

## Chapter Ind 43

## ANHYDROUS AMMONIA

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PART I  
DEFINITIONS

**Ind 43.01 Definitions.** For the purpose of these rules, the terms listed below shall be construed to have the following meanings:

(1) The term ANHYDROUS AMMONIA refers to the compound formed by the combination of the 2 gaseous elements, nitrogen and hydrogen, in the proportion of one part of nitrogen to 3 parts of hydrogen by volume. Anhydrous ammonia is ammonia gas in compressed and liquefied form. It is not to be confused with aqueous ammonia which is a solution of ammonia gas in water.

(2) TANK refers to vessels designed and constructed for the storage and handling of anhydrous ammonia.

(3) GAS refers to anhydrous ammonia in either the gaseous or liquefied state.

(4) CODE refers to the boiler and pressure vessel code published by the department.

(4a) "Department" means the department of industry, labor and human relations.

(5) **DESIGN PRESSURE** is identical to the term **MAXIMUM ALLOWABLE WORKING PRESSURE**.

(6) **APPURTENANCES** refers to all devices such as safety devices, liquid level gaging devices, valves, pressure gages, fittings, metering or dispensing devices.

(7) **CONTAINER** includes all vessels such as tanks or cylinders used for the storage and handling of anhydrous ammonia.

(8) **SYSTEMS** refers to an assembly of equipment consisting essentially of the container or containers, appurtenances, pumps, compressors, and inter-connecting piping.

(9) **APPROVED** means: (a) Listed by a recognized testing laboratory, which has been approved by the department or

(b) Accepted by the department.

(10) **FILLING DENSITY** is defined as the per cent ratio of the weight of the gas in a container to the weight of water the container will hold at 60° F.

(11) **CAPACITY** refers to the total volume of the container measured in standard U.S. gallons, unless otherwise specified.

**Note:** 1. In the interest of safety, it is important that personnel understand the properties of anhydrous ammonia and that they be thoroughly trained in safe practices for its storage and handling.

2. Under moderate pressure the gas liquefies, but upon release of the pressure, the liquid is readily converted into the gaseous phase. Advantage of this characteristic is taken by the industry, and for convenience the gas is shipped and stored under pressure as a liquid.

3. Anhydrous ammonia may cause varying degrees of irritation of the skin or mucous membrane, and may injure severely the respiratory mucosa.

4. At atmospheric temperatures and pressures, ammonia is a pungent and colorless gas and serves as its own warning agent. Since ammonia gas is lighter than air, adequate ventilation is the best means of preventing any accumulation.

5. In the case of the pure product at atmospheric pressure and below -28° F., anhydrous ammonia is a liquid. Anhydrous ammonia freezes to a white crystalline mass at -107.9° F.

6. The common metals are not affected by dry "anhydrous" ammonia. Moist "aqua" ammonia will not corrode iron or steel, but will rapidly react with copper, brass, zinc, and many alloys, especially those containing copper. It is required that only iron, steel, and certain nonferrous alloys, proved to be satisfactory for ammonia service, be used for ammonia containers, fittings, and other equipment.

7. The flammable limits of ammonia are from 16 to 25% by volume in air. Experience has shown that ammonia is extremely hard to ignite in spite of these theoretical limits, and is generally considered to be a non-flammable gas.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60; am. (4) and (9), cr. (4a), Register, July, 1978, No. 271, eff. 8-1-78.

## PART II APPLICATION OF RULES

**Ind 43.02 Application.** These rules are intended to apply to the design, construction, location, installation, and operation of anhydrous ammonia systems. These rules do not apply to ammonia manufacturing plants, refrigerating or air conditioning systems.

(1) Sections Ind 43.10 through Ind 43.23. "Basic Rules" apply to all installations unless otherwise specified.

(2) Sections Ind 43.30 through 43.40 apply to stationary, non-refrigerated storage installations utilizing containers other than those stamped ICC.

(3) Sections Ind 43.50 through 43.61 apply to systems mounted on trucks, semi-trailers and full trailers (other than farm vehicles) used for the transportation of ammonia.

(4) Sections Ind 43.70 through 43.75 apply to systems mounted on farm vehicles for the transportation of ammonia.

(5) Sections Ind 43.80 through 43.83 apply to systems mounted on farm vehicles for the application of ammonia.

History: Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Note: Penalty For Violation of Rules**

Section 101.02(12), Stats., provides that "every day during which any person, persons, corporation or any officer, agent or employe thereof, shall fail to observe and comply with any order of the department or to perform any duty enjoined by ss. 101.01 to 101.25 inclusive, shall constitute a separate and distinct violation of such order, or of said sections as the case may be."

Section 101.02(13)(a), Stats., provides that any employer or other person who violates an order, or fails or refuses to comply with the requirements of a legal order of the department shall forfeit and pay into the state treasury the sum of not less than \$10, nor more than \$100, for such violation.

**Ind 43.03 Inspections.** (1) The authorized inspectors of the department, upon presenting appropriate credentials to the owner, operator, or agent in charge, are authorized—

(a) To enter without delay and at reasonable times any factory, plant, establishment, construction site, or other area, workplace or environment where work is performed by an employe of an employer; and

(b) To inspect and investigate during regular working hours and at other reasonable times, and within reasonable limits and in a reasonable manner, any such place of employment and all pertinent conditions, structures, machines, apparatus, devices, equipment, and materials therein, and to question privately any such employer, owner, operator, agent or employe.

(2) The inspector before making an inspection shall contact a representative of the employer and a representative authorized by the employes who shall be given an opportunity to accompany the inspector during the physical inspection of any workplace under sub. (1) for the purpose of aiding such inspection.

(a) Where there is no authorized employe representative, the inspector shall consult with a reasonable number of employes concerning matters of health and safety in the workplace.

Note: The department policy is not to give advance notice, but in the scheduling and in the act of inspecting it may not always be possible to avoid advance notice or to obtain accompaniment as, for example, inside boilers or in precarious locations of elevator installations, but otherwise these rules will be diligently observed.

History: Cr. Register, April, 1973, No. 208, eff. 5-1-73; am. (2) (intro.), Register, July, 1978, No. 271, eff. 8-1-78.

**PART III  
BASIC RULES**

**Ind 43.10 Approval of equipment and systems.** (1) Each system utilizing containers of 1,200 U.S. gallons capacity or less shall be:

(a) Listed by a nationally recognized testing laboratory, which has been approved by the department, or

(b) Accepted by the department.

(2) In systems utilizing containers of over 1,200 U. S. gallons capacity, each metering or dispensing device, container valve, excess-flow valve, gaging device and relief valve shall have its correctness as to design, construction, and performance determined by:

(a) Listing by a nationally-recognized testing laboratory which has been approved by the department, or

(b) The department.

(3) (a) Before construction or installation of new or additional facilities for the bulk storage or handling of anhydrous ammonia is undertaken, approval of the department shall be obtained. The department shall review and make a determination on an application for installation approval within 15 business days of receiving the required information and fees.

(b) In applying for approval, full information shall be submitted in writing together with at least 3 prints of scaled engineering plans. The submitted plans shall show the following:

1. The name of the person, firm or corporation proposing the construction or installation.

2. The location of the proposed construction or installation showing the property lines on all sides and adjacent railways or streets and highways.

3. A plot of the area to be utilized showing location of buildings, tanks, loading and unloading points and clearances as covered in s. Ind 43.13 (1).

4. The capacity and outside surface area of each tank.

5. The size, manufacturer, figure number and capacity of safety relief valves.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60; am. (1)(a) and (b), (2)(a) and (b) and (3)(a), Register, July, 1978, No. 271, eff. 8-1-78; am. (3) (a), Register, May, 1985, No. 353, eff. 6-1-85.

**Ind 43.11 Requirement for construction and original test of containers.**

(1) All containers (except those stamped ICC) used for the storage, transportation or dispensing of anhydrous ammonia shall be constructed in accordance with the Wisconsin boiler and unfired pressure vessel code.

(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:

(a) Containers shall be stress-relieved after fabrication in accordance with the code, or

(b) Cold-formed heads, when used shall be stress-relieved, or

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(c) Hot-formed heads shall be used.

(3) Non-code welding, where necessary, shall be made only on saddles or brackets originally welded to the container by the manufacturer. Non-code welding directly to the container or any part subject to pressure is not authorized.

(4) The provisions of section Ind 43.11 (1) and (2) shall not be construed as prohibiting the continued use of reinstallation of containers constructed and maintained in accordance with the standards of the department in effect at the time of fabrication.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60; am. (4), Register, July, 1978, No. 271, eff. 8-1-78.

**Ind 43.12 Markings on containers and systems.** (1) All aboveground containers (except those stamped ICC) shall have the manufacturer's nameplate firmly attached to the container, designating manufacturer's serial number A.S.M.E. or National Board number, year built, working pressure in pounds per square inch gage, outside surface area in square feet, shell and head thickness, and capacity in U. S. gallons.

(2) On underground containers, the manufacturer's nameplate designating the same information as required in section Ind 43.12 (1) shall be fastened to the system.

(3) Marking shall indicate the maximum level to which the container may be filled with liquid at liquid temperatures between 20° F. and 100° F., except on containers provided with fixed maximum level indicators, or which are filled by weighing. Markings shall be in increments of not more than 20° F.

(a) For underground and aboveground containers the markings shall appear on system nameplate or on liquid level gaging device.

(4) Where a container is fabricated with "welded-in" internal piping, the container openings shall be marked to indicate whether they communicate with the liquid or vapor space.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.13 Location of storage tanks.** (1) Tanks shall be located outside of buildings other than those especially constructed for that purpose. Permanent storage shall be located outside of densely populated areas and subject to the approval of the department. However, this distance shall not be less than 50 feet from the line of property which may be built on, or from a source of drinking water; or not less than 400 feet from any school, hospital, or other place of public assembly.

(2) A permanent storage location which at the time of its establishment was in conformity with the requirements of section Ind 43.13 (1) shall continue to be lawful notwithstanding the subsequent installation or constructed by others within the clearances specified in section Ind 43.13 (1).

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60; am. (1), Register, July, 1978, No. 271, eff. 8-1-78.

**Ind 43.14 Container valves and accessories.** (1) All shut-off valves and accessory equipment (liquid or vapor) shall be approved for use

with anhydrous ammonia, and designed for not less than the maximum pressure to which they may be subjected. Valves which may be subjected to container pressure shall have a rated working pressure of at least 250 psig.

(2) All connections to containers, except safety relief connections and gaging devices, shall have shut-off valves located as close to the container as practicable.

(3) Liquid level gaging devices which are so constructed that outward flow of container content shall not exceed that passed by a No. 54 drill size opening, need not be equipped with excess-flow valves.

(4) Openings from container or through fittings attached directly on container, to which pressure gage connection is made, need not be equipped with excess-flow valve if such openings are protected by not larger than No. 54 drill size opening.

(5) All excess-flow valves shall be plainly and permanently marked with the name or trademark of the manufacturer, the catalog number and the rated capacity.

(6) Excess-flow valves shall close automatically at the rated flows of vapor or liquid as specified by the manufacturer. The connections and line including valves, fittings, etc., being protected by an excess-flow valve, shall have a greater capacity than the rated flow of the excess-flow valve, so that the valve will close in case of failure at any point in the line or fittings.

(7) Excess-flow and back-pressure check valves shall be located inside of the container or at a point outside where the line enters the container. In the latter case, installation shall be made in such a manner that any undue strain, beyond the excess-flow or back-pressure check valve, will not cause breakage between the container and the valve.

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

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.15 Piping, tubing and fittings.** (1) All fittings, where subjected to container pressure, shall be made of materials specified for use with anhydrous ammonia and designed for a minimum working pressure of 250 psig. No cast iron bushings, plugs or pipe fittings shall be used.

(2) Galvanized pipe shall not be used. Black steel or wrought iron pipe of at least 800 pounds minimum bursting pressure (ASA Schedule 40) may be used, provided pipe joints are welded or joined by means of welding type flanges. Screwed joints are permissible only with extra heavy (ASA Schedule 80) pipe. Pipe joint compounds shall be resistant to ammonia.

(3) All pipe lines shall be installed as nearly as possible in a straight line with a minimum amount of pipe, and shall not be restricted by an excessive number of elbows and bends. Where nipples are used, they shall be of extra heavy seamless type.

(4) Rigid connections, or all metal flexible connections with a bursting pressure of 1,000 psig, are recommended for permanent installation,



but other types of flexible connections may be used for temporary installation.

(5) Provisions shall be made for expansion, contraction, jarring, vibration and for settling.

(6) Adequate provisions shall be made to protect 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.

(7) 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, or at 150 psig, whichever is greater.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.16 Hose specifications.** (1) Hose and hose connectors shall be fabricated of materials that are resistant to the action of anhydrous ammonia.

(2) Hose subject to container pressure shall be designed for a minimum working pressure of 350 psig and a minimum bursting pressure of 1750 psig. Such hose assemblies, when made up, shall be capable of withstanding a test pressure of 500 psig.

(3) Hose and hose connections located on the low pressure side of flow control or pressure reducing valves or devices discharging to atmospheric pressure shall be designed for a minimum working pressure of 60 psig. All connections shall be designed, constructed, and installed so that there will be no leakage when connected.

(4) Where hose is to be used for transferring liquid, wet hose shall be used. 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 section Ind 43.17 (10)).

(5) On all hose ½ inch I.D. and larger, used for the transfer of anhydrous ammonia liquid or vapor, there shall be permanently and clearly marked at intervals of not more than 5 feet with the following information:

ANHYDROUS AMMONIA  
Maximum W.P.-----  
Manufacturer's Name or Trademark  
  
Year of Manufacture

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.17 Safety devices.** (1) Every container used with systems described in sections Ind 43.40 through Ind 43.83 shall be provided with one or more safety relief valves of springloaded or equivalent type. The discharge from safety relief valves shall be directed away from the container upward and unobstructed to the open air. The rate of discharge shall be in accordance with the provisions of Appendix A.

(2) Container safety relief valves shall be set to start-to-discharge as follows, with relation to the design pressure of the container:

Containers Stamped		Minimum	Maximum
(a) ASME—U-68, U-69 & UW52 (b) .....		100%*	125%*
(b) ASME—U-200, U-201, UW52 (a) .....		95%*	100%*
(c) ICC	As approved by the department.		

\* A plus tolerance of 10% is permitted.

(3) Safety relief valves used on containers or systems described in sections Ind 43.40 through Ind 43.83 shall be constructed to discharge at the rates required in section Ind 43.17 (1). The design of these valves must insure such discharge before the pressure exceeds 120% of the maximum (not including the 10% referred to in section Ind 43.17 (2)) start-to-discharge pressure setting.

(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 approved means for sealing the adjustment.

(5) Shut-off valves shall not be installed between the safety relief valves and the container, except that a shut-off valve may be used where the arrangement of this valve is such as always to afford full required capacity flow through the relief valves.

(6) The exception in section Ind 43.17 (5) is made to cover such cases as a three-way valve installed under 2 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 may be where 2 separate relief valves are installed with individual shut-off valves. In this case, the 2 shut-off valve stems shall be mechanically interconnected in a manner which allows full required flow of one relief valve at all times.

(7) Safety relief valves shall have direct communication with the vapor space of the container.

(8) Each safety relief valve used with systems described in sections Ind 43.40 through Ind 43.83 shall be plainly and permanently marked as follows:

- (a) With the letters "AA".
- (b) The pressure in pounds per square inch gage (psig) at which the valve is set to start-to-discharge.
- (c) The rate of discharge of the valve at its full open position in cubic feet per minute of air at 60° F. and atmospheric pressure (14.7 psia).
- (d) The manufacturer's name and catalog number.

**Note:** A safety relief valve marked AA-250-4200 (air) would mean that this valve is suitable for use on an anhydrous ammonia container, that is set to start-to-discharge at 250 psig; and that its rate of discharge at full-open position (See section Ind 43.17 (1) and (2)) is 4200 cubic feet per minute of air.

(9) Connections such as couplings, flanges, nozzles, and discharge lines for venting, to which relief valves are attached, shall have internal dimensions of sufficient size to avoid any restriction of flow through the relief valves.

(10) A safety relief valve, venting to atmosphere at a safe location, shall be installed between each pair of shut-off valves in an ammonia line where liquid may be trapped. It is recommended that the start-to-discharge pressure of such relief valves be not less than 350 psig, and not in excess of 400 psig.

(11) Discharge from safety relief devices shall not terminate in or beneath any building.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60; am. (2) (c), Register, July, 1978, No. 271, eff. 8-1-78.

**Ind 43.18 Filling densities.** The filling densities for containers shall not exceed the following:

	Aboveground	Underground
(1) Uninsulated.....	56%*	58%
(2) Insulated.....	57%	—
(3) ICC stamped containers shall be filled in accordance with the department requirements which are identical to the ICC regulations.		

\*This corresponds to 85% by volume at 5° F. At 60° F. it is 90.6% by volume.

**Note:** If containers are to be filled according to liquid level by any gaging method other than a fixed length dip tube gage, each container shall have a thermometer well so that the internal liquid temperature can be easily determined.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60; am. (3), Register, July, 1978, No. 271, eff. 8-1-78.

**Ind 43.19 Transfer of liquids.** (1) At least one competent attendant shall supervise the transfer of liquids from the time the connections are first made until they are finally disconnected.

(2) Containers shall be filled or used only upon authorization of owner. Containers shall be gaged and charged only in the open air or in buildings especially provided for that purpose.

(3) Pumps used for transferring ammonia shall be recommended and labelled for ammonia service by the manufacturer.

(a) Positive displacement pumps shall have installed off the discharge port a constant differential relief valve discharging 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 recommendation.

(b) On the discharge side of the pump before the relief valve line there shall be installed a pressure gage graduated from 0 to 400 psi.

(c) Centrifugal or regenerative pumps do not require a by-pass relief valve but the installation shall incorporate a line from the discharge side of the pump to the vapor space of the supplying tank and in this line, at accessible level, a shut-off valve shall be installed.

(d) Shut-off valves shall be installed within 3 feet of the inlet of the pump and within 2 feet of the discharge.

(4) Compressors used for transferring or refrigerating ammonia shall be recommended and labelled for ammonia service by the manufacturer.

(a) Plant piping shall contain shut-off valves located as close as practical to compressor connections.

(b) A relief valve large enough to discharge the full capacity of the compressor shall be connected to the discharge before any shut-off valve. The discharging pressure of this valve shall not exceed 300 psig.

(c) Compressors shall have pressure gages graduated from 0-400 psi at suction and discharge.

(d) Means, such as a drainable liquid trap or suitable valve arrangement, shall be provided on the compressor suction to minimize the entry of liquid into the compressor.

(e) The pipe line to which the loading or unloading hoses are connected shall be equipped with a backflow check valve or excess-flow check valve to prevent discharge of ammonia from the containers and the line in case of hose or fitting failure.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.20 Prohibited transfer.** (1) Transferring from tank cars or transports into mobile containers is prohibited. Anhydrous ammonia shall be transferred from tank cars and transports into permanent bulk storage only.

(a) *Exception.* Where ammonia is used directly in the manufacturing of mixed fertilizers, tank cars may be connected directly to the plant facilities if the tank cars are on a private or leased railway spur.

(2) The capacity of such permanent storage shall be not less than the capacity of the tank car or transport being unloaded.

(3) Railway tank cars are not to be used for bulk storage of anhydrous ammonia. *Exception:* Cars may be retained on a private or leased railway spur until they can be completely unloaded into storage complying with section Ind 43.20 (1) and (2).

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.21 Tank car unloading points and operations.** (1) Tank car siding shall be substantially level.

(2) A sign reading, "Stop—Tank Car Connected", shall be displayed at the active end or ends of the siding while the tank car is connected for unloading.

(3) While tank cars are on siding for unloading, the wheels at both ends shall be blocked on the rails.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.22 Liquid level gaging devices.** (1) Each container, except containers filled by weight, shall be equipped with a liquid level gaging device of approved design.

(2) All gaging devices shall be arranged so that the maximum liquid level to which the container may be filled is readily determinable. (See sections Ind 43.12 (4) and Ind. 43.18 (1)).

(3) Gaging devices that require bleeding of the product to the atmosphere, such as the rotary tube, fixed tube and slip tube, shall be so designed that the bleed valve maximum opening is not larger than a No. 54 drill size, unless provided with an excess flow valve. The provisions of

section Ind 43.22 (3) do not apply to sections Ind 43.80 through Ind 43.83.

(4) Gaging devices shall have a design working pressure of at least 250 psig.

(5) Fixed liquid level 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 gage is threaded shall be placed at the 85% level of the container. If located elsewhere, the dip tube of this gage shall be installed in such a manner that it cannot be readily removed.

(6) Gage glasses of the columnar type shall be restricted to bulk storage installations. They shall be equipped with valves having metallic handwheels, with excess-flow valves, and with extra heavy glass adequately protected with a metal housing applied by the gage manufacturer. They shall be shielded against the direct rays of the sun.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.23 Painting.** Tanks shall be painted a light reflecting color.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

#### **PART IV SYSTEMS UTILIZING CONTAINERS CONSTRUCTED IN ACCORDANCE WITH THE WISCONSIN BOILER AND UNFIRED PRESSURE VESSEL CODE**

**Ind 43.30 Application.** Sections Ind 43.30 through Ind 43.40 apply to stationary, non-refrigerated storage installations utilizing containers constructed in accordance with the Wisconsin boiler and unfired pressure vessel code. All basic rules of sections Ind 43.10 to Ind 43.23, inclusive, apply to sections Ind 43.30 through Ind 43.40 unless otherwise noted.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.31 Design pressure of containers.** Containers shall be constructed in accordance with section Ind 43.11 with a minimum design pressure of 250 psig.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.32 Installation of storage containers.** (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 must 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 foundations shall maintain the lowest point of the tank at not less than 18 inches above the ground.

(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. Suitable means of preventing corrosion shall be provided on that portion of the container in contact with the foundations or saddles.

(3) Secure anchorage or adequate pier height shall be provided against container flotation wherever high flood water might occur.

(4) 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 will not be 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.

(5) 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 department. Such protective coating shall be equivalent to hot-dip galvanizing, or to 2 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.

(6) Distance between aboveground containers of over 1,200 gallons capacity shall be at least 5 feet.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60; am. (5), Register, July, 1978, No. 271, eff. 8-1-78.

**Ind 43.33 Container valves and accessories.** (1) All containers shall be equipped with a fixed liquid level gage.

(2) All containers shall be equipped with a pressure indicating gage having a dial graduated from 0-400 psi.

(3) The filling connection shall be fitted with an approved combination back-pressure check valve and excess-flow valve; one double or 2 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.

(4) All containers shall be equipped with an approved vapor return valve.

(5) All vapor and liquid connections, except safety relief valves and those specifically exempt in section Ind 43.14 (3) and (4) 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.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.34 Safety devices.** Every container shall be provided with one or more safety relief valves of spring-loaded or equivalent type and shall comply with the following:

(1) 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 restricted or smaller in size than the relief valve outlet connection. All relief valve discharges shall have suitable raincaps 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.

(2) If desired, vent pipes from 2 or more safety relief devices located on the same unit, or similar lines from 2 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.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.35 Underground containers.** (1) Spring-loaded relief valves installed on underground containers may be reduced to a minimum of 30% 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 therefrom. 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 requirement of the relief valves.

(2) On underground installations where there is a probability of the manhole or housing becoming flooded, the discharge from vent pipes should be above the possible water level. All manholes or housings shall be provided with ventilated louvers or their equivalent, the area of such openings equalling or exceeding the combined discharge areas of safety relief valves and vent pipes which discharge their content into the manhole housing.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.36 Marking of containers.** Each tank or group of tanks shall be marked on at least 2 sides with the words "Caution--Ammonia" in sharply contrasting colors with letters not less than 6 inches high.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.37 Capacity of containers.** Individual storage container capacity shall be limited only by good engineering practice.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.38 Protection of tanks, accessories, grounding.** (1) Valves and other appurtenances shall be protected against tampering and physical damage. Such appurtenances shall also be protected during the transit of containers intended for installation underground.

(2) All connections to underground containers shall be located within a substantial dome, housing, or manhole fitted with a substantial removable cover.

(3) All aboveground storage containers shall be electrically grounded in an effective manner.

(4) All areas occupied by storage installations shall be kept free of dry grass and weeds. Manually controlled valves which if open would allow gas to discharge into the atmosphere, shall be kept locked when the installation is unattended.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.39 Reinstallation of containers.** Containers once installed underground shall not later be reinstalled aboveground or underground, unless they successfully withstand hydrostatic pressure re-tests at the pressure specified for the original hydrostatic test as required by the

code under which constructed and show no evidence of serious corrosion. Where containers are installed underground, the corrosion-resistant coating shall be put in good condition. Where reinstalled aboveground, all requirements for aboveground containers shall apply.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.40 Safety equipment.** All stationary storage plants shall have on hand as a minimum the following equipment:

- (1) An approved ammonia type gas mask with refill charges.
- (2) One pair of rubber gloves.
- (3) Easily accessible shower bath and/or one 50-gallon open top drum filled with water and/or open-top stock tank.
- (4) One pair tight-fitting ventless-type goggles.
- (5) First aid kit (ammonia type).

**Recommendation:** Additional equipment consisting of rubber boots, rubber slicker and/or rubber pants and jacket should be provided.

**Note:** 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 concentrations. 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 may as well be discarded after use. Unopened canisters may be guaranteed for as long as 3 years. All should be dated 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. Oxygen-supplied masks should not be used in this service.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

## PART V SYSTEMS MOUNTED ON TANK TRUCKS, SEMI-TRAILERS, AND TRAILERS FOR TRANSPORTATION OF AMMONIA

**Ind 43.50 Application.** Sections Ind 43.50 through Ind 43.61 apply specifically to systems mounted on trucks, semi-trailers, and trailers (other than vehicles covered in sections Ind 43.70 through Ind 43.75) used for the transportation of ammonia. All basic rules of sections Ind 43.10 to Ind 43.23, inclusive, apply to these sections unless otherwise noted. Systems for tank trucks and trailers for transportation of anhydrous ammonia, in addition to complying with these requirements, shall also comply, where required, with the requirements of the interstate commerce commission and those of any other regulatory body which may apply. For systems mounted on farm vehicles for transporting and for the application of ammonia, see sections Ind 43.70 through Ind 43.75 and Ind 43.80 through Ind 43.83.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.51 Design pressure of containers.** (1) Containers shall be constructed in accordance with section Ind 43.11 with a minimum design pressure of 250 psig, except that containers used in interstate commerce shall meet interstate commerce commission regulations.

(2) The shell or head thickness of any container shall not be less than 3/16 of an inch.



(3) Baffles are not required for cargo tanks designed for service in which under normal conditions the tank is loaded to capacity and discharged at one unloading point. All other containers over 500 gallons capacity should be equipped with suitable (semi-rigid) baffle plates.

(4) All container openings except safety relief valves, liquid level gaging devices and pressure gages, shall be labeled to designate whether they communicate with liquid or vapor space. Labels may be on valves, except where a container is fabricated with welded-in interal piping; the container opening shall be marked to indicate whether or not it communicates with the liquid or vapor space.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.52 Mounting containers on truck.** (1) A suitable "stop" or "stops" shall be mounted on the truck, semi-trailer, or trailer or on the container in such a way that the container shall not be is dislodged from its mounting due to the vehicle coming to a sudden stop. Back slippage shall also be prevented by proper methods.

(2) A suitable "hold-down" device shall be provided which will anchor the container at one or more places on each side of the container to the truck, semi-trailer or trailer frame.

(3) Whenever any tank truck or trailer is designed so that the container or containers constitute in whole or in part the stress member or chassis of the vehicle in lieu of a frame, then the installation of the container or containers shall be constructed to withstand the additional stresses thereby imposed. In that case the cradles shall be welded to the container.

(4) Stops and anchors shall be so installed as to be readily accessible for inspections and maintenance.

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

(6) Provisions shall be made to secure both ends of the hose while in transit.

(7) When the cradle and the tank are not welded together, suitable material shall be used between them to eliminate metal-to-metal friction.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.53 Container valves and accessories.** (1) All containers shall be equipped with a fixed liquid level gage.

(2) All containers shall be equipped with a pressure indicating gage having a dial graduated from 0—400 psi.

(3) Fittings shall be adequately protected from physical damage by means of a metal box or cylinder with open top, securely fastened to container; or by means of rigid guards well braced, welded to the container on both sides of fittings; or by means of a metal dome.

(4) Filling connections shall be provided with approved automatic valves to prevent back-flow in case the filling connection is broken, except that where the filling and discharge connect on a common opening

in the container shell, and that opening is fitted with quick-closing internal valve as specified in section Ind 43.53 (5), the automatic valve shall not be required.

(5) All other connections to containers, except safety relief valves and those specifically exempt in section 43.14 (3) and (4) shall be provided with approved excess-flow valves, or in lieu thereof may be fitted with approved quick-closing internal valves which, except during delivery operations, shall remain closed. 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 cause the internal valve to close automatically in case of fire.

(6) All containers shall be equipped with an approved vapor return valve of adequate capacity.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.54 Safety devices.** (1) The discharge from safety relief valves shall be directed away from the container upward and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas. Loose-fitting raincaps shall be used.

(2) The unloading line shall be provided with an excess-flow valve at the point where the hose leaves the truck.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.55 Marking of container.** Every tank, 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 at least 4 inches high; and with the words "Anhydrous Ammonia" in letters at least 2 inches high, or in compliance with interstate commerce commission regulations.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.56 Piping, tubing and fittings.** (1) All piping, tubing, and metering or dispensing devices shall be securely mounted and protected against damage.

(2) Piping, whether welded or screwed, shall be at least extra heavy (ASA Schedule 80).

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.57 Safety equipment.** All tank trucks, trailers, and semi-trailers shall be equipped with the following:

- (1) An approved ammonia type gas mask with refill charges.
- (2) One pair of rubber gloves.
- (3) One pair of tight-fitting ventless goggles.
- (4) A first aid kit (ammonia type).
- (5) A container of not less than 5 gallons of fresh water.

**Note:** 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 concentrations. 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 may as

well be discarded after use. Unopened canisters may be guaranteed for as long as 3 years. All should be dated 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. Oxygen-supplied masks should not be used in this service.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.58 Transfer of liquids.** (1) Truck and trailer containers shall be loaded by weight or by a suitable liquid level gaging device.

(2) Pumps or compressors when designed and installed in accordance with section Ind 43.19 and properly protected against physical damage may be mounted upon ammonia tank trucks and trailers.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.59 Protection against collision.** Each tank truck and trailer shall be provided with properly attached steel bumpers or a chassis extension so arranged as to protect the tank, piping, valves, and fittings in case of collision.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.60 Chock blocks.** Chock blocks shall be provided. These blocks shall be placed at rear wheels to prevent rolling of the vehicle whenever it is parked, including loading and unloading operations.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.61 Skid tanks.** Where skid tanks are used in lieu of containers permanently mounted on trucks, semi-trailers, or trailers for the day-to-day transportation of ammonia, they shall comply with all requirements of sections Ind 43.30 through Ind 43.61.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

## PART VI SYSTEMS MOUNTED ON FARM VEHICLES IN THE TRANSPORTATION OF AMMONIA

**Ind 43.70 Application.** Sections Ind 43.70 through Ind 43.75 apply to containers of 1,200 gallons capacity or less and pertinent equipment mounted on farm vehicles and used for the transportation of ammonia. All basic rules of sections Ind 43.10 to Ind 43.21, inclusive, apply to these sections unless otherwise noted.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.71 Design pressure of containers.** (1) Containers shall be constructed in accordance with section Ind 43.11 with a minimum design pressure of 250 psig.

(2) The shell or head thickness of any container shall not be less than 3/16 of an inch.

(3) All containers over 500 gallons capacity shall be equipped with suitable (semi-rigid) baffle plates.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.72 Mounting containers.** (1) A suitable stop or stops shall be mounted on the vehicle or on the container in such a way that the

container shall not be dislodged from its mounting due to the vehicle coming to a sudden stop. Back slippage shall also be prevented by proper methods.

(2) A suitable hold-down device shall be provided which will anchor the container at one or more places on each side of the container to the vehicle.

(3) When containers are mounted on four-wheel trailers, care shall be taken to insure that the weight is distributed evenly over both axles.

(4) When the cradle and the tank are not welded together, suitable material shall be used between them to eliminate metal-to-metal friction.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.73 Container valves and accessories.** (1) All containers shall be equipped with a fixed liquid level gage.

(2) All containers with a capacity of 250 gallons or more shall be equipped with a pressure indicating gage having a dial graduated from 0-400 psi.

(3) The filling connection shall be fitted with an approved combination back-pressure check valve and excess-flow valve; one double or 2 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.

(4) All containers with a capacity of 250 gallons or more shall be equipped with an approved vapor return valve.

(5) All vapor and liquid connections, except safety relief valves and those specifically exempt in section Ind 43.14 (3) and (4) shall be equipped with approved excess-flow valves or may be fitted with approved quick-closing internal valves which, except during operating periods, shall remain closed.

(6) Fittings shall be adequately protected from physical damage by means of a metal box or cylinder with open top securely fastened to the container; or by means of rigid guards, well braced, welded to the container on both sides of the fittings; or by means of a metal dome. If a metal dome is used, the relief valve shall be properly vented through the dome.

(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 vehicle axle.

(8) Provision shall be made to secure both ends of the hose while in transit.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.74 Marking of container.** There shall appear on each side and on the rear of the container the words "Caution—Ammonia" on a background of sharply contrasting colors in letters at least 4 inches high or the container shall be marked in accordance with the interstate commerce commission regulations.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.75 Farm vehicles.** (1) Farm vehicles shall conform with state regulations.

(2) All trailers shall be securely attached to the vehicle drawing them by means of drawbars supplemented by suitable safety chains.

(3) A trailer shall be constructed so that it will follow in the path of the towing vehicle and will prevent the towed vehicle from whipping or swerving dangerously from side to side.

(4) All vehicles shall carry a can containing 5 gallons or more of fresh water.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**PART VII  
SYSTEMS MOUNTED ON FARM VEHICLES FOR THE  
APPLICATION OF AMMONIA**

**Ind 43.80 Application:** Sections Ind 43.80 through Ind 43.84 [43.83] apply to systems utilizing containers of 250 gallons capacity or less which are mounted on farm vehicles and used for the application of ammonia. (Where larger containers are used, they shall comply with sections Ind 43.70 through Ind 43.75).

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.81 Design pressure of containers.** (1) Containers shall be constructed in accordance with section Ind 43.11 with a minimum design pressure of 250 psig.

(2) The shell or head thickness of any container shall not be less than 3/16 of an inch.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.82 Mounting of containers.** All containers and flow-control devices shall be securely mounted.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

**Ind 43.83 Container valves and accessories.** (1) Each container shall have a fixed liquid level gage.

(2) The filling connection shall be fitted with an approved combination back-pressure check valve and excess-flow valve; one double or 2 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) To assist in filling applicator tanks, it will be permissible to bleed the tank to the open air provided the controlling orifice of the bleeder valve is not in excess of 5/16 inch in diameter.

(4) Regulation equipment may be connected directly to the tank coupling or flange, in which case a flexible connection shall be used between such regulating equipment and the remainder of the liquid withdrawal system. Regulating equipment not so installed shall be flexibly connected to the container shut-off valve.

(5) No excess-flow valve is required in the liquid withdrawal service line provided the controlling orifice between the contents of the

container and the outlet of the shut-off valve (section Ind 43.14 (2a)) does not exceed 7/16 of an inch in diameter.

**History:** Cr. Register, December, 1959, No. 48, eff. 1-1-60.

#### **APPENDIX A**

Minimum required rate of discharge in cubic feet per minute of air at 120% of the maximum permitted start-to-discharge pressure for safety relief valves to be used on containers other than those constructed in accordance with Interstate Commerce Commission specifications. Discharge measured at 60° F. and atmospheric pressure (14.7 psia).

Surface Area, Sq. Ft.	CFM Air	Surface Area, Sq. Ft.	CFM Air	Surface Area, Sq. Ft.	CFM Air
20	258	185	1,600	900	5,850
25	310	190	1,640	950	6,120
30	360	195	1,670	1,000	6,380
35	408	200	1,710	1,050	6,640
40	455	210	1,780	1,100	6,900
45	501	220	1,850	1,150	7,160
50	547	230	1,920	1,200	7,410
55	591	240	1,980	1,250	7,660
60	635	250	2,050	1,300	7,910
65	678	260	2,120	1,350	8,160
70	720	270	2,180	1,400	8,410
75	762	280	2,250	1,450	8,650
80	804	290	2,320	1,500	8,900
85	845	300	2,380	1,550	9,140
90	885	310	2,450	1,600	9,380
95	925	320	2,510	1,650	9,620
100	965	330	2,570	1,700	9,860
105	1,010	340	2,640	1,750	10,090
110	1,050	350	2,700	1,800	10,330
115	1,090	360	2,760	1,850	10,560
120	1,120	370	2,830	1,900	10,800
125	1,160	380	2,890	1,950	11,030
130	1,200	390	2,950	2,000	11,260
135	1,240	400	3,010	2,050	11,490
140	1,280	450	3,320	2,100	11,720
145	1,310	500	3,620	2,150	11,950
150	1,350	550	3,910	2,200	12,180
155	1,390	600	4,200	2,250	12,400
160	1,420	650	4,480	2,300	12,630
165	1,460	700	4,760	2,350	12,850
170	1,500	750	5,040	2,400	13,080
175	1,530	800	5,300	2,450	13,300
180	1,570	850	5,590	2,500	13,520

Surface Area = Total Outside Surface Area of Container in Square Feet.

When the surface area is not stamped on the nameplate 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

$$\text{Area} = \text{overall length in feet times outside diameter in feet times } 3.1416$$

- (2) Cylindrical container with semi-ellipsoidal heads

$$\text{Area} = (\text{overall length in feet plus } 0.3 \text{ outside diameter in feet}) \text{ times outside diameter in feet times } 3.1416$$

- (3) Spherical container

$$\text{Area} = \text{outside diameter in feet squared times } 3.1416$$

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.