North Carolina Department of Labor
Occupational Safety and Health Division

Date:
Reviewed by:

Process Safety Management
Checklist for Ammonia Refrigeration Inspection

Employee Participation: [1910.119 (c)]

1. Does a written program exist regarding employee participation?
YES ( ) NO ( ) Comments:
2. Does the written program include consultation with employees on the development of the PHA(s)? YES ( ) NO ( ) Comments:
3. Does the written program provide employees access to PHA(s) and other PSM information?
YES ( ) NO ( ) Comments:
4. Have employees been consulted on the development of the PHA(s)?
YES ( ) NO ( ) Comments:
5. Have employees been consulted on all other elements of the PSM program?
YES ( ) NO ( ) Comments:
6. Have employees been provided access to PHA(s) and other required PSM information?
YES ( ) NO ( ) Comments:

Process Safety Information: [1910.119 (d)]

1. Has written process safety information been compiled before conducting the PHA(s)?
YES ( ) NO ( ) Comments:
2. Is material safety data sheet information (MSDS) readily available to operators?
YES ( ) NO ( ) Comments:
3. Does information pertaining to hazardous chemicals include at least:
   - toxicity information? YES ( ) NO ( ) Comments:
   - permissible exposure limits? YES ( ) NO ( ) Comments:
   - physical data? YES ( ) NO ( ) Comments:
   - reactivity data? YES ( ) NO ( ) Comments:
   - corrosivity data? YES ( ) NO ( ) Comments:
   - stability data? YES ( ) NO ( ) Comments:
   - effects and outcome of inadvertent mixing of chemicals?
   YES ( ) NO ( ) Comments:
4. Does information pertaining to process technology include at least:
   - block or process flow diagram? YES ( ) NO ( ) Comments:
   - process chemistry? YES ( ) NO ( ) Comments:
   - maximum intended inventory? YES ( ) NO ( ) Comments:
   - safe upper and lower limits? YES ( ) NO ( ) Comments:
   - consequences of deviation from safe limits? YES ( ) NO ( ) Comments:
5. Does information pertaining to all process equipment include at least:
   - materials of construction of all wetted parts? YES ( ) NO ( ) Comments:

- electrical classification of equipment/ appliances? YES ( ) NO ( ) Comments:
- relief system design and design basis? YES ( ) NO ( ) Comments:
- design codes and standards? YES ( ) NO ( ) Comments:
- material and energy balances for systems built after 5/26/92?
YES ( ) NO ( ) Comments:
- safety systems? YES ( ) NO ( ) Comments:

6. Does the system comply with good engineering practices? YES ( ) NO ( ) Comments:
- Is it documented (engineer's sealed calculations, plans)? YES ( ) NO ( ) Comments:

7. Is equipment inspected, maintained and operated in a safe manner?
YES ( ) NO ( ) Comments:
- preventative maintenance (PMs) follow manufacturer's recommendations?
YES ( ) NO ( ) Comments:
- inspections follow manufacturer/ industry (IIAR, RETA) recommended practices?
YES ( ) NO ( ) Comments:

Process Hazard Analysis: [1910.119 (e)]

1. Is the PHA(s) completed? YES ( ) NO ( ) Comments:
2. Does the PHA(s) use an acceptable method (hazop/ checklist/ what-if checklist)?
YES ( ) NO ( ) Comments:
3. Does the PHA address the hazards of the process? YES ( ) NO ( ) Comments:
4. Does the PHA address previous incidents? YES ( ) NO ( ) Comments:
5. Does the PHA address consequences of failure of engineering and administrative controls?
YES ( ) NO ( ) Comments:
6. Does the PHA address facility siting? YES ( ) NO ( ) Comments:
7. Does the PHA address human factors? YES ( ) NO ( ) Comments:
8. Does the PHA address possible safety and health effects of failure of controls on employees?
YES ( ) NO ( ) Comments:
9. Does the PHA team include one hourly employee, one engineering qualified person, one person with expertise in the process and a person qualified in the analysis method used?
YES ( ) NO ( ) Comments:
10. Has a system been established to address findings & recommendations?
YES ( ) NO ( ) Comments:
11. Does the plant system assure recommendations are documented and resolved in a timely manner? YES ( ) NO ( ) Comments:
12. Does the plant system document the actions to be taken.
13. Are actions completed as soon as possible? YES ( ) NO ( ) Comments:
14. Is there a written shedule (work orders) of when actions to be taken are to be completed?
YES ( ) NO ( ) Comments:
15. Are corrective actions communicated to affected employees? YES ( ) NO ( ) Comments:
16. Are PHA(s) updated and re-validated at least every five years?
YES ( ) NO ( ) Comments:
17. Are PHA(s) updated by the team of qualified personnel? YES ( ) NO ( ) Comments:
18. Are PHA(s) and documented actions being retained for the life of the process?

YES ( ) NO ( ) Comments:

Standard Operating Procedures: [1910.119 (f)]

1. Do written operating procedures exist for each covered process?
YES ( ) NO ( ) Comments:
2. Do the procedures provide clear instruction(s) for the safe conduct of the following:
   - initial startup? YES ( ) NO ( ) Comments:
   - normal startup? YES ( ) NO ( ) Comments:
   - normal shutdown? YES ( ) NO ( ) Comments:
   - temporary shutdown? YES ( ) NO ( ) Comments:
   - restart after temporary shutdown? YES ( ) NO ( ) Comments:
   - line break procedures? YES ( ) NO ( ) Comments:
   - floodout control? YES ( ) NO ( ) Comments:
   - blast defrost? YES ( ) NO ( ) Comments:
3. Do the procedures detail normal operating conditions, ranges and settings and the consequences of deviations from those ranges? YES ( ) NO ( ) Comments:
4. Do the procedures detail the actions to be taken when normal conditions are not met?
YES ( ) NO ( ) Comments:
5. Do the procedures provide clear instructions for safe response in the following emergency conditions:
   - total electrical failure? YES ( ) NO ( ) Comments:
   - total loss of water supply? YES ( ) NO ( ) Comments:
   - major vessel failure? YES ( ) NO ( ) Comments:
   - piping rupture? YES ( ) NO ( ) Comments:
   - valve failure? YES ( ) NO ( ) Comments:
   - water in system? YES ( ) NO ( ) Comments:
   - cooling failure? YES ( ) NO ( ) Comments:
   - natural disaster (hurricane, tornado)? YES ( ) NO ( ) Comments:
6. Do the procedures clearly define the operator's authority to implement emergency procedure(s) without seeking higher levels of authority? YES ( ) NO ( ) Comments:
7. Are ALL necessary operating procedures available to operators?
YES ( ) NO ( ) Comments:
8. Do procedures include the following safety and health considerations:
   - properties and hazards of process chemicals? YES ( ) NO ( ) Comments:
   - precautions to prevent exposure? YES ( ) NO ( ) Comments:
   - control measures if chemical contact is made? YES ( ) NO ( ) Comments:
   - quality control for raw materials? YES ( ) NO ( ) Comments:
   - any special or unique hazard(s)? YES ( ) NO ( ) Comments:
9. Are safety systems and their functions included in the SOPs? YES ( ) NO ( ) Comments:
10. Are the SOP's consistent with process safety information? YES ( ) NO ( ) Comments:
11. Are SOPs reviewed and re-authorized at least annually? YES ( ) NO ( ) Comments:
12. Do SOPs reflect current requirements for:
   - process chemical (ammonia)? YES ( ) NO ( ) Comments:
   - process technology? YES ( ) NO ( ) Comments:

- process equipment? YES ( ) NO ( ) Comments:

13. Have safe work practices been developed and implemented to control entrance to the process area by plant maintenance, contractors and contract employees or other support personnel? YES ( ) NO ( ) Comments:

14. Have safe work practices been developed and implemented to control hazards during such operations as:

- hot work? YES ( ) NO ( ) Comments:
- lockout/tagout? YES ( ) NO ( ) Comments:
- confined space entry? YES ( ) NO ( ) Comments:
- pipe (line) breaking? YES ( ) NO ( ) Comments:
- equipment opening? YES ( ) NO ( ) Comments:

Training: [1910.119 (g)]

1. Has each employee involved in a covered process been trained and certified in:
   - overview of the process? YES ( ) NO ( ) Comments:
   - all operating procedures? YES ( ) NO ( ) Comments:
   - normal operating limits? YES ( ) NO ( ) Comments:
   - emergency procedures? YES ( ) NO ( ) Comments:
   - safety and health considerations/ requirements? YES ( ) NO ( ) Comments:
   - safety systems and their functions? YES ( ) NO ( ) Comments:
2. For operators employed before 5/26/92, is there written certification that they possess the knowledge, skills and abilities to safely carry out their duties, in leiu of initial training? YES ( ) NO ( ) Comments:

3. Or, is documented initial training provided to the operator PRIOR to starting a new job assignment? YES ( ) NO ( ) Comments:
4. Does the certification record include proof of the means used to verify that the employee understood the training (testing, interview)? YES ( ) NO ( ) Comments:
5. Have operator(s) been consulted to determine the appropriate frequency of REFRESHER training? YES ( ) NO ( ) Comments:
6. Is Refresher training conducted at least every three years? YES ( ) NO ( ) Comments:
7. Are records (spreadsheet) kept on each employee who has completed the refresher training? YES ( ) NO ( ) Comments:

Contractors: [1910.119 (h)]

1. Does the PSM program include all contractors performing repairs, maintenance, renovation or specialty work on or adjacent to the covered process? YES ( ) NO ( ) Comments:
2. Is a contractor's safety record, performance and programs obtained and evaluated as a basis for selection? YES ( ) NO ( ) Comments:
3. Prior to beginning any work, are contract employers briefed regarding known hazards related to the contractors work and process(es) including:
   - potential fire hazards? YES ( ) NO ( ) Comments:
   - risk of explosion? YES ( ) NO ( ) Comments:

- toxic release hazards? YES ( ) NO ( ) Comments:

4. Are contract employers informed of the applicable provisions of the plant emergency action plan? YES ( ) NO ( ) Comments:

5. Are procedures in place and effective to control entrance, presence and safe exit of contractor employees in covered process area(s)? YES ( ) NO ( ) Comments:

6. Do contract employers assure their employees:

- are trained in safe work practice(s)? YES ( ) NO ( ) Comments:
- are trained in potential hazards? YES ( ) NO ( ) Comments:
- have their training documented? YES ( ) NO ( ) Comments:
- verify they understood the training? YES ( ) NO ( ) Comments:
- follow plant safety rules and practices? YES ( ) NO ( ) Comments:

7. Do contractor employers advise the plant manager of any unique (not disclosed in site meetings) hazards presented by the contractor's work? YES ( ) NO ( ) Comments:

8. Does the plant maintain a log of injuries and illnesses of contractor employees relate to their work in covered process areas? YES ( ) NO ( ) Comments:

9. Are plant rules inforced with contractor employees regarding personal protective equipment? YES ( ) NO ( ) Comments:

Pre-Startup Safety Review: [1910.119 (i)]

1. Does the PSM program clearly detail the procedures for completion of pre-starup safety reviews? YES ( ) NO ( ) Comments:

2. Has a pre-startup safety review been performed on all new facilities?
YES ( ) NO ( ) Comments:

3. Has a pre-startup safety review been performed when modifications warrant a change in proces safety information? YES ( ) NO ( ) Comments:

4. Do the reviews confirm that:

- construction and equipment are in accordance with design specifications?
YES ( ) NO ( ) Comments:
- safety, operating, maintenance and emergency procedures are in place and adequate?
YES ( ) NO ( ) Comments:
-for new facilities, that a PHA has been performed and the recommendations resolved and implemented before startup? YES ( ) NO ( ) Comments:
- for modified facilities, that management of change procedures have been completed and resolved? YES ( ) NO ( ) Comments:
- that training has been completed and documented for each employee involved in operating the process? YES ( ) NO ( ) Comments:

Mechanical Integrity: [1910.119 (j)]

1. Has a mechanical integrity program been written to maintain the on-going integrity of the following:

- pressure vessels? YES ( ) NO ( ) Comments:
- storage tanks? YES ( ) NO ( ) Comments:

- piping systems? YES ( ) NO ( ) Comments:
- valves? YES ( ) NO ( ) Comments:
- compressors? YES ( ) NO ( ) Comments:
- pumps and components? YES ( ) NO ( ) Comments:
- relief and vent systems? YES ( ) NO ( ) Comments:
- emergency shutdown systems? YES ( ) NO ( ) Comments:
- controls, monitoring devices, sensors, alarms and interlocks?

YES ( ) NO ( ) Comments:

2. Does the documentation indicate the procedures have been implemented?
YES ( ) NO ( ) Comments:
3. Have maintenance employees received training on the hazards associated with the process and been certified for the tasks they are required to perform? YES ( ) NO ( ) Comments:
4. Are inspections and tests performed on each item of process equipment in the program?
YES ( ) NO ( ) Comments:
5. Do inspection and testing procedures follow good engineering practice?
YES ( ) NO ( ) Comments:
6. Is the frequency of inspection and testing consistent with manufacturer's recommendations?
YES ( ) NO ( ) Comments:
7. Are inspections and tests carried out more frequently if warranted by operational experience?
YES ( ) NO ( ) Comments:
8. Does the documentation for inspections and tests include:
- date of the inspection or test? YES ( ) NO ( ) Comments:
- name of the person performing the procedure? YES ( ) NO ( ) Comments:
- serial number or other identifier for equipment being inspected or tested? YES ( ) NO ( ) Comments:
- description of the inspection or test (recognized test method, standard used)? YES ( ) NO ( ) Comments:
- results of the inspection or test? YES ( ) NO ( ) Comments:

9. Are deficiencies which are outside normal limits corrected before further use, or are the appropriate steps taken in a timely manner to assure safe operation? YES ( ) NO ( ) Comments:
10. Are procedures in place to ensure that new plants and equipment as fabricated and supplied is suitable for the process? YES ( ) NO ( ) Comments:
11. Are inspections conducted to insure that the installation of new equipment complies with design and manufacturer's specification? YES ( ) NO ( ) Comments:
12. Prior to use, are maintenance materials, spare parts, and equipment checked for suitability for the process application(s)? YES ( ) NO ( ) Comments:

Non-Routine Work Permits: [1910.119 (k)]

1. Does the written program include procedures and sample forms for authorizing:
- hot work? YES ( ) NO ( ) Comments:
- confined space entry? YES ( ) NO ( ) Comments:

- lockout/tagout? YES ( ) NO ( ) Comments:
- over-ride of safety devices? YES ( ) NO ( ) Comments:

2. Do the permit(s) indicate the date(s) authorized for the performance of the non-routine tasks? YES ( ) NO ( ) Comments:
3. Have work permits been issued for all welding, cutting, brazing conducted on or near the process? YES ( ) NO ( ) Comments:
4. Do the hot work permits describe the object on which the work will be performed? YES ( ) NO ( ) Comments:
5. Have hot work permits been kept on file until the operations are complete? YES ( ) NO ( ) Comments:
6. Have hot work permits identified openings, cracks and holes where sparks may drop onto combustible materials? YES ( ) NO ( ) Comments:
7. Have the hot work permits described the fire equipment required to handle emergencies? YES ( ) NO ( ) Comments:
8. Have the hot work permits assigned fire watchers whenever welding is performed in locations where other than a minor fire could occur? YES ( ) NO ( ) Comments:
9. Are the hot work permits being authorized by the individual responsible for all welding and cutting operations? YES ( ) NO ( ) Comments:
10.Is permit authorization preceded by a site visit? YES ( ) NO ( ) Comments:
11. Have hot work permits described precautions associated with combustible materaisl on floors, walls, ceilings of combustible construction? YES ( ) NO ( ) Comments:
12. Has hot work permitting suceeded in prohibiting welding in unauthorized areas? YES ( ) NO ( ) Comments:
13. Have hot work permits required relocation of combustibles where practical, and the use of flameproof covers where not practical? YES ( ) NO ( ) Comments:
14. Have hot work permits identified for shutdown any ducts or conveyor systems that might convey sparks to distant combustibles? YES ( ) NO ( ) Comments:
15. Have hot work permits required precautions whenever welding on components that could transmit heat by radiation or conduction? YES ( ) NO ( ) Comments:
16. Have hot work permits identified hazards associated with welding on walls, partitions, ceilings or roofs with combustible coverings? YES ( ) NO ( ) Comments:
17. Have hot work permits identified hazards associated with welding on walls or panels of sandwich-type construction? YES ( ) NO ( ) Comments:
18. Has management established areas and procedures for safe welding and cutting based on fire potential? YES ( ) NO ( ) Comments:
19. Has management assigned the individual responsible for authorizing cutting and welding operations in process areas? YES ( ) NO ( ) Comments:
20. Has management insured that welders, cutters and supervisors are trained in the safe operation of their equipment? YES ( ) NO ( ) Comments:
21. Has management advised outside contractors working on the site of the hot work permitting program? YES ( ) NO ( ) Comments:
22. Has the supervisor determined if combustibles are being protected from ignition prior to welding by moving or shielding them or sceduling welding at off-use hours? YES ( ) NO ( ) Comments:
23. Has the supervisor, prior to welding, secured authorization from the responsible individual

designated by management? YES ( ) NO ( ) Comments:

Management of Change:[1910.119 (l)]

1. Are there written procedures for managing changes (except replacements in kind) to changes in process chemicals, technology, equipment and procedures? YES ( ) NO ( ) Comments:
2. Do the procedures insure that the technical basis for the proposed change is addressesed prior to any change? YES ( ) NO ( ) Comments:
3. Do the procedures insure that the impact of the change on safety and health is addressed prior to any change? YES ( ) NO ( ) Comments:
4. Do the procedures insure that modifications to operating procedures are addressed prior to any change? YES ( ) NO ( ) Comments:
5. Do the procedures insure that the necessary time period for the change is addressed prior to any change? YES ( ) NO ( ) Comments:
6. Do the procedures insure that the authorization requirements for the propose change are addressed prior to any change? YES ( ) NO ( ) Comments:
7. Are operators, as well as maintenance and contractor personnel whose tasks will be affected by the change, informed of, and trained in the change prior to start-up of the process?
YES ( ) NO ( ) Comments:
8. Is process safety information updated by the change, where applicable?
YES ( ) NO ( ) Comments:
9. Are operating procedures updated by the change where applicable?
YES ( ) NO ( ) Comments:

Incident Investigation:[1910.119 (m)]

1. Is there a written procedure for investigating all incidents involving the process?
YES ( ) NO ( ) Comments:
2. Has each incident been investigated which resulted in or could have resulted in a catastrophic release? YES ( ) NO ( ) Comments:
3. Have incident investigations been initiated as soon as possible and not later than 48 hours following the incident? YES ( ) NO ( ) Comments:
4. Are incidents investigated by a team knowledgeable in the process, including contractor employee(s), when the incident involved their work? YES ( ) NO ( ) Comments:
5. Have report(s) been prepared at the conclusion of an investigation which include, at a minimum:
    - date of incident? YES ( ) NO ( ) Comments:
    - date investigation began? YES ( ) NO ( ) Comments:
    - factors contributing to incident? YES ( ) NO ( ) Comments:
    - description of incident? YES ( ) NO ( ) Comments:
    - recommendation(s) from team? YES ( ) NO ( ) Comments:
6. Has a system been established to promply address and resolve the findings and recommendations? YES ( ) NO ( ) Comments:
7. Have resolution(s) and corrective action(s) been documented? YES ( ) NO ( ) Comments:
8. Have incident investigation reports been reviewed with all affected employee(s) and contractor personnel? YES ( ) NO ( ) Comments:

9. Are incident report(s) maintained for five years? YES ( ) NO ( ) Comments:

Emergency Planning and Response: [1910.119 (n)]

1. Has an emergency action plan been established and implemented in accordance with 1910.38, meeting the following requirements:
   - escape procedure(s) and routes? YES ( ) NO ( ) Comments:
   - accounting for employee(s)? YES ( ) NO ( ) Comments:
   - reporting emergencies? YES ( ) NO ( ) Comments:
   - duties of personnel remaining to operate critcal equipment? YES ( ) NO ( ) Comments:
   - duties of rescue and medical personnel? YES ( ) NO ( ) Comments:
   - contact persons for emergencies? YES ( ) NO ( ) Comments:
   - employee alarm system(s)? YES ( ) NO ( ) Comments:

2. Is the emergency action plan published and available for review? YES ( ) NO ( ) Comments:
3. Are sufficient personnel designated and trained to assist in orderly evacuation? YES ( ) NO ( ) Comments:
4. Was the plan reviewed with each employee covered? YES ( ) NO ( ) Comments:
   - When the plan was developed? YES ( ) NO ( ) Comments:
   - Whenever employee responsibilities change? YES ( ) NO ( ) Comments:
   - Whenever the EAP changed? YES ( ) NO ( ) Comments:
5. Is an alarm system established and implemented in compliance with 1910.165? YES ( ) NO ( ) Comments:
6. Are alarms:
   - distinctive for each purpose? YES ( ) NO ( ) Comments:
   - can be heard distinctively over ambient (background) noise? YES ( ) NO ( ) Comments:
   - recogniable as a signal to evacuate? YES ( ) NO ( ) Comments:
   - maintained in operating order? YES ( ) NO ( ) Comments:
7. Are supervised alarm systems tested at least annually and non-supervised systems at least every two months? YES ( ) NO ( ) Comments:
8. Does the emergency action plan detail procedures for handling sm,all releases in accordance with 1910.120? YES ( ) NO ( ) Comments:
9. If employee(s) are engaged in emergency response, does the plan address:
   - co-ordination with outside parties? YES ( ) NO ( ) Comments:
   - personnel roles? YES ( ) NO ( ) Comments:
   - lines of authority? YES ( ) NO ( ) Comments:
   - training? YES ( ) NO ( ) Comments:
   - communications? YES ( ) NO ( ) Comments:
   - emergency recognition? YES ( ) NO ( ) Comments:
   - prevention? YES ( ) NO ( ) Comments:
   - safe distances and refuge for employee(s)? YES ( ) NO ( ) Comments:
   - site security and control(s)? YES ( ) NO ( ) Comments:
   - evacuation route(s)? YES ( ) NO ( ) Comments:

- decontamination? YES ( ) NO ( ) Comments:
- emergency medical treatment? YES ( ) NO ( ) Comments:
- response procedure(s)? YES ( ) NO ( ) Comments:
- personal protective emergency equipment ? YES ( ) NO ( ) Comments:
- critique and follow-up? YES ( ) NO ( ) Comments:

Compliance Audits:[1910.119 (o)]

1. Have written audit procedures been established and implemented to insure PSM compliance at least every three years? YES ( ) NO ( ) Comments:
2. Has there been an audit in the last three years? YES ( ) NO ( ) Comments:
3. Do audit reports include an evaluation of all required paragraphs of the PSM Standard? YES ( ) NO ( ) Comments:
4. Are audits conducted by at least one person knowledgeable in the process? YES ( ) NO ( ) Comments:
5. Has a report of findings been developed for each audit? YES ( ) NO ( ) Comments:
6. Has the employer promply determined and documented an appropriate response to the findings? YES ( ) NO ( ) Comments:
7. Does the employer document that the findings have been corrected? YES ( ) NO ( ) Comments:
8. Are the two most recent audit(s) report(s) and documented responses retained? YES ( ) NO ( ) Comments:

Trade Secrets: [1910.119 (p)]

1. Does the employer require a confidentiality agreement for trade secret information related to the process? YES ( ) NO ( ) Comments:
2. What areas of the process are considered to be trade secrets? YES ( ) NO ( ) Comments:

CGA—G-2.1 — 1989
ANSI K 61.1 — 1989

American National Standard

Safety Requirements for the Storage and Handling of Anhydrous Ammonia

ANSI American National Standards Institute
1430 Broadway
New York, New York
10018

to the shells and heads. The method employed shall be as prescribed in the ASME Code. It is recommended that post-weld heat treatment be performed in a furnace of a size sufficient to accommodate the entire container. Welded attachments to pads may be made after post-weld heat treatment. [8]

5.2.2.2 Steels used in fabricating pressure-containing parts of a container shall have a tensile strength no greater than a nominal 70 000 psi (480 MPa) (does not apply to Sections 8, 9, and 10).

5.2.3 All containers, except refrigerated storage tanks with a design pressure of 15 psig (100 kPa) and less, and cylinders and containers covered in Section 8, shall be inspected by a person who holds a valid National Board Commission as an Authorized Inspector or as an Owner-User Inspector as defined in the National Board Inspection Code. [11]

5.2.4 Welding for the repair or alteration of pressure-containing parts of a container shall be performed in compliance with the applicable provisions of the current edition of the National Board Inspection Code. [11] Where specific procedures are not given, it is intended that subject to acceptance of the Inspector, all repair or alteration shall conform insofar as possible to the ASME Code section and edition to which the container was constructed.

5.3 Location of Containers

5.3.1 Selection of a location for a storage container shall be made considering the potential physiological and environmental effects of ammonia on the surroundings adjacent to the proposed site. Containers shall be located outside of buildings except in buildings or sections thereof especially approved for the purpose.

5.3.2 Containers shall be located at least 50 feet (15 m) from a dug well or other sources of potable water supply, unless the container is a part of a water treatment installation.

5.3.3 The minimum distance of a storage container to dwellings or to population centers shall be in accordance with the requirements of the local jurisdiction having authority.

5.3.4 Container locations shall comply with Table 8.

5.3.5 Container storage areas shall be accessible to emergency vehicles and personnel.

5.3.6 Areas within 10 feet (3 m) of a storage container shall be maintained clear of dry grass and weeds and other combustible materials.

5.4 Markings of Non-Refrigerated Containers and Systems Other than DOT Containers

5.4.1 Each system nameplate, when required, shall be made of a noncorroding metal permanently attached to the system by continuous welding around its perimeter, and located so as to be readily accessible for inspection. Nameplates shall be maintained in legible condition and include markings as prescribed in 5.4.2.

TABLE 8

MINIMUM DISTANCES FOR LOCATION OF AMMONIA STORAGE CONTAINERS
(Customary Units and SI Units)

Nominal Capacity of Container (Gallons or Cubic Meters)	Minimum Distances (in feet or meters) from Each Container to:		
	Line of Adjoining Property which may be built upon, Highways & Mainline of Railroad	Place of Public Assembly	Institution Occupancy
*Over 500 to 2000 gals	25 ft	150 ft	250 ft
Over 2000 to 30 000 gals	50 ft	300 ft	500 ft
Over 30 000 to 100 000 gals	50 ft	450 ft	750 ft
Over 100 000 gals	50 ft	600 ft	1 000 ft
Over 2 to 8 m^3	8 m	45 m	75 m
Over 8 to 110 m^3	15 m	90 m	150 m
Over 110 to 400 m^3	15 m	140 m	230 m
Over 400 m^3	15 m	180 m	300 m

*NOTE: For 500 gallons (2 m^3) or less, see 5.3.1 and 5.3.3.

lowest flow, shall be used to establish the flow rate marked on the manifold nameplate. The marking shall be similar to that required in 5.8.8 for individual valves.

5.8.11 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 to relieve the pressure which could develop from the trapped liquid. If an equivalent pressure relieving device is used, the maximum accumulative pressure possible within the system shall not exceed the limits of the system.

5.8.12 The discharge opening from any pressure relief valve shall not terminate inside any building or below the highest roof line of any such building.

5.8.13 A pressure relief device shall be subject to a systematic, periodic visual external inspection at least annually, to determine that it:

(1) Meets the applicable requirements specified in 5.8

(2) Is free of evidence of tampering, damage, corrosion, or foreign matter that might prevent proper operation

(3) Is free of leakage when subject to pressures below the minimum allowable start-to-discharge setting

(4) Has a properly installed rain cap or other device to avoid entry of moisture or other matter into the relief valve outlet

(5) Has an open weep hole to permit moisture to escape

5.8.14 Any deficiency as may be found in 5.8.13 shall require immediate corrective action, replacement, or repair of the pressure relief device as may be appropriate.

5.8.15 No container pressure relief device shall be used after the replacement date as specified by the manufacturer of the device. If no date is specified, a pressure relief valve shall be replaced no later than five years following the date of its manufacture or last repair unless it has first been disassembled, inspected, repaired, and tested by the manufacturer, or by a qualified repair organization in a manner such that the valve's condition and performance is certified as being equivalent to the standards for the original valve.

5.9 Filling Densities. (See 2.15)

5.9.1 The filling densities for non-refrigerated containers shall not exceed the following:

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

(3) DOT containers and cylinders shall be filled in accordance with DOT regulations.

*NOTE: This corresponds to 32% by volume at -28°F (-33.3°C), 85% by volume at 5°F (-15°C), 87.5% by volume at 30°F (-1.1°C), and 90.6% by volume at 60°F (15.6°C).

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

5.9.3 If containers are to be filled according to liquid level by any gauging method other than a fixed length dip tube gauge, each container should have a thermometer well and thermometer 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 (15.6°C) basis.

5.10 Transfer of Liquids

5.10.1 Anhydrous ammonia shall always be at a temperature suitable for the material of construction and design of the receiving containers. Certain steels are not suitable for refrigerated ammonia. See Appendix R of API Standard 620, *Recommended Rules for Design and Construction of Large Welded Low-Pressure Storage Tanks*, for materials for low temperature service. [22]

5.10.2 At least one qualified operator experienced in the procedures shall monitor the transfer of ammonia from the time the connections are first made until they are finally disconnected. Such monitoring may be performed by a person on site, or from a remote location, or by electronic means. Capability shall be provided to halt the transfer in the event of an emergency.

5.10.3 Cargo tanks and tank cars shall not be unloaded with gas pressure other than from an ammonia source.

5.10.4 Containers and cylinders shall be filled or used only upon the owner's authorization.

5.10.5 Containers and cylinders shall be gauged and charged only in the open atmosphere or in buildings provided for that purpose.

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

5.10.6.1 Positive displacement pumps shall be equipped with a pressure actuated by-pass valve on

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SPILL CONTAINMENT

The diking of anhydrous ammonia tanks is a subject which customers and regulatory authorities raise frequently. Historically, we have indicated to customers that, in most states, it is not a requirement and we recommend against it, citing the lack of any experience in industry where a dike could have moderated a leak or spill situation and the fact that the frequency of catastrophic failure for permanent industrial anhydrous ammonia storage tanks in the United States is zero.

Recently, in working with the State of New Jersey and its Toxic Catastrophe Prevention Act, we were required to put our position in writing. Dr. Robert Wiesboeck was retained to research the subject and write a position letter. A copy is attached, including the reference bibliography.

Please feel free to use the letter in response to customers' inquiries about spill containment. Copies of most of the nine items in the bibliography are in the technical files at the IPG offices in Atlanta.

BOCA NATIONAL MECHANICAL CODE/1990

The Building Officials and Code Administrators' National Mechanical Code/1990 governing refrigeration now specifies that the preferred method for the dispersing of ammonia be to the air rather than into water. Each state must adopt this code; therefore, some states may still be using the 1987 Code, which does not contain this statement.

(see CLEAN AIR ACT on reverse side)

LA ROCHE INDUSTRIES INC.
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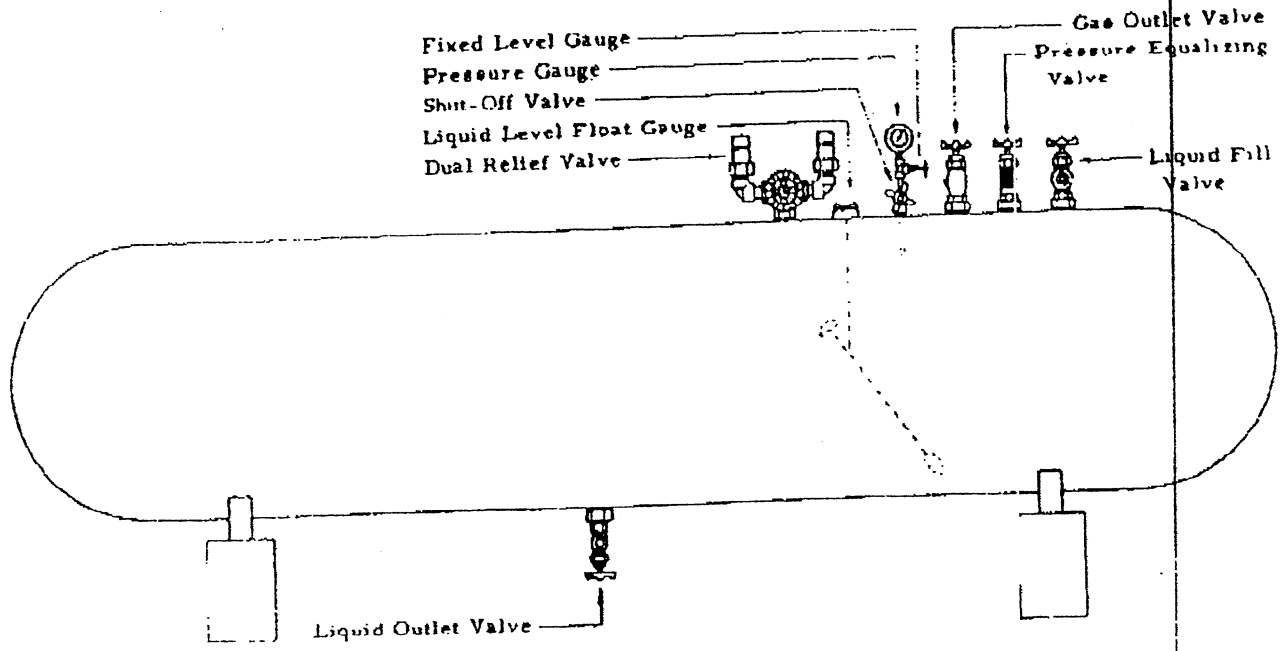
Industrial Products Group

TECHNICAL BULLETIN

TYPICAL HORIZONTAL ANHYDROUS AMMONIA STORAGE TANK



SIZE OF ANHYDROUS AMMONIA STORAGE TANK	APPROXIMATE ANHYDROUS AMMONIA CAPACITY
1000 Gallons	4400 LBS.
2000 Gallons	8800 LBS.

Anhydrous ammonia storage tanks supplied by LaRoche Industries Inc. are constructed in complete accordance with the ASME Code for Unfired Pressure Vessels (Section VIII). Each tank is inspected, tested, and stamped by an inspector qualified by the National Board of Boiler and Pressure Vessel Inspectors.

NOTE: The standard arrangement of storage tank openings shown in the drawing is suitable for most ammonia storage systems. It is possible, however, to order tanks and tank openings designed to meet specific requirements. For further information about storage systems for anhydrous ammonia, contact your nearest LaRoche Industrial Products Group Sales Office.

LaRoche Industries Inc.
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