanks are used in lieu of cargo tanks and are permanently mounted on tank motor vehicles for the transportation of ammonia, they shall comply-with the requirements of Section 6. Where portable tanks, including those built to DOT Specification 51, 106A or 110A, are used for

farm storage they shall comply with Section 3. When portable tanks are used as shipping containers in interstate commerce they shall comply with Section 5.

6.13 Safety Equipment

6.13.1 All tank trucks, trailers, and semitrailers shall be equipped with the following for emergency and rescue purposes:

*(a) One full face gas mask with anhydrous ammonia refill canisters.

(b) One pair of protective gloves made of rubber or other material impervious to ammonia.

(c) Tight-fitting goggles or one full face shield.

(d) A container of not less than five gallons of readily available clean water.

*See footnote on Page 13.

7. SYSTEMS MOUNTED ON FARMWAGONS (IMPLEMENTS OF HUSBANDRY) FOR THE TRANSPORTATION OF AMMONIA

This section applies to containers of 3000 gallons capacity or less and pertinent equipment mounted on farm wagons (implements of husbandry) and used for the transportation of ammonia. All Basic Rules of Section 2 apply to this section unless otherwise noted.

7.1 Design of Containers

7.1.1 Containers shall be constructed in accordance with Paragraph 2.2.

7.2 Mounting Containers

7.2.1 A suitable “stop” or “stops” shall be mounted on the farm wagon or on the container in such a way that the container shall not be dislodged from its mounting due to farm wagon coming to a sudden stop. Back slippage shall also be prevented by proper methods.

7.2.2 A suitable “hold-down” device shall be provided which will anchor the container to the farm wagon at one or more places on each side of the container.

7.2.3 When containers are mounted on four-wheel farm wagons, care shall be taken to insure that the weight is distributed evenly over both axles.

7.2.4 When the cradle and the container are not welded together, suitable material -shall be used between them to eliminate metal-to-metal friction.

7.3 Container Appurtenance**S***

7.3.1 All containers shall be equipped with a fixed maximum liquid level **GAUGE** ~~**gage**~~.

7.3.2 All containers with a capacity exceeding 250 gallons shall be equipped with a pressure **GAUGE** ~~**gage**~~ having a dial graduated from 9-400 psi.

Editing comments: Changes to this rule are indicated in ~~strikethrough~~ for removal and SMALL CAP, DOUBLE UNDERLINE for additions. If you are able to view this document in color the changes are also indicated in red.

7.3.3 The filling connection shall be fitted with combination back-pressure check valve and excess-flow valve; one double or two single back-pressure check valves; or a positive shut-off valve in conjunction with either an internal back-pressure check valve or an internal excess flow valve.

7.3.4 All containers with a capacity exceeding 250 gallons shall be equipped for spray loading or with an approved vapor return valve.

7.3.5 All vapor and liquid connections, except safety relief valves and those specifically exempt in 2.6.5, shall be equipped with approved excess flow valves or may be fitted with quick-closing internal valves which, except during operating periods, shall remain closed.

7.3.6 Fittings shall be protected from physical damage by means of a rigid guard designed to withstand static loading in any direction equal to twice the weight of the container and lading using a safety factor of four (4) based upon the ultimate strength of the material used. If the guard is fully enclosed, the safety relief valves shall be properly vented through the guard.

7.3.7 If a liquid withdrawal line is installed in the bottom of a container, the connections thereto, including hose, shall not be lower than the lowest horizontal edge of the farm wagon axle.

7.3.8 Provision shall be made to secure both ends of the hose while in transit.

7.4 Marking of Container

7.4.1 There shall appear on each side and on the rear end of the container in letters at least four inches high, the words “ANHYDROUS AMMONIA” and the container shall be marked in accordance with Department of Transportation Regulations,

7.5 Farm Wagons (Implements of Husbandry)

7.5.1 Farm wagons (Implements of Husbandry) shall conform with State Regulations.

7.5.2 All farm wagons shall be securely attached to the vehicle drawing them by means of drawbars supplemented by suitable safety chains.

7.5.3 A farm wagon shall be constructed so that it will follow substantially in the path of the towing vehicle and will prevent the towed farm wagon from whipping or swerving dangerously from side to side.

7.5.4 All farm wagons shall have five (5) gallons or more of readily available clean water, one pair of tight fitting goggles or full face shield, and one pair of protective gloves.

8. SYSTEMS MOUNTED ON FARM EQUIPMENT (IMPLEMENTS OF HUSBANDRY) FOR THE APPLICATION OF AMMONIA

This section applies to systems mounted on farm equipment and used for the field application of ammonia. All Basic Rules of Section 2 apply to this section unless otherwise noted,

8.1 DESIGN ~~Dotign~~ of Containers

8.1.1 The minimum design for containers shall be in accordance with Paragraph 2.2.

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8.2 Mounting of Containers

8.2.1 All containers shall be securely mounted.

8.3 Container Valves and Appurtenances

8.3.1 Each container shall have a fixed maximum liquid level GAUGE ~~gage~~.

8.3.2 The filling connection shall be fitted with combination back-pressure check valve and excess-flow valve; one double or two single back-pressure check valves; or a positive shut-off valve in conjunction with either an internal back-pressure check valve or an internal excessflow valve.

8.3.3 An excess-flow valve is not required in the vapor connection, provided the controlling orifice is not in excess of seven sixteenths (7/16) of an inch in diameter and the valve is a hand-operated (attached hand wheel or equivalent) shut-off valve. To assist in filling applicator tanks, it is permissible to bleed vapors to the open air, providing the preceding requirements are met.

8.3.4 Metering devices may be connected directly to the tank withdrawal valve. A union type connection is permissible between the tank valve and metering device. Remote mounting of metering devices is permissible using hose which meets with specifications set out in Appendix B. When the applicator tank is trailed and the metering device is remotely mounted, such as on the tractor tool bar, an automatic break-a-way type, self-closing, coupling must be used.

8.3.5 No excess-flow valve is required in the liquid withdrawal line provided the controlling orifice between the contents of the container and the outlet of the shut-off valve (see 2.6.2) does not exceed 7/16 inch in diameter.

9. ADDITIONAL SAFETY REQUIREMENTS

9.1 The following minimum requirements of equipment shall be on hand at all places wherever Anhydrous Ammonia is handled or transported, if not otherwise prescribed in these Rules and Regulations:

(a) One pair of tight fitting goggles or full face shield.

(b) One pair of protective gloves.

(c) A container of not less than five gallons of readily available clean water.

9.2 It shall be considered a violation if, at any time in the handling of Anhydrous Ammonia, the prescribed safety equipment is not worn or used.

9.3 Agricultural anhydrous ammonia tank cars and transport trucks shall be unloaded only through permanent, approved unloading sites and into permanently installed bulk storage tanks, except as otherwise provided below.

(a) Agricultural anhydrous ammonia may be unloaded directly from a railroad tank car into a U.S. Department of Transportation approved over-the-road transport truck of more than 3500 gallons capacity only for the purpose of transport to bulk storage tanks which do not have access to a railroad siding.

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(b) Tank cars and transport trucks may be unloaded at permanent, approved unloading sites into portable acid-fertilizer conversion units for the purpose of producing liquid fertilizer, if such conversion units have approved, automatic, normally closed valves in the line connecting the source tank and the conversion unit.

10. REGISTRATION

ON OR BEFORE JANUARY 1 OF EACH YEAR, EVERY PERSON WHO OWNS ONE OR MORE ANHYDROUS AMMONIA STORAGE TANKS, MOBILE TRANSPORTATION TANKS, OR TANK-MOUNTED APPLICATORS WITHIN THIS STATE SHALL REGISTER EACH OF SUCH TANKS OR APPLICATORS WITH THE DEPARTMENT AND SHALL PAY A REGISTRATION FEE AS ESTABLISHED BY THE AGRICULTURAL COMMISSION.

11. STATEMENTS OF BASIS, SPECIFIC STATUTORY AUTHORITY AND PURPOSE

STATUTORY AUTHORITY:

THE COMMISSIONER OF AGRICULTURE, COLORADO DEPARTMENT OF AGRICULTURE, ADOPTS THESE PERMANENT RULES PURSUANT TO THE PROVISIONS AND REQUIREMENTS OF THE ANHYDROUS AMMONIA ACT, 35-13-101 - 109, C.R.S.

PURPOSE:

THE PURPOSE OF THESE RULES IS TO:

IMPLEMENT THE STATUTORY CHANGE TO THE ANHYDROUS AMMONIA ACT WHICH REQUIRE THE COMMISSIONER TO ESTABLISH RULES TO SPECIFY THE DATES FOR THE REGISTRATION OF ANHYDROUS AMMONIA STORAGE TANKS, MOBILE TRANSPORTATION TANKS AND TANK MOUNTED APPLICATORS.

CORRECT TYPOGRAPHICAL ERRORS.

FACTUAL POLICY AND ISSUES:

THE FACTUAL AND POLICY ISSUES ENCOUNTERED IN THE PROPOSAL OF THESE PERMANENT RULES IS AS FOLLOWS:

ON AUGUST 6, 2008, THE ANHYDROUS AMMONIA ACT WAS AMENDED BY SENATE BILL 08-097. SECTION 35-13-109 (1) REQUIRES THE COMMISSIONER TO SPECIFY BY RULE THE DATES FOR THE REGISTRATION OF ANHYDROUS AMMONIA STORAGE TANKS, MOBILE TRANSPORTATION TANKS AND TANK MOUNTED APPLICATORS.

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APPENDIX A

Minimum required rate of discharge in cubic FEET ~~tat~~ per minute of air at 120 per cent of the maximum permitted start to discharge pressure for safety relief valves to be used on containers other than those constructed in accordance with United States Department of Transportation cylinder specifications.

Surface Area, Sq. Ft.	Flow Rate CFM Air	Surface Area, Sq. Ft.	Flow Rate CFM Air	Surface Area, Sq. Ft.	Flow Rate CFM Air	Surface Area, Sq. Ft.	Flow Rate CFM Air
20	288	146	1,310	340	2,640	1,350	8,160
25	310	150	1,350	350	2,700	1.400	8,410
30	380	188	1,390	360	2.760	1,450	8,660
35	408	160	1,420	370	2,830	1,500	8,900
40	455	168	1.460	380	2,890	1,550	9,140
41	501	170	1,500	390	2,950	1,600	9,380
50	54?	175	1,530	400	3,010	1.650	9,620
55	591	180	1,570	460	3,320	1,700	9,860
60	638	186	1.600	500	3,620	1,750	10,090
65	678	190	1,640	350	3.910	1,800	10,330
70	720	196	1.670	600	4,200	1,860	10,560
75	762	200	1.710	660	4.480	1,900	10,800
80	804	210	1.780	700	4.760	1,950	11,030
85	848	220	1,850	750	5.040	2,000	11,260
90	886	230	1,920	800	5,300	2,050	11,490
95	928	240	1,980	850	5,590	2,100	11.720
100	948	250	2,050	900	5,850	2,150	11.360
105	1,010	260	2,120	960	6,120	2,200	12,180
110	1.060	270	2,180	1,000	6,380	2,250	12.400
115	1,090	280	2,250	1,060	6,640	2,300	12.630
120	1020	290	2,320	1,100	6,900	2.350	12.360
125	1.160	300	2.380	1,150	7,160	2,400	13.080
130	1.200	310	2,450	1,200	7,410	2,450	13.300
135	1.240	320	2,510	1,250	7.660	2,500	13.520
140	1.280	330	2,570	1,300	7,910		

Surface ~~Are* a~~ AREA = Total Outside Surface Area of Container in Square Feet. When the Surface Area is not stamped on the name plate or when the marking is not legible, the area can be calculated by using one of the following formulas:

(1) Cylindrical container with hemispherical heads

Area = overall length in feet times outside diameter in feet times 3.1418.

(2) Cylindrical container with other than hemispherical heads

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Area = (overall length in feet plus 0.3 outside diameter in feet) times outside diameter in feet times 3.1416.

(3) Spherical container

Area ~~a~~ = outside diameter in feet squared times 3.1416.

Flow Rate - CFM Air = cubic feet per minute of air required at standard conditions, 60 F and atmospheric pressure (14.7 psia).

The rate of discharge may be interpolated for intermediate values of surface area. For containers with total outside surface area greater than 2.500 sq. ft., the required flow rate can be calculated using the formula, Flow Rate CFM Air = 22.11 $A^{~~0.82~~}$ where A = outside surface area of the container in square feet.

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APPENDIX B

TFI-RMA SPECIFICATION FOR ANHYDROUS AMMONIA HOSE TFI-RMA STANDARD NO. M-5

1. SCOPE

This specification covers hose and hose assemblies commonly referred to as "pressure transfer hose," used to convey anhydrous ammonia liquid or to convey anhydrous ammonia gas where the gas is in contact with liquid ammonia. This specification primarily covers hose and hose assemblies which have a minimum burst pressure of 1750 psig, a safety factor of 5, and a maximum working pressure of 350 psig. These figures should not be misconstrued to mean that they are the maximum pressures to which anhydrous ammonia hose and hose assemblies are built, since higher pressure hose and hose assemblies are available for special applications.

2. SIZES AND TOLERANCES

Anhydrous ammonia HOSE ~~nose~~ shall be made with the following~~:~~ dimensions and tolerances:

RUBBER COVERED NOSE ~~ROSE~~ FOR USE WITH TWO-PIECE SCREW TYPE COUPLINGS

I.D.	Tolerance	O.D.	Tolerance
½"	± 1/32"	15/16"	± 1/32"
3/4"	± 1/32"	1 ½"	± 1/32"
1"	± 1/16"	1 ½"	± 1/16"

NON-RUBBER ~~RULBER~~ COVERED AND RUBBER COVERED HOSE FOR USE WITH FULL FLOW COUPLINGS

I.D.	Tolerance	O.D.	Tolerance	Nominal Tubing O.D.
13/32"	+ .039", - .015"	49/64"	± .031"	½"
½	+ .047", - .015"	59/64"	± .031"	5/8"
5/8"	+ .047", - .015"	1-5/64"	± .031"	3/4"
7/8"	+ .047", - .015"	1-15/64"	± .031"	1"
1 1/8"	+ .062". - .015"	1 ½"	± .047"	1 ½"
1 3/8"	+ .062", - .015"	13/4"	± .047"	1 ½"
1-13/16"	+ .062", - .015"	2-7/32"	± .047"	2"

HOSE FOR USE WITH OTHER TYPES OF COUPLINGS*

I.D.	Tolerance
½"	± 1/32"
3/4"	± 1/32"
1"	± 1/16"
½"	± 1/16"
1½"	± 1/16"

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HOSE FOR USE WITH OTHER TYPES OF COUPLINGS*	
I.D.	Tolerance
2"	± 1/16"

* The O.D. dimension and tolerance were intentionally omitted from this tabulation to provide for developments in both hose and couplings.

3. CONSTRUCTION

3.1 Inner Tube

The tube shall be uniform in quality and thickness and free from injurious defects. It shall meet the physical requirements of Section 4. The material shall be resistant to hardening or other deterioration due to the action of ammonia.

3.2 Reinforcement

The reinforcement shall consist of any material not adversely affected by permeating ammonia. The reinforcement shall be applied evenly and uniformly, and in such a way that it will meet the physical requirements of Section 4. In constructions utilizing a ply or plies of wire reinforcement, the composition of the wire shall be a suitable corrosion resistant stainless steel.

3.3 Cover

A rubber cover if used shall be uniform in quality and thickness and free from injurious defects. It shall meet the physical requirements of Section 4. The cover shall be so compounded or constructed that it will not blister in service, and will be resistant to deterioration due to the action of ammonia. A gas tight cover shall be pricked to relieve pressure build-up between inner tube and cover. The cover shall be resistant to deterioration due to exposure to the elements.

4. PHYSICAL TESTS

4.1 Tension Test of Tube and Cover

	Tube	Cover
Tensile, psi. min.	800	1200
Elongation, percent, min.	150	200

4.2 Adhesion Test

	Tube	Ply	Cover
Adhesion lbs./in.	10	8	10

4.2.1 In constructions having-braided wire or woven wire filler reinforcing members, only the cover ADHESION ~~adehsion~~ requirement will apply, as it is impractical to prepare ADHESION ~~adehsion~~ test specimens except for determining cover adhesion.

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4.3 Burst Test

All sizes have a minimum burst of 1750 psig. (See Scope).

4.4 Ammonia Performance Test

During the conditioning and flexing described in Sections 7.4 and 7.4.2 there shall be no evidence of cover blistering or leakage. At the conclusion of the conditioning and at the conclusion of the flexing test, the burst must still meet the requirements of Section 4.3. There shall be no evidence of separation of the component parts when the remainder of the samples are examined.

4.5 Low Temperature Test

The hose shall not fail at minus 40° F plus or minus 2°, when tested as described in Section 7.5, of this Specification.

5. TYPES OF TESTS

5.1 Acceptance Inspection

This includes all the tests specified, with the exception of the ammonia performance test.

5.2 Qualification Tests

The qualification tests are intended to establish that the hose is properly designed and constructed to give satisfactory service life. These tests shall be conducted by a recognized independent laboratory. The qualification tests shall consist of all the tests specified herein including the ammonia performance test.

6. METHOD OF SAMPLING

6.1 Acceptance Inspection

A 24-inch sample of each size and type hose, representative of the lot, shall be selected from each lot manufactured at one time, or from each 25,000 feet, whichever is smaller.

6.2 Qualification TEST ~~Teat~~

In addition to the samples specified in Section 6.1, two 12-foot lengths of each size hose shall be selected for the ammonia performance test. Each new hose shall be subjected to a qualification test, and again whenever there has been a design change.

7. METHODS OF TESTING

7.1 Tension Test of Tube and Rubber Cover

The tension test shall be made in accordance with ASTM D-380.

7.2 Friction Test

The friction test shall be made in accordance with ASTM D-380.

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7.3 Burst Test

The burst test shall be made in accordance with ASTM D-380 using the method entitled "Straight Bursting Test"

7.4 Ammonia Performance Test

Two 12-foot lengths of hose, to be marked "A" and "B", shall be filled with liquid anhydrous ammonia by connecting to a tank and flushing out with ammonia to remove all the air. One end of each length shall be sealed and the other end left connected to the liquid space of a tank of ANHYDROUS ~~anyhdrous~~ ammonia. The hose shall then be conditioned for 14 days at ambient temperature of 60º to 100º F. A valve between the ammonia tank and the hose may be closed providing it is opened at least ONCE ~~one~~ each day to completely fill the hose with liquid anhydrous ammonia. The hose shall be examined each day for visible defects. There shall be no evidence of the cover blistering or perceptible leakage. If the hose is valved off at each end when liquid full, a HYDROSTATIC ~~hydrosatic~~ relief valve should be provided between the block valves.

7.4.1 Conditioned Hose Burst Test

A 24-inch sample cut from hose marked "A" shall be subjected to a straight hydrostatic bursting test in accordance with Section 7.3.

7.4.2 Conditioned Hose Flexing Test

7.4.2.1 The 12-foot hose length marked "B" shall be installed in flexing test machine (Fig. 1). One end of the hose is to be connected to the traveling block and the free end passed around two pulleys with diameters as shown in Table 1. A 30-pound weight shall then be attached to the free end.

7.4.2.2 From the remainder of hose length marked "A", (sizes 1 inch and under only), cut a section to length indicated in Table 1. Connect one end to the vertically traveling block as shown in Fig. 1 and connect the other end to the liquid space of a tank of anhydrous ammonia. Maintain the temperature of hose and ammonia between 70º F and 90º F. The test on the feeder hose-does not apply to sizes over 1 inch. To conduct the flex test on the larger sizes any convenient hose may be used as a feeder hose.

7.4.2.3 The flexing test shall continue for 72 hours at a rate of approximately 470 cycles per hour with a 42-inch vertical movement of the traveling block. A valve between the ammonia tank and the hose may be closed providing it is opened at least once each day to pressurize the hose. The hose shall be examined each day for visible defect. There shall be no evidence of cover blistering or leakage.

7.4.2.4 At the conclusion of the flexing period, cut a 24-inch sample from hose "A" and from hose "~~6~~ B" and subject each sample to a straight burst test in accordance with Section 7.3. All samples shall have a minimum burst of 1750 psig.

TABLE 1

Hose Size	Pulley Diameter	Feeder Hose Length
½	14" ± ½"	36"
3/4"	14" ± ½"	36"
1"	14" ± ½"	36"
1 ½"	15" ± ½"	
1 ½"	18" ± ½"	

Editing comments: Changes to this rule are indicated in ~~strikethrough~~ for removal and SMALL CAP, DOUBLE UNDERLINE for additions. If you are able to view this document in color the changes are also indicated in red.

TABLE 1

Hose Size	Pulley Diameter	Feeder Hose Length
2"	24" ± ½"	

7.5 Low Temperature Test

A straight piece of hose at least 24 inches long, conditioned to minus 40° F plus or minus 2° F for 5 hours, and bent 180° within two seconds around a mandrel 12 times the nominal inside diameter of the hose, shall not break or show cracks in the tube or cover.

8. RETESTS AND REJECTIONS

Any hose which fails in one or more tests may be resampled and retested, for which purpose two additional samples shall be selected from the hose for the test that failed to MEET THE ~~meetthe~~ requirements. Failure of either of the retested samples shall be cause for final rejection.

9. HOSE ASSEMBLIES

The couplings must be so designed and constructed that an assembly shall have sufficient strength that it will reach the minimum burst pressure, as required by Section 4.3, before the end fittings leak or come off when pressure is applied as specified in ASTM D-380 for Hydrostatic Tests. Fittings must be resistant to the action of anhydrous and aqueous ammonia and in no case may assemblies be supplied with copper alloy fittings.

10. MARKINGS

Hose shall be clearly marked at least once every five feet with manufacturer's name or trademark, “Anhydrous Ammonia,” the maximum working pressure in psig, year of manufacture, and “TFI-RMA Spec.,” for all hose manufactured after January 1, 1964. As indicated in the Scope, the maximum working pressure must not be less than 350 psig.

11. PACKAGING

11.1 Packing

Unless otherwise specified, hose shall be packed in substantial commercial containers of the type, size and kind commonly used for the purpose, so constructed as to insure acceptance and safe delivery to common or other carriers, at the lowest rate, to the point of delivery specified on the order.

11.2 Identification

Unless otherwise specified, shipping containers shall be marked with the size and quantity of hose therein, the name of the manufacturer and the number of the order.

TYPICAL HOSE FLEXING MACHINE

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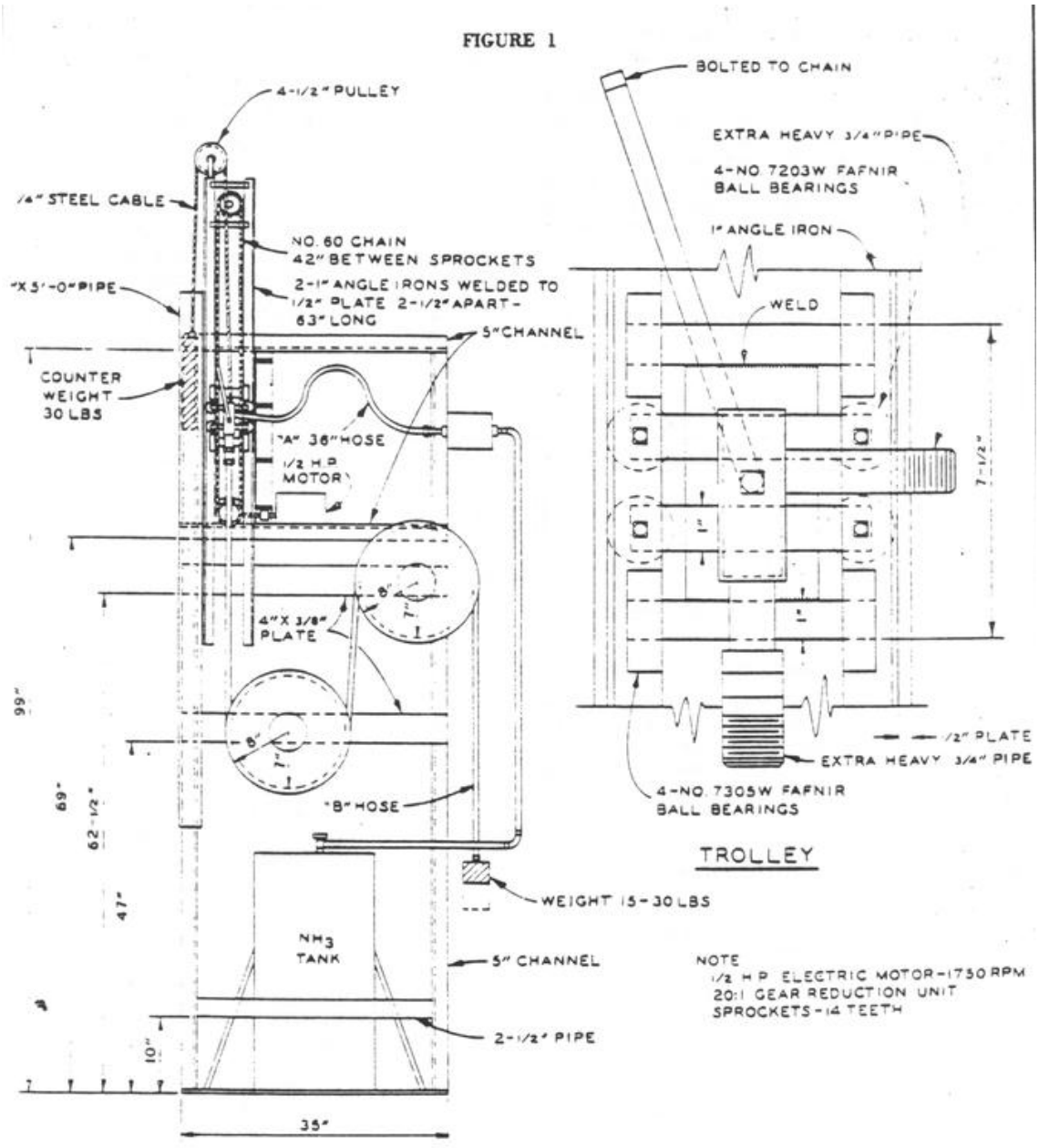
APPENDIX C

AVAILBILITY OF REFERENCE MATERIAL

1. TYPICAL HOSE FLEXING MACHINE



TYPICAL HOSE FLEXING MACHINE