Chapter ILHR 43

ANHYDROUS AMMONIA

Note: Chapter Ind 43 as it existed on November 30, 1985 was repealed and a new chapter ILHR 43 was created effective December 1, 1985.

Subchapter I
General Requirements and Definitions

ILHR 43.01 Purpose. The purpose of this chapter is to establish minimum safeguards to life, health and property by the adoption of reasonable and effective standards relating to the storage and handling of anhydrous ammonia.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.02 Scope. (1) APPLICATION. The provisions of this chapter shall apply to the design, construction, repair, alteration, location, installation, inspection and operation of anhydrous ammonia systems, including refrigerated ammonia storage systems. The provisions of this chapter are not retroactive unless specifically stated in the administrative rule.

(2) EXEMPTIONS. The provisions of this chapter shall not apply to:

(a) Ammonia manufacturing plants:

(b) Refrigeration plants where ammonia is used solely as a refrigerant; and

Note: Refrigeration plants where ammonia is used as a refrigerant are covered in ch. ILHR 45. The provisions of ch. ILHR 45 are not appropriate to refrigerated ammonia storage systems as covered in this chapter.

(c) Ammonia transportation pipelines.

Note 1: In the interest of safety, it is important that personnel understand the properties of anhydrous ammonia and that they be throughly trained in safe practices for its storage and handling. Training material may be obtained from the Fertilizer Institute, the National Fertilizer Solutions Association, the Compressed Gas Association, or from equipment and chemical suppliers.

Note 2: Under moderate pressure ammonia 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.

Note 3: Anhydrous ammonia may cause varying degrees of irritation of the eyes, skin or mucuous membrane, and may severely injure the respiratory mucosa with possible loss of eyesight or life.

Note 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.

Note 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.

Note 6: Anhydrous 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, such as aluminum, proved to be satisfactory for ammonia service, be used for ammonia containers, fittings, and other equipment.

Note 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.

Note 8: See Appendix for a listing of the physical properties of ammonia.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.04 Definitions. For the purpose of this chapter, the following definitions shall apply:

(1) "Alteration" means a change in any item described in the original manufacturer's data report which affects the pressure containing capability of the container. Rerating a container by increasing maximum allowable working pressure or temperature shall be considered an alteration.

(2) "Anhydrous ammonia" means the compound formed by a chemical combination of 2 gaseous elements, nitrogen and hydrogen, in the proportion of one part nitrogen to 3 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 chapter, it is understood to mean anhydrous ammonia.

(3) "Approved" means any one of the following:

(a) Listed by a recognized testing laboratory which has been accepted by the department;

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

(c) Accepted by the department.

(4) "Appurtenance" means all devices such as safety relief devices, liquid level gaging devices, valves, pressure gages, fittings, metering or dispensing devices.

(5) "Capacity" means the total volume of the container measured in U.S. gallons, unless otherwise specified.

(6) "Container" means all tanks, except cylinders as defined in sub. (7), used for the storage and transportation of anyhdrous ammonia.

(7) "Cylinder" means a container of 1000 pounds of water capacity or less constructed as approved by the department.

Note: The department will accept cylinders which meet the U.S. department of transportation specifications.

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

(9) "Design pressure" means the maximum allowable working pressure.

(10) "Emergency" means any occurrence, such as but not limited to equipment failure, which has the potential to, or does, result in the release of more than 300 pounds of anhydrous ammonia.

(11) "Filling density" means the per cent ratio of the weight of the gas in a container to the wieght of water at 60° F that the container will hold.

Note: One pound of water equals 27.737 cu. in. at 60°F. For determining the water capacity of a tank in pounds, the weight of a gallon (231 cubic inches) of water at 60°F in air equals 8.32828 pounds.

(12) "Gas" means anhydrous ammonia in either the gaseous or liquefied state.

(13) "Gas mask" means an air purifying respiratory device approved by the department for use in ammonia contaminated atmospheres.

(14) "Hydrostatic relief valve" means an automatic pressure activated valve for liquid service designed to prevent excessive pressure due to thermal expansion when a pipe or container becomes liquid filled.

(15) "Immediately dangerous to life or health" means any atmospehere that poses an immediate hazard to life or produces irreversible debilitating effects on health.

(16) "Nurse tank" means a container mounted on a farm wagon used to transport anhydrous ammonia from a storage location to the application equipment.

(17) "Permanent storage installation" means a system which is used for storage or supply of ammonia and which is mounted on a slab, pier or skid and not intended for mobile use.

(18) "Positive pressure self-contained breathing apparatus" means a supplied air respirator in which the pressure inside the tight-fitting facepiece in relation to the immediate environment is positive during inhalation and exhalation.

(19) "Pressure relief valve" means a pressure relief device characterized by rapid opening or pop action, or by opening in proportion to the increase in pressure over the opening pressure, depending on application.

(20) "Psia" and "psig" mean pounds per square inch absolute and pounds per square inch gage, respectively.

(21) "Repair" means the work necessary to restore a container to a safe and satisfactory operating condition provided that in all cases the container design shall continue to comply with the requirements of this chapter or the chapter in effect at the time of installation.

(22) "Semi-trailer" means a 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.

(23) "System" means an assembly of equipment consisting essentially of the container, hoses, appurtenances, pumps, compressors, and interconnecting piping.

(24) "Tank motor vehicle" means a motor vehicle designed or used for the transportation of anhydrous ammonia in a tank designed to be per-

manently attached to the motor vehicle or in a container not permanently attached to a motor vehicle which by reason of its size, construction or attachment to the motor vehicle must be loaded and unloaded without being removed from the motor vehicle.

(25) "Trailer" means a vehicle designed for carrying persons 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.

(26) "Transfer", "fill" and "charge" mean movement of a quantity of ammonia from one container to another container or cylinder, as contrasted to feeding ammonia to a use or application device.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.05 Adoption of standards. (1) CONSENT TO INCORPORATE. Pursuant to s. 227.025, Stats., the attorney general and the revisor of statutes have consented to the incorporation by reference of the following standards:

(a) American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005; API 620-1982, Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks.

(b) American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103; ASTM A53-82, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

(c) Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202; CGA S-1.3-1980, Pressure Relief Device Standards for Compressed Gas Storage Containers.

(2) INTERIM AMENDMENTS. Interim amendments of the standards listed in sub. (1) shall have no effect in the state until the time that this section is correspondingly revised to reflect those changes.

(3) AVAILABILITY OF STANDARDS. The standards in reference may be obtained at a nominal cost by writing to the respective addresses listed in sub. (1).

(4) FILING OF STANDARDS. Copies of the standards in reference are on file in the offices of the department, the secretary of state and the revisor of statutes.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.06 Approval of equipment and systems. (1) DEPARTMENT APPROVAL. Before construction of any new or additional permanent storage installation for the 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 complete information as specified in sub. (2).

(2) REQUIRED INFORMATION. In applying for department approval, the following information shall be submitted in writing together with at least 2 prints of scaled engineering plans of the proposed construction or installation:

(a) The name of the person, firm or corporation proposing the construction or installation;

(b) The location of the proposed construction or installation showing the property lines on all sides and adjacent railways, streets and highways;

(c) A plot of the area to be utilized showing location of buildings, tanks, loading and unloading points and clearances as covered in s. ILHR 43.19;

(d) A plot plan showing the land use of the area surrounding the proposed site for a distance of 2000 feet;

(e) The capacity and outside surface area of each tank; and

(f) The size, manufacturer, catalog number and capacity of safety relief valves.

(3) LOCAL APPROVAL. Approval of a permanent storage installation site shall be obtained from the local fire department and shall be verified at the time of plan submittal.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.07 Inspections. (1) GENERAL REQUIREMENTS. The authorized inspectors of the department, upon presenting appropriate credentials to the owner, operator or agent in charge, may:

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

(2) REPRESENTATION. The inspector, before making an inspection, shall contact the employer or employer's representative who shall be given an opportunity to accompany the inspector during the physical inspection of any workplace under sub. (1).

Note: The department procedure is not to give advance notice. In the scheduling and in the act of inspecting it may not always be possible to avoid advance notice or to obtain accompaniment, but otherwise these rules will be diligently observed.

(3) INITIAL INSPECTIONS. Anhydrous ammonia systems which require approval under s. ILHR 43.06 shall be inspected by the department before the systems are placed in operation. The department shall conduct the inspection within 15 business days of receiving the request for inspection.

(4) PERIODIC INSPECTIONS. Permanent storage tanks exceeding 2000 gallons water capacity and all anhydrous ammonia nurse tanks located at storage facilities shall be subject to an inspection by the department at least once every 3 years.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.08 Petition for variance. (1) PROCEDURE. The department shall consider and may grant a variance to an administrative rule upon receipt of a fee, a completed petition for variance form from the owner and, where applicable, a completed position statement from the chief of the local fire department, provided an equivalency is established in the petition for variance which meets the intent of the rule being petitioned. The department may impose specific conditions in granting a variance to promote the protection of the health, safety or welfare of the employes or the public. Violation of those conditions under which the variance is granted shall constitute a violation of the rules of this chapter.

Note 1: Copies of the petition for variance form (SB-8) and the position statement (SB-8A) are available at no charge from the Division of Safety and Buildings, P.O. Box 7969, Madison, Wisconsin 53707.

Note 2: Section 101.02 (6), Stats., and ch. ILHR 3 outline the procedure for submitting petitions to the department and the department procedures for hearing petitions.

(2) PETITION PROCESSING TIME. Except for priority petitions, the department shall review and make a determination on a petition for variance within 30 business days of receipt of all calculations, documents and fees required to complete the review. The department shall process priority petitions within 10 business days of receipt of the required items.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.09 Appeals. (1) APPEAL OF LOCAL ORDER. Any person affected by a local order which may be in conflict with a rule of the department may petition the department for a hearing on the grounds that the local order is unreasonable and in conflict with the rule of the department.

Note: Section 101.01 (1) (f), Stats., defines "local order" as any ordinance, order, rule or determination of any common council, board of aldermen, board of trustees or the village board, or any village or city, or the board of health of any municipality, or an order or direction of any official of such municipality, upon any matter over which the department has jurisdiction.

(2) PETITION OF ADMINISTRATIVE RULE. Pursuant to s. 227.015, Stats., any municipality, corporation or any 5 or more persons having an interest in an administrative rule may petition the department requesting the adoption, amendment or repeal of the rule.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.10 Penalties. Penalties for violation of any rule in this chapter shall be assessed in accordance with s. 101.02, Stats.

Note 1: Section 101.02 (13) (a), Stats., indicates penalties will be assessed against any employer, employe, owner or other person who fails or refuses to perform any duty lawfully enjoined, within the time prescribed by the department, for which no penalty has been specifically provided, or who fails, neglects or refuses to comply with any lawful order made by the department, or any judgement or decree made by any court in connection with ss. 101.01 to 101.25, Stats. For each such violation, failure or refusal, such employe, owner or other person must forfeit and pay into the state treasury a sum not less than $10 nor more than $100 for each violation.

Note 2: Section 101.02 (12), Stats., indicates that every day during which any person, persons, corporation or any officer, agent or employe thereof, fails to observe and comply with an order of the department will constitute a separate and distinct violation of such order.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.11 Fees. Fees for the plan examination, registration and inspection of anhydrous ammonia systems shall be submitted as specified in ch. Ind 69.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.12 Reporting accidents. Whenever an accident occurs at an anhydrous ammonia installation and causes personal injury requiring professional medical attention, the owner or operator shall report the facts involved to the department within 2 business days.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

Subchapter II
Basic Rules

ILHR 43.15 Application. Sections ILHR 43.15 to 43.30 shall apply to all anhydrous ammonia installations unless otherwise specified.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.16 Secondhand vessels. Except for the hydrostatic pressure test requirements, secondhand anhydrous ammonia tanks shall comply with ch. ILHR 42.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.17 Requirements for construction, repair, alteration and test of containers. (1) GENERAL. (a) Containers used with systems covered in subchs. III, VI, VII and VIII shall be constructed and tested in accordance with the ASME boiler and pressure vessel code as adopted by reference in chs. ILHR 41-42, except that construction under Table UW 12 of the ASME code at a basic joint efficiency of under 80% shall not be permitted.

(b) Containers built in accordance with the ASME code are not required to comply with paragraphs UG 125 to UG 128 and paragraphs UG 132 and 133.

(2) STRESS RELIEVING. Containers other than refrigerated storage containers shall be constructed to comply with one or more of the following additional requirements:

(a) Containers shall be stress relieved after fabrication by a procedure in accordance with the ASME code;

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

(c) Hot formed heads shall be used.

(3) WELDED REPAIR OR ALTERATION. Welded repair or alteration of the vessel shall be done in compliance with the procedures detailed in ch. ILHR 42. Reports for the welded repair or alteration of the vessel shall be submitted to the department as specified in ch. ILHR 42. Other welding is permitted only on saddle plates, lugs or brackets attached to the container by the container manufacturer.

(4) EXISTING INSTALLATIONS. The provisions of subs. (1) and (2) shall not be construed as prohibiting the continued use or reinstallation of con-

tainers constructed and maintained in accordance with the standards of the department in effect at the time of initial installation.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.18 Markings on nonrefrigerated containers. (1) INFORMATION REQUIRED. (a) Each container covered in subchs. III, VI, VII and VIII shall be marked with:

1. A marking identifying compliance with the rules of the ASME code under which the container is constructed;

2. A notation on the container when the container is designed for underground installation;

3. The name of the fabricator of the container or the trade name of the container and with the year of fabrication;

4. The water capacity of the container in pounds at 60° F or in gallons;

5. The design pressure in pounds per square inch gage;

6. The outside surface area in square feet; and

7. The minimum temperature in degrees Fahrenheit for which the container is designed.

(b) The marking specified on the container shall be on the container itself or on a nameplate permanently affixed to the container, and shall be accessible for inspection.

(2) LIQUID LEVEL GAGES. Each container or system covered in subchs. III, VI, VII and VIII shall be fitted with a liquid level gage 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.

(3) MARKING OF CONTAINER OPENINGS. All container openings, except for safety relief devices or level indicators, shall be marked, stenciled, tagged or decaled to indicate whether the opening is in liquid or vapor service when the container is filled to the maximum allowable filling density.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.19 Location of containers. (1) BUILDING LOCATIONS. Consideration shall be given to the physiological effects of ammonia as well as to adjacent fire hazards in selecting the location for storage container. Containers shall be located outside of buildings or in buildings or sections thereof specially approved for this purpose.

(2) WATER SUPPLY LOCATIONS. 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.

(3) POPULATED AREAS. The location of permanent storage containers shall be outside densely populated areas.

(4) MINIMUM DISTANCES. Container locations shall comply with Table 43.19.

(5) IGNITABLE MATERIALS. Storage areas shall be kept free of readily ignitable materials such as waste, weeds and long dry grass.

(6) SUBSEQUENT CONSTRUCTION. A permanent storage installation which at the time of its establishment was in conformity with the requirements of this section, shall continue to be lawful provided that subsequent construction remains within the clearances specified in this section.

Table 43.19
Location of Containers

Nominal Capacity of Container in Gallons	Minimum Distances in Feet from Container to:		
	Line of Adjoining Property which may be built upon, Highways & Mainline of Railroad	Place of Public Assembly	Institutional Occupancy
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

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.20 Container appurtenances. (1) PRESSURE AND MATERIALS. All appurtenances shall be designed for not less than the maximum allowable working pressure of that portion of the system on which they are installed. All appurtenances shall be frabricated from materials proved suitable for anhydrous ammonia service.

(2) SHUT-OFF VALVES. All connections to containers except those for safety relief devices, gaging devices, or those fitted with a No. 54 drill size orifice or those plugged, shall have shut-off valves located as close to the container as practicable.

(3) EXCESS-FLOW VALVES. Excess-flow valves, where required by this chapter, 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.

(4) LIQUID LEVEL DEVICES. Liquid level 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.

(5) OPENINGS AND THROUGH FITTINGS. Openings from containers or through fittings attached directly on containers to which pressure gage connections are made need not be equipped with excess flow valves if these openings are not larger than No. 54 drill size.

(6) EXCESS-FLOW AND CHECK VALVE LOCATION. Excess-flow and backpressure check valves, where required by this chapter, 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 stress beyond the excess-flow or back-pressure check valve will not cause breakage between the container and the valve.

(7) EXCESS-FLOW VALVE BYPASS. Excess-flow valves shall be designed with a bypass, not to exceed a No. 60 drill size opening to allow equalization of pressures.

(8) SHUT-OFF VALVE DESIGN. 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 close should the shut-off valve break.

(9) EXCESS-FLOW VALVE MARKINGS. 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.

(10) FILLING CONNECTION VALVE. The filling connection shall consist of a positive shut-off valve in conjunction with either a back-pressure check valve or an excess-flow valve.

(11) QUICK OPENING VALVES. Unless equipped with an approved safety catch, quick opening, ¼-turn valves shall not be used on the end of a filler hose line.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.21 Piping, tubing and fittings. (1) MATERIALS. All piping, tubing and fittings shall be made of material suitable for anhydrous ammonia service.

(2) DESIGN PRESSURE. 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.

(3) PIPING SUPPORTS. All piping, tubing and fittings shall be well supported to prevent sagging and possible breakage because of gravity, vibration and other forces which may be encountered in the ordinary course of operations.

(4) NONREFRIGERATED SYSTEM PIPING. Piping used on nonrefrigerated systems shall be at least ASTM A-53 Grade B Electric Resistance Welded Pipe or equal. The pipe shall be at least Schedule 40 when joints are welded, or welded and flanged. The pipe shall be at least Schedule 80 when joints are threaded. Brass, copper, or galvanized steel pipe or tubing shall not be used.

Note: See ch. ILHR 45 for refrigerated system piping requirements.

(5) FLEXIBLE CONNECTIONS. All metal flexible connections for permanent installations shall have a minimum design pressure of 250 psig and a maximum length of 36 inches. Metal flexible connections for permanent installations shall not be used for alignment. For temporary installations, hose meeting the requirements of s. ILHR 43.22 may be used.

(6) IRON FITTINGS. Cast iron fittings shall not be used for ammonia service. Properly identified malleable or nodular iron fittings may be used for ammonia service.

(7) PROTECTION OF PIPING. Adequate provisions shall be made to protect all piping from physical damage that might result from moving ma-

chinery, the presence of automobiles or trucks, or any other undue strain that may be placed upon the piping.

(8) JOINT COMPOUNDS. Joint compounds shall be resistant to ammonia at the maximum pressure and temperature to which they may be subjected in service.

(9) TESTING. 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.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.22 Hose specifications. (1) MATERIALS. Hose subject to container pressure shall be designed and fabricated of material suitable for anhydrous ammonia service.

(2) PRESSURES. Hose subject to container pressure shall be constructed for a minimum design 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.

(3) CONNECTIONS. 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 constructed for the maximum low side design pressure. All connections shall be designed, constructed and installed so that there will be no leakage when connected.

(4) SHUT-OFF VALVE. Where liquid transfer hose is not drained of liquid upon completion of transfer operations, the 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.

Note: See s. ILHR 43.23 (10).

(5) MARKINGS. On all hose one-half inch outside diameter and larger, used in ammonia service and subject to container pressure, there shall be etched, cast, or impressed at 5 foot intervals the following information:

Anhydrous Ammonia
XXX psig (Maximum Allowable Working Pressure)
Manufacturer's Name or Trademark
Year of Manufacture

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.23 Pressure relief devices. (1) GENERAL REQUIREMENTS. Every container used in systems covered in subchs. III, VI, VII and VIII shall be provided with one or more pressure relief valves of the spring-loaded or equivalent type conforming to the following:

(a) The discharge from pressure relief valves shall be vented away from the container, upward and unobstructed to the atmosphere.

(b) All pressure relief valve discharge openings shall have 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.

(c) The minimum rate of the discharge of pressure relief valves shall be in accordance with the provisions of Table 43.23.

Table 43.23
Pressure Relief Valve
Rate of Discharge

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	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.

Note 1: Table 43.23 gives the 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 United States Department of Transportation cylinder specifications.

Note 2: 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:
Area = overall length in feet times outside diameter in feet times 3.1416

(2) Cylindrical container with semi-ellipsoidal heads:
Area = (overall length in feet plus 0.3 outside diameter in feet) times outside diameter in feet times 3.1416

(3) Spherical container:
Area = outside diameter in feet squared times 3.1416

Note 3: Flow Rate CFM Air = cubic feet per minute of air required at standard conditions, 60° F and atmospheric pressure.

Note 4: 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:

ILHR 43

Flow Rate CFM Air = 22.11 A $^{0.82}$ where A = outside surface area of the container in square feet.

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

Containers Stamped	Minimum	Maximum*
ASME U-68, U-69	110%	125%
ASME U-200, U-201	95%	100%
ASME U	95%	100%
API-ASME	95%	100%
U.S. Coast Guard	(As approved by the department)	
DOT	(As approved by the department)	

*A relief valve manufacturer's tolerance of plus 10% is permitted.

(3) RELIEF VALVE DISCHARGE PRESSURE. Pressure relief devices used in systems covered in subchs. III, VI, VII and VIII shall be constructed to discharge at not less than the rates required in sub. (1) before the pressure is in excess of 120% of the maximum permitted start-to-discharge pressure setting of the device.

(4) RELIEF VALVE PROTECTION. Pressure 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 have the adjustment sealed.

(5) SHUT-OFF VALVES. Shut-off valves shall not be installed between the pressure relief valves and the containers or systems described in subchs. III, VI, VII and VIII, 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 2 pressure relief valves, each of which has the required rate of discharge and is so installed as to allow either of the pressure relief valves to be closed off, but does not allow both pressure relief valves to be closed off at the same time. Another exception to this may be where 2 separate pressure relief valves are installed with individual shut-off valves. In this case, the 2 shut-off valve stems are mechanically interconnected in a manner which will allow full required flow of one pressure relief valve at all times. Still another exception is a pressure relief valve manifold which allows one valve of 2, 3, 4 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.

(6) VAPOR SPACE COMMUNICATION. Pressure relief valves shall have direct communication with the vapor space of the container.

(7) RELIEF VALVE MARKINGS. Each pressure relief valve used with systems described in subchs. III, VI, VII and VIII shall be plainly and permanently marked with:

(a) The letters "AA" or the symbol "NH_3";

(b) The pressure in pounds per square inch gage 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 60° F and atmospheric pressure; and

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

Note: A pressure 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 is 4200 cubic feet per minute of air.

(8) FLOW RESTRICTION. The flow capacity of the pressure relief valve shall not be restricted by any connection to it on either the upstream or downstream side.

(9) RELIEF VALVE MANIFOLDS. The manufacturer or supplier of a pressure relief valve manifold shall publish complete data showing the flow rating through the combined assembly of the manifold with pressure relief valves installed. The manifold flow rating shall be determined by testing the manifold 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 sub. (7) for individual valves.

(10) HYDROSTATIC RELIEF VALVE. A hydrostatic relief valve or equivalent shall be installed in each section of piping, including hose, in which liquid ammonia can be isolated between shut-off valves so as to relieve the pressure which could develop from the trapped ammonia. If an equivalent pressure relieving device is used, the maximum accumulative pressure possible within the system shall not exceed the limits of the system.

(11) DISCHARGE LOCATION. Discharge from pressure relief valves shall lead to a safe place and shall not terminate in or beneath any building.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.24 Safety. (1) PERSONNEL TRAINING. Personnel required to handle ammonia shall be trained in safe operating practices and the proper action to take in emergencies.

(2) EMERGENCY PROCEDURES. If a leak occurs in a permanent storage installation, the personnel trained for and designated to act in the emergencies shall:

(a) See that persons not required to deal with an emergency are evacuated from the contaminated areas;

(b) Put on suitable respiratory protection;

(c) Wear gauntlet-type plastic or rubber gloves, plastic or rubber suits and protective boots in heavily contaminted areas;

(d) Shut-off the appropriate valves; and

(e) Notify local, state or federal emergency governmental regulatory authorities as may be appropriate.

(3) EMERGENCY EQUIPMENT FOR LARGE SYSTEMS. All permanent storage installations of 500 gallons water capacity or greater shall have on hand, as a minimum, for emergency and rescue purposes the following equipment:

(a) Two full face gas masks with industrial size ammonia canisters and at least 2 spare ammonia canisters in a readily accessible location. Positive pressure self-contained breathing apparatus is not required to be on hand but shall be used in ammonia contaminated atmospheres that are

immediately dangerous to life or health. Gas masks and self-contained breathing apparatus shall be approved by the department;

Note 1: Gas masks approved by NIOSH/MSHA will be acceptable.

Note 2: An ammonia gas mask will provide effective respiratory protection in concentrations of ammonia in air that are not immediately dangerous to life or health for short periods of time. A gas mask is not recommended for respiratory protection in concentrations exceeding this amount. Facepiece fitting should be used to determine the ability of each individual gas mask wearer to obtain a satisfactory fit. If ammonia vapor is detected within the gas mask facepiece, the facepiece fit is improper, the ambient concentration is excessive, or the canister is exhausted. The wearer should return to fresh air immediately to take appropriate corrective measures. The life of a canister in service is controlled by the concentration of ammonia vapor to which it is exposed. Canisters should not be opened until ready for use and should be discarded after use. Unopened canisters should be discarded after the expiration date stamped on the canister by the manufacturer. In addition to this protection, an independently supplied, positive pressure self-contained breathing apparatus approved by NIOSH/MSHA should be used for entry into concentrations of ammonia vapor that are immediately dangerous to life or health. The American National Standard, Practices for Respiratory Protection, Z88.2, should be referred to whenever respirators may be used.

(b) One pair of protective gauntlet-type gloves, one pair of protective boots, and one protective slicker or protective pants and jacket. Gloves, boots, slickers, jackets and pants shall be made of rubber or other material impervious to ammonia;

(c) Easily accessible shower or at least 100 gallons of clean water in an open top container; and

(d) Flexible fitting, hooded ventilation goggles.

(4) EMPLOYE PROTECTIVE EQUIPMENT. Each employe shall be provided with suitable gloves and a pair of flexible fitting, hooded ventilation goggles and, as an option, a full face shield worn over the goggles, when making, breaking or testing any ammonia connection, transferring ammonia or performing maintenance on an ammonia system under pressure.

(5) MOTOR VEHICLE EQUIPMENT. Each tank motor vehicle transporting anhydrous ammonia, except farm applicator vehicles, shall carry a container of at least 5 gallons of water and shall be equipped with one pair of protective gauntlet-type gloves, a full face gas mask, a pair of flexible fitting hooded ventilation goggles and, as an option, one full face shield to be worn over the goggles. The driver shall be instructed in their use and the proper action to take to provide for driver safety.

(6) EMERGENCY EQUIPMENT FOR SMALL SYSTEMS. At an ammonia installation of less than 500 gallons water capacity, the employer shall provide a container holding at least 5 gallons of clean water or ready access to a running water supply for emergency use by employes. The water container shall have an opening suitable to permit flushing the eyes in the event of contact with ammonia.

Note 1: If liquid ammonia contacts the skin or eyes, the affected area should be promptly and thoroughly flushed with water for at least 15 minutes. Neutralizing solutions or ointments should not be used on the affected areas. A physician should treat all cases of eye exposure to liquid ammonia.

Note 2: 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.

Note 3: Water should be used on liquid ammonia spills only if sufficient water is available and the spill has not refrigerated. Sufficient water may be taken to be 100 parts of water to one part of ammonia.

Note 4: If an ammonia container is exposed to fire and cannot be removed, water should be used to cool it.

Note 5: 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.

Note 6: If it is found necessary to dispose of ammonia, as from a leaking container, ammonia should be discharged into a vessel containing water sufficient to absorb it. Sufficient water may be taken to be 10 parts of water per part of ammonia. The ammonia should be injected into the water as near the bottom of the vessel as practical.

(7) LEAKS IN TRANSPORTATION EQUIPMENT. If a leak occurs in transportation equipment and it is not practical to stop the leak, the driver shall move the vehicle to an isolated location downwind from populated communities or heavily traveled highways.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.25 Filling Densities. (1) NONREFRIGERATED CONTAINERS. The filling densities for nonrefrigerated containers shall not exceed the following:

	Aboveground	Underground
Uninsulated	56%*	58%
Insulated	57%	-
DOT containers and cylinders	(As approved by the department)	

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

Note: The department will accept filling densities in accordance with U.S. DOT regulations.

(2) REFRIGERATED STORAGE TANKS. 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 pressure relief valve.

(3) THERMOMETER WELL. If containers are to be filled to a level greater than 85% by volume, each container shall 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.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.26 Transfer of liquids. (1) RECEIVING CONTAINER MATERIAL. Anhydrous ammonia shall always be at a temperature suitable for the material of construction and the design of the receiving containers. Ordinary steels shall not be suitable for refrigerated ammonia.

(2) SUPERVISION OF TRANSFER. At least one attendant shall supervise the transfer of liquids from the time the connections are first made until they are finally disconnected.

(3) USE OF GASES. Flammable gases or gases which will react with ammonia, such as air, shall not be used to unload tank cars or transport trucks. The unloading of tank cars or transport trucks with gas pressure other than ammonia is not recommended. If due to special operating circumstances, pressure unloading with other gases is necessary, the owner shall be consulted and permission obtained.

(4) PERMISSION TO FILL. Containers and cylinders shall be filled or used only upon authorization of the owner.

(5) PROPER LOCATION. Containers and cylinders shall be gaged and charged only in the open atmosphere or in buildings provided for that purpose.

(6) PUMPS. (a) Pumps used for transferring ammonia shall be recommended and labeled for ammonia service by the manufacturer.

(b) Positive displacement pumps shall be equipped with a pressure actuated bypass valve on the discharge side of the pump. Piping or tubing sized to carry the full capacity of the pump at the actuation pressure of this valve shall connect the discharge of this valve with the container from which ammonia is being pumped. If this line is capable of being valved closed, an additional bypass device shall be incorporated in the pump to bypass back to the suction port. The pressure actuated bypass valve and the return piping or tubing shall be installed in accordance with the pump manufacturer's recommendations.

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

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

(7) COMPRESSORS. (a) Compressors used for transferring or refrigerating ammonia shall be recommended and labeled for ammonia service by the manufacturer.

(b) Compressors, except those used for refrigeration, shall be constructed for at least 250 psig design pressure. Crankcases of compressors not designed to withstand system pressure shall be protected with a suitable pressure relief valve.

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

(d) A pressure relief valve large enough to discharge the full capacity of the compressor shall be connected to the discharge before any shut-off valve.

(e) Compressors shall have pressure gages at suction and discharge graduated to at least one and one-half times the maximum pressure that can be developed.

(f) Adequate means, such as a drainable liquid trap, shall be provided on the compressor suction to minimize the entry of liquid into the compressor.

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

(8) EXCESS-FLOW PROTECTION. Excess-flow valves or other protective devices shall be installed to prevent discharge of the contents of containers if loading or unloading connectors or valves are cleanly broken. Piping shall be sized so as not to restrict flow to rates such that the protective devices will not function. If excess-flow valves cannot be installed to provide adequate protection, remotely operated internal or external shut-off valves shall be installed.

(9) METERS. (a) Meters used for the measurement of liquid anhydrous ammonia shall be recommended and labeled for ammonia service by the manufacturer.

(b) Liquid meters shall be constructed for a minimum design pressure of 250 psig.

(c) Liquid metering systems shall incorporate devices that will prevent the inadvertent measurement of vapor.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.27 Tank car unloading points and operations. (1) REQUIRED PERSONNEL. Unloading operations shall be performed by reliable persons properly instructed and made responsible for careful compliance with all applicable procedures.

(2) SIGNS. Caution signs shall be so placed on the track or car as to give necessary warning to persons approaching the car from the open end of the siding. The signs shall remain in place until the car is unloaded and disconnected from the discharge connections.

(3) BRAKES AND BLOCKING. Brakes shall be set and wheels blocked on all cars being unloaded.

(4) APPROVED LOCATIONS. Tank cars of anhydrous ammonia shall be unloaded only at approved locations meeting the requirements of ss. ILHR 43.24 (3) and 43.26 (8).

(5) PROHIBITED STORAGE. (a) Except as provided as par. (b), railway tank cars shall not be used as a permanent storage installation for anhydrous ammonia.

(b) Where anhydrous ammonia is used directly in a chemical process, tank cars may be connected directly to the plant facilities if the tank cars are on a railway spur.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.28 Liquid level gaging devices. (1) GENERAL. Each container, except those filled by weight, shall be equipped with an approved liquid level gaging device.

(2) DEVICE ARRANGEMENT. All gaging devices shall be arranged so that the maximum liquid level to which the container is filled is readily determined.

(3) BLEED VALVE. 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 drill size unless provided with an excess-flow valve. This subsection does not apply to farm vehicles used for the application of ammonia as covered in subch. VIII.

(4) DESIGN PRESSURE. Gaging devices shall have a design pressure equal to or greater than the design pressure of the container on which they are installed.

(5) MAXIMUM VOLUME. 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. This subsection does not apply to refrigerated storage as covered in subch. IV.

(6) COLUMNAR TYPE GAGE GLASSES. Gage glasses of the columnar type shall be restricted to stationary storage installations. They shall be equipped with shut-off valves having 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, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.29 Painting of containers. Aboveground uninsulated containers shall have a reflective surface maintained in good condition. White is recommended for painted surfaces, but other light reflecting colors shall be acceptable.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.30 Electrical equipment and wiring. (1) GENERAL. Electrical equipment and wiring for use in ammonia installations shall be general purpose or weather resistant as appropriate.

(2) SPECIAL REQUIREMENTS. Where concentrations of ammonia in air in excess of 16% by volume are likely to be encountered, electrical equipment and wiring shall be of a type specified by and be installed in accordance with ch. ILHR 16 for Class I, Group D locations.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

Subchapter III
Systems Utilizing Stationary Pier-Mounted or Skid-Mounted, Aboveground or Underground, Nonrefrigerated Storage

ILHR 43.40 Application. Sections ILHR 43.40 to 43.48 shall apply to stationary, pier-mounted, skid-mounted, aboveground or underground, nonrefrigerated storage installations utilizing containers constructed in accordance with chs. ILHR 41-42. All basic rules of subch. II shall apply to this subchapter unless otherwise specified.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.41 Design pressure and construction of containers. The minimum design pressure for nonrefrigerated aboveground containers shall be 250 psig. U-68 and U-69 ASME Code containers with a design pressure of 200 psig are acceptable if equipped with pressure relief valves as permitted in s. ILHR 43.23 (2).

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.42 Container valves and accessories. (1) FILLING CONNECTION. Each filling connection shall be provided with a 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 a back-pressure check valve or an excess-flow valve.

(2) VAPOR AND LIQUID CONNECTIONS. All vapor and liquid connections, except pressure relief valves and those specifically exempt in s. ILHR 43.20 (4) and (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) PRESSURE GAGE. Each storage container shall be provided with a pressure gage graduated from 0 to 400 psig. Gages shall be designated for use in ammonia service.

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

(5) LIQUID LEVEL GAGE. All containers shall be equipped with a fixed maximum liquid level gage.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.43 Pressure relief devices. (1) GENERAL REQUIREMENTS. Every container shall be provided with one or more pressure relief valves of springloaded or equivalent type and shall comply with pars. (a) and (b).

(a) The discharge from pressure 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 pressure relief valve outlet connection. All pressure relief valve discharges shall have rain caps that will allow free discharge of the vapor and prevent the entrance of water. Provision shall be made for draining condensate which may accumulate.

(b) Vent pipes from 2 or more pressure 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 the header is at least equal to the sum of the cross-sectional areas of the individual vent pipes.

(2) RATE OF DISCHARGE. The rate of discharge of spring-loaded pressure relief valves installed on underground containers may be reduced to a minimum of 30 percent of the rate of discharge specified in Table 43.23. 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 shall be considered aboveground containers when determining the rate of discharge requirements of the pressure relief valves.

(3) DISCHARGE LOCATION. 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 the openings equalling or exceeding the combined discharge areas of pressure relief valves and vent lines which discharge their content into the manhole housing.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.44 Installation of storage containers. (1) FOOTINGS AND FOUNDATIONS. 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. 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.

(2) BEARING SUPPORTS. 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. Means for preventing corrosion shall be provided on that portion of the container in contact with the foundations or saddles.

(3) COVERING UNDERGROUND TANKS. 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.

(4) CORROSION PROTECTION. Underground containers shall be set on firm foundations 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. The 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.

Note: Firm earth may be used to meet the firm foundation requirement.

(5) GROUNDWATER PROTECTION. (a) *Liners.* Underground containers shall be enclosed within a secondary containment provided with a liner conforming to one of the following standards:

1. Asphalt or concrete liners. Asphalt or concrete liners shall be designed according to good engineering practice to withstand any foreseeable loading conditions, including a full hydrostatic head of discharged liquid. Cracks and seams shall be sealed to prevent leakage.

2. Synthetic liners. Synthetic liners shall be approved by the department. Synthetic liners shall have a minimum thickness of 0.8 millimeters (30 mils), and be installed under the supervision of a qualified representative of the manufacturer. Synthetic liners shall be protected by an inorganic soil layer at least 12 inches thick. The soil layer shall be free of large rocks angular stones, sticks, and other material that may puncture the liner.

3. Clay soil liners. A liner may be constructed of existing soil, or of existing soil treated with bentonite clay, provided that the liner meets the requirements of this paragraph. The liner shall be designed and con-

structed according to good engineering practices, to achieve a coefficient of permeability not to exceed 1×10^{-6} cm/sec, with a thickness of not less than 6 inches. The liner may be less than 6 inches thick if a correspondingly smaller coefficient of permeability is achieved, but the liner shall in no case be less than 4 inches thick. The liner shall be covered by an inorganic soil layer not less than 4 inches thick, and shall be maintained, as necessary, to prevent cracking. Liners shall not be constructed of frost-susceptible soils, which include soils primarily composed of silt, silty sand, or lean clay having a plasticity index of less than 12.

4. Other liners. Other liners may be acceptable if approved by the department.

(b) *Monitoring.* A groundwater monitoring program approved by the department shall be established by the owner at the storage site.

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

(7) PROTECTION AGAINST FLOTATION. Secure anchorage or adequate pier height shall be provided against container flotation wherever sufficiently high flood water might occur.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.45 Reinstallation of containers. (1) PRESSURE RETESTS. 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.

(2) UNDERGROUND REINSTALLATION. Where containers are reinstalled underground, the corrosion resistant coating shall be in good condition.

(3) ABOVEGROUND REINSTALLATION. Where containers are reinstalled aboveground, pressure relief devices or gaging devices shall comply with ss. ILHR 43.23 and 43.43 respectively for aboveground containers.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.46 Marking of containers. Each container shall be marked on at least 2 sides with the words "ANHYDROUS AMMONIA" or "CAUTION - AMMONIA" in sharply contrasting colors with letters not less than 4 inches in height and ½ inch in stroke.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.47 Protection of container appurtenances. (1) PROTECTION AGAINST DAMAGE AND TAMPERING. Valves and other appurtenances shall be protected against physical damage. Manually controlled valves which, if open, would allow gas to discharge into the atmosphere, shall be kept closed and locked when the installation is unattended. If the facility is protected against tampering by fencing or other means, valve locks are not required.

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

nances shall also be protected during the transit of containers intended for installation underground.

(3) ELECTRICAL GROUNDING. Storage containers need not be electrically grounded.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.48 Identification. 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.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

Subchapter IV
Refrigerated Storage

ILHR 43.50 Application. Sections ILHR 43.50 to 43.60 shall apply to systems utilizing tanks for the storage of anhydrous ammonia under refrigerated conditions. All basic rules of subch. II shall apply to this subchapter unless inconsistent with the requirements of this subchapter.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.51 Design of tanks. (1) STORAGE PRESSURE. Tanks may be designed for any storage pressure desired as determined by economical design of the refrigerated system.

(2) DESIGN TEMPERATURE. The design temperature shall be the minimum temperature to which the container will be refrigerated and shall be so designated.

(3) HIGH PRESSURE TANKS. Containers with a design pressure exceeding 15 psig shall be constructed in accordance with s. ILHR 43.17.

(4) LOW PRESSURE TANKS. 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.

(5) OTHER MATERIALS. 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.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.52 Installation of storage tanks. (1) FOUNDATIONS. Tanks shall be supported on suitable noncombustible foundations designed to accommodate the type of tank being used.

(2) WATER PROTECTION. Adequate protection against flotation or other water damage shall be provided whenever high flood water might occur.

(3) FROST PROTECTION. 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) AREA AROUND TANKS. 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.

(a) 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.

(b) Provision shall be made for drainage of rain water from the diked or impounding area. The drainage shall not permit the release of ammonia.

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

(d) 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.

Note: 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 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.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.53 Marking refrigerated containers. Each refrigerated container shall be marked with a nameplate on the outer covering in an accessible place with:

(1) The name and address of the builder and the date of fabrication;

(2) The maximum volume or weight of the product, whichever is most meaningful to the user;

(3) The design pressure;

(4) The minimum temperature in degrees Fahrenheit for which the container was designed;

(5) The maximum allowable water level to which the container may be filled for the test purposes;

(6) The density of the product in pounds per cubic foot for which the container was designed; and

(7) The maximum level to which the container may be filled with liquid anhydrous ammonia.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.54 Tank valves, fill pipes and discharge pipes. (1) SHUT-OFF VALVES. Shut-off valves shall be:

(a) Provided for all connections except those with a No. 54 drill size restriction, plugs, safety valves and thermometer wells; and

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

(2) CONNECTION VALVES. When operating conditions make it advisable, a check valve shall be installed on the fill connection and a remotely

operated shut-off valve shall be installed on other connections located below the maximum liquid level.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.55 Pressure relief devices. (1) SETTING AND CAPACITY. Pressure 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.

(2) TOTAL RELIEVING CAPACITY. The total relieving capacity of pressure relief devices shall be in accordance with applicable sections of CGA Pamphlet S-1.3, Pressure Relief Device Standards for Compressed Gas Storage Containers.

(3) SHUT-OFF VALVES. Shut-off valves of adequate flow capacity may be provided and used to facilitate inspection and repair of pressure 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) STACKS AND DISCHARGE LINES. Pressure relief devices shall comply with the following:

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

(b) Discharge lines may be used if desired. Multiple pressure 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 10% of the design pressure of the storage container. This back pressure shall be included in the 120% total maximum pressure given in sub. (1). No other container or system may exhaust into this discharge line or header. The vent lines shall be installed to prevent accumulation of liquid in the lines.

(5) VACUUM BREAKERS. Atmospheric storage shall be provided with vacuum breakers. Ammonia gas may be used to provide a pad.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.56 Protection of container appurtenances. Refrigerated storage containers shall comply with the provisions of s. ILHR 43.47.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.57 Reinstallation of containers. 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.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.58 Damage from vehicles. Precaution shall be taken to avoid any damage by trucks, tractors or other vehicles.

Note: Properly located bumper posts or guard rails provide good protection from vehicles.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.59 Refrigeration load and equipment. (1) TOTAL LOAD. The total refrigeration load shall be computed as the sum of the following:

(a) Load imposed by heat flow into the container caused by the temperature differential between the ambient temperature and the storage temperature;

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

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

(2) MULTIPLE TANKS. More than one storage tank may be handled by the same refrigeration system.

(3) COMPRESSORS. (a) A minimum of 2 compressors shall be provided, either of which is of sufficient size to handle the loads listed in sub. (1) (a) and (b). Where more than 2 compressors are provided, minimum standby equipment equal to the largest normally operating equipment shall be installed. Compressors required for the load specified in sub. (1) (c) may be used as standby equipment for compressors required for the loads specified in sub. (1) (a) and (b).

(b) Compressors shall be sized to operate with a suction pressure at least 10% below the minimum setting of the pressure relief valve 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) COMPRESSOR DRIVES. (a) Each compressor shall have its individual driving unit.

(b) Any standard drive consistent with good design may be used.

(c) An emergency source of power of sufficient capacity to handle the loads listed in sub. (1) (a) and (b) shall be provided, unless facilities are provided to safely dispose of vented vapors while the refrigeration system is not operating.

(5) AUTOMATIC CONTROL EQUIPMENT. (a) The refrigeration system shall be arranged with controls to govern the compressor operation in accordance with the load as evidenced by the pressure in the container.

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

(c) 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.

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

(6) SEPARATORS. (a) An entrainment separator shall be installed in the compressor suction line. The separator shall be equipped with a drain and gaging device, and shall be capable of withstanding the design pressure.

(b) An oil separator shall be installed in the compressor discharge line. It shall be designed for at least 250 psig operating pressure and shall be equipped with a gaging device and drain valve.

(7) CONDENSERS. The condenser system may be cooled by air or water or both. The condenser shall be designed for at least 250 psig operating pressure. Provision shall be made for purging non-condensibles either manually or automatically.

(8) RECEIVER AND LIQUID DRAIN. A receiver shall be provided which is equipped with an automatic float valve to discharge the liquid ammonia to storage or with a high pressure liquid drain trap of suitable capacity. The receiver shall be designed for at least 250 psig operating pressure and be equipped with the necessary connections, pressure relief valves and gaging device.

(9) INSULATION. 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 supported and protected against the weather. Weatherproofing shall be of a type which will not support flame propagation.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.60 Safety equipment. All refrigerated storage plants shall have on hand the minimum safety equipment required under s. ILHR 43.24 (3).

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

Subchapter V

Systems Utilizing Portable U.S. DOT Containers and Cylinders

ILHR 43.61 Application. Sections ILHR 43.61 to 43.64 shall apply to systems utilizing cylinders, portable tanks and "ton containers" marked DOT-51, DOT-106A or DOT-110A, and constructed in accordance with U.S. department of transportation specifications. All basic rules of subch. II shall apply to this subchapter unless otherwise noted.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.62 Containers and cylinders. (1) GENERAL. Containers and cylinders shall comply with U.S. department of transporation regulations.

(2) STORAGE. Containers and cylinders shall be stored in an area free from ignitable debris and in a manner to prevent external corrosion. Storage may be indoors or outdoors.

(3) PROHIBITED LOCATION. Containers and cylinders shall not be buried below ground.

(4) FOUNDATIONS. Containers and cylinders shall be set upon firm foundations or otherwise firmly secured. The possible effect of settling on the outlet piping shall be guarded against by a flexible connection or special fitting.

(5) PROTECTION FROM HEAT. Containers and cylinders shall be protected from heat sources such as radiant flame and steam pipes. Heat shall not be applied directly to containers or cylinders to raise the pressure.

(6) PROTECTION FROM DAMAGE. Containers and cylinders shall be stored in a manner to protect them from moving vehicles or external damage.

(7) VALVE PROTECTION. Any container or cylinder which is designed to have a valve protection cap or device shall have the cap or device securely in place when the container or cylinder is not in service.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.63 Container and cylinder valves and regulating equipment. (1) PROTECTION AGAINST TAMPERING. Container and cylinder valves and pressure regulating equipment shall be protected against tampering when installed for use.

(2) PROTECTION DURING TRANSIT. Container and cylinder valves shall be protected while in transit, in storage, and while being moved into final utilizations:

(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-pound weight dropped 4 feet. Construction shall be such that a blow will not be transmitted to the valves or other connections.

(3) PROTECTION WHEN NOT IN SERVICE. When containers or cylinders are not connected for service, the outlet valves shall be kept tightly closed and protected even though containers are considered empty.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.64 Pressure relief devices. Containers shall be provided with pressure relief devices as required by U.S. department of transportation regulations.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

Subchapter VI
Systems Mounted on Trucks, Semi-Trailers and Trailers for Transportation of Ammonia

ILHR 43.65 Application. Sections ILHR 43.65 to 43.78 shall apply to systems mounted on trucks, semi-trailers and trailers, other than those covered under subchs. VII and VIII, used for the transportation of am-

monia. All basic rules of subch. II shall apply to this subchapter unless otherwise noted.

Note: Systems for trucks and trailers for transportation of anhydrous ammonia are also required to comply with the applicable regulations of the U.S. department of transportation.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.66 Design pressure of containers. (1) MINIMUM PRESSURE. Containers used in intrastate commerce shall be constructed in accordance with s. ILHR 43.17 with a minimum design pressure of 265 psig.

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

(3) LABELS. All container openings, except pressure 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.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.67 Mounting containers on truck. (1) MEANS OF ATTACHMENT. The means of attachment of any container to the cradle, frame or chassis of a vehicle shall be designed on a basis of 2 "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, 2 "g" of load support is equivalent to 3 times the static weight of the articles supported; 2 "g" of loading and bending, acceleration, and torsion is equivalent to twice the static weight support applied horizontally at the road surface.

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

(3) CRADLES. 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 requirements under which the cargo tank was designed.

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

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

(5) CRADLE ATTACHMENT. When the cradle and the container are not welded together, proper material shall be used between them to eliminate metal-to-metal friction.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.68 Container appurtenances. (1) PROTECTION AGAINST DAMAGE. Nonrecessed container fittings and appurtenances shall be pro-

tected against physical damage by either a protected location, the vehicle frame or bumper, or a protective housing.

(a) 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.

(b) The protective housing, if used, shall be protected with a weather cover, if necessary, to insure proper operation of valves and pressure relief devices.

(2) EXCESS-FLOW VALVES. All connections to containers, except filling connections, pressure relief devices, and liquid level and pressure gage connections, shall be provided with automatic excess-flow valves, or in lieu thereof, may be fitted with quick-closing internal valves, which shall remain closed except during delivery operations. The control mechanism for the valves may be provided with a fusible section with a melting point of 208°F to 220°F, which will permit the internal valve to close automatically in case of fire.

(3) BACK-FLOW PREVENTION. Filling connections shall be provided with automatic back-pressure check valves, excess-flow check valves or quick-closing 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-closing internal valve as specified in sub. (2), the automatic valve shall not be required.

(4) SPRAY LOADING. All containers shall be equipped for spray loading or with an approved vapor return valve.

(5) LIQUID LEVEL GAGE. All containers shall be equipped with a fixed maximum liquid level gage.

(6) PRESSURE GAGE. All containers shall be equipped with a pressure-indicating gage having a dial graduated from 0-400 psig.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.69 Piping and fittings. (1) MOUNTING. All piping, tubing and fittings shall be securely mounted and protected against physical damage.

(2) PIPE TYPE AND MATERIAL. Piping used on nonrefrigerated systems shall be at least ASTM A-53 Grade B Electric Resistance Welded Pipe or equal. The pipe shall be at least Schedule 40 when joints are welded, or welded and flanged. The pipe shall be at least Schedule 80 when joints are threaded. Brass, copper or galvanized steel pipe or tubing shall not be used.

(3) EXCESS-FLOW VALVE. The truck unloading line shall be provided with an excess-flow valve at the hose connection unless an approved quick-closing internal valve is provided in the container unloading connection.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.70 Pressure relief devices. (1) DISCHARGE VENT. The discharge from container pressure relief valves shall be vented away from the container upward and unobstructed to the open air in a manner to prevent any impingement of escaping gas upon the container. Loose fitting rain caps shall be used.

(2) DISCHARGE LINE SIZE. Size of discharge lines from pressure relief valves shall not be smaller than the nominal size of the pressure relief valve outlet connection.

(3) CONDENSATE DRAIN. Provision shall be made for draining condensate which may accumulate in the discharge pipe.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.71 Placarding and marking of containers. Every container, whether loaded or empty, shall be conspicuously and legibly marked on each side and each end thereof on a background of sharply contrasting color with the words, "ANHYDROUS AMMONIA" in letters at least 2 inches in height and ¼ inch in stroke and U.S. department of transportation "NONFLAMMABLE GAS" placards.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.72 Transfer of liquids. (1) CONTENT DETERMINATION. (a) The content of tank motor vehicle containers shall be determined by weight, by liquid level gaging devices, meters, or other approved methods.

(b) 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. The volume, when converted to weight, shall not exceed the filling density specified by the U.S. department of transportation regulations.

(2) PUMPS AND COMPRESSORS. Pumps and compressors shall be designed and installed in accordance with s. ILHR 43.26 and protected against physical damage when mounted on ammonia tank trucks and trailers.

(3) UNLOADING LOCATIONS. Tank motor vehicles of greater than 3500 gallons water capacity shall be unloaded only at approved locations meeting the requirements of ss. ILHR 43.24 (3) and 43.26 (8).

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.73 Trailers and semi-trailers. (1) TRAILER ATTACHMENT. Trailers shall be firmly and securely attached to the vehicle drawing them by means of drawbars, supplemented by safety chains or safety cables.

(2) BRAKING SYSTEM. Every trailer and semi-trailer shall be equipped with an emergency braking system to be activated in the event of hitch failure.

(3) TRAILER CONSTRUCTION. Trailers shall be of the 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.

(4) FIFTH WHEEL REQUIREMENTS. 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 2 units except by manual release.

(5) LIGHTS. Every trailer or semi-trailer shall be provided with side lights and tail lights.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.74 Electrical equipment and lighting. Tank trucks, tank trailers and tank semi-trailers shall not be equipped with any artificial light other than electric light. Electric lighting circuits shall have overcurrent protection such as fuses or automatic circuit breakers. The wiring shall have sufficient current-carrying capacity and mechanical strength, and shall be secured, insulated and protected against physical damage.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.75 Protection against collision. 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.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.76 Chock blocks. At least 2 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.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.77 Portable tanks. When portable tanks, including skid 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 this subchapter. Where portable tanks, including those built to DOT Specification 51, 106A or 110A, are used for farm storage, they shall comply with subch. III.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.78 Safety equipment. All tank trucks, trailers and semi-trailers shall be equipped for emergency and rescue purposes with:

(1) One full-face gas mask with an anhydrous ammonia canister and at least one spare anhydrous ammonia canister;

(2) One pair of protective gauntlet-type gloves made of rubber or other material impervious to ammonia;

(3) One pair of flexible fitting, hooded ventilation goggles; and

(4) A container of not less than 5 gallons of readily available clean water.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

Subchapter VII
Systems Mounted on Farm Wagons for the Transportation of Ammonia

ILHR 43.80 Application. Sections ILHR 43.80 to 43.86 shall apply to containers of 3000 gallons water capacity or less and pertinent equip-

ment mounted on farm wagons and used for the transportation of ammonia. All basic rules of subch. II shall apply to this subchapter unless otherwise noted.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.81 Design of containers. Containers shall be constructed in accordance with s. ILHR 43.17.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.82 Mounting of containers. (1) STOPS. A stop 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 the farm wagon coming to a sudden stop. Back slippage shall also be prevented.

(2) HOLD-DOWN DEVICE. A 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.

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

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

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.83 Container appurtenances. (1) LIQUID LEVEL GAGE. All containers shall be equipped with a fixed maximum liquid level gage.

(2) PRESSURE GAGE. All containers exceeding 250 gallons water capacity shall be equipped with a pressure gage having a dial graduated from 0-400 psig.

(3) SHUT-OFF VALVE. The filling connection shall consist of a positive shut-off valve in conjunction with either a back-pressure check valve or an excess-flow valve.

(4) SPRAY LOADING. All containers exceeding 250 gallons water capacity shall be equipped for spray loading or with an approved vapor return valve.

(5) EXCESS-FLOW VALVE. All vapor and liquid connections, except pressure relief valves and those specifically exempt in s. ILHR 43.20 (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.

(6) DAMAGE PROTECTION. 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 4 based upon the ultimate strength of the material used. If the guard is fully enclosed, the pressure relief valves shall be properly vented through the guard.

(7) LIQUID WITHDRAWAL LINE. (a) If a liquid withdrawal line is installed in the bottom of a container, the connection thereto, including

hose, shall not be lower than the lowest horizontal edge of the farm wagon axle.

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

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.84 Placarding and marking of containers. (1) PLACARDS. There shall appear on each side and on each end of the container in letters at least 2 inches in height and ¼ inch in stroke, the words, "ANHYDROUS AMMONIA" and U.S. department of transportation "NONFLAMMABLE GAS" placards.

(2) SLOW MOVING EMBLEM. Slow moving farm wagons operating on public roads shall be provided with an emblem consisting of a fluorescent yellow-orange triangle with a dark red reflective border.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.85 Farm wagons. (1) WAGON ATTACHMENT. All farm wagons shall be securely attached to the vehicle drawing them by means of drawbars supplemented by safety chains.

(2) WAGON CONSTRUCTION. A farm wagon shall be of a type of construction which will cause it to follow substantially in the path of the towing vehicle and which will prevent the towed farm wagon from whipping or swerving dangerously from side to side.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.86 Safety equipment. All nurse tanks shall be equipped for safety purposes with the following equipment:

(1) One pair of flexible fitting, hooded ventilation goggles;

(2) One pair of protective gauntlet-type gloves made of rubber or other material impervious to ammonia;

(3) A container of not less than 5 gallons of readily available clean water;

(4) An eye wash bottle filled with not less than ½ pint of clean water;

(5) Decals depicting step-by-step ammonia transfer instructions and connecting/disconnecting instructions for quick couplers; and

(6) One decal listing first aid procedures to use when contaminated with ammonia.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

Subchapter VIII
Systems Mounted on Farm Equipment for the Application of Ammonia

ILHR 43.90 Application. Sections ILHR 43.90 to 43.94 shall apply to systems mounted on farm equipment and used for the field application of

ammonia. All basic rules of subch. II shall apply to this supchapter unless otherwise noted.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.91 Design of containers. Containers shall be constructed in accordance with s. ILHR 43.17.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.92 Mounting of containers. All containers shall be securely mounted on the application vehicle.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.93 Container valves and appurtenances. (1) LIQUID LEVEL GAGE. Fixed maximum liquid level gages shall be designed to indicate when the container has been filled to 85% of its water capacity. The dip tube of this gage shall be installed in such a manner that it cannot be readily removed.

(2) SHUT-OFF VALVE. The filling connection shall consist of a positive shut-off valve in conjunction with either a back-pressure check valve or an excess-flow valve.

(3) EXCESS-FLOW VALVE. (a) An excess-flow valve is not required in the vapor connection, provided the controlling orifice is not in excess of 7/16 of an inch in diameter and the valve is a hand-operated shut-off valve. To assist in filling applicator tanks, it is permissible to bleed vapors to the open air, provided the requirements of this paragraph are met.

(b) 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 does not exceed 7/16 inch in diameter.

(4) METERING DEVICES. 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 the requirements of s. ILHR 43.22. 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 shall be used. Hydrostatic pressure relief shall be provided between the applicator tank and the metering device.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

ILHR 43.94 Safety equipment. All applicator tanks shall be equipped for safety purposes with the following equipment:

(1) One pair of flexible fitting, hooded ventilation goggles;

(2) One pair of protective gauntlet-type gloves made of rubber or other material impervious to ammonia;

(3) A container of not less than 5 gallons of readily available clean water; and

(4) An eye wash bottle filled with not less than ½ pint of clean water.

History: Cr. Register, November, 1985, No. 359, eff. 12-1-85.

APPENDIX

The material contained in this appendix is for clarification and general information only.

Physical Properties of Ammonia

Molecular symbol	NH_3
Molecular weight	17.031
Boiling point at one atmosphere*	-28°F
Melting point one atmosphere*	-107.9°F
Critical temperature	271.4°F
Critical pressure	1657 psia
Latent heat at -28°F and one atmosphere*	589.3 Btu/lb
Relative density of vapor compared to dry air at 32°F and one atmosphere*	0.5970
Vapor density at -28°F and one atmosphere*	0.05555 lb/ft^3
Specific gravity of liquid at -28°F compared to water at 39.2°F	0.6819
Weight per gallon of liquid at -28°F	5.69 lbs/gallon
Liquid density at -28°F and one atmosphere*	42.57 lbs/ft^3
Specific volume of vapor at 32°F and one atmosphere*	20.78 ft^3/lb
Flammable limits by volume in air at atmospheric pressure	16% to 25%
Ignition Temperature (in a standard quartz container)	1562°F
Specific Heat, Gas, at 59°F and one atmosphere*	
at constant pressure, C_p	0.5232 Btu/lb.°F
at constant volume, C_v	0.3995 Btu/lb.°F

* One atmosphere = 14.7 psia