Department of Labor and Industry

Adopted Permanent Rules Relating to Ammonia Refrigeration Systems

Rules as Adopted

5230.5000 MINIMUM STANDARDS.

Parts 5230.5000 to 5230.6200 form the code for ammonia refrigeration systems and applies to ammonia piping systems used for closed circuit refrigeration systems. Parts 5230.5000 to 5230.6200 are minimum standards and are not intended to be used as or considered as a system design manual except as otherwise specified. If a system has any component designed for temperatures below minus 20 degrees Fahrenheit (minus 28.9 degrees centigrade), then the entire system, including components, must meet the test requirements of the American Society of Mechanical Engineers, American National Standards Institute, B31.5 refrigerating systems for operating at temperatures below minus 20 degrees Fahrenheit (minus 28.9 degrees centigrade).

5230.5010 INCORPORATIONS BY REFERENCE.

Items A to E are documents incorporated by reference in parts 5230.5000 to 5230.6200 to the extent of the cited references. The documents are subject to frequent change and are available through the Minitex interlibrary loan system.

A. 1989 American Society of Mechanical Engineers Boiler and Pressure Vessel Code, section VIII, division 1 and section IX; 1989 American Society of Mechanical Engineers, American National Standards Institute, standard B31.5, refrigeration piping; and 1989 American Society of Mechanical Engineers, American National Standards Institute, standard A13.1 scheme for the identification of piping. American Society of Mechanical Engineers, 345 East 47th Street, New York, New York 10017.

B. 1990 American Welding Society, Structural Welding

Approved by Revisor MEO

Code-Steel, American National Standards Institute, standard D1.1-90. American Welding Society, 550 Northwest LeJeune Road, Post Office Box 351040, Miami, Florida 33135.

C. 1989 American National Standards Institute, standard Z87.1, Practice for Occupational and Educational Eye and Face Protection, American National Standards Institute, Inc., 1430 Broadway, New York, New York 10018.

D. 1990 Annual Book of American Society for Testing and Materials, Volume 01.01, Steel - Piping, Tubing, Fittings, Publication Number: 01-010190-02, American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103-1187.

5230.5015 AMMONIA TASK FORCE.

When a technical organization recognized by the ammonia industry, for example, the American Society of Mechanical Engineers, International Institute for Ammonia Refrigeration, or the American Society of Heating, Refrigeration and Air Conditioning Engineers, adopts substantial changes or modifications in nationally recognized standards for ammonia, a task force of industry representatives may be appointed by the commissioner of the Department of Labor and Industry. The purpose of the ammonia task force will be to review the changes in the standards and to recommend to the commissioner the adoption of applicable changes.

5230.5020 DEFINITIONS.

Subpart 1. **Scope.** For purposes of parts 5230.5000 to 5230.6200, the following terms are defined in this part.

Subp. 2. **Accessible.** "Accessible" means to be accessible for inspection or service, such as exposed in shafts, tunnels, or concealed by readily removable construction.

Subp. 3. **Administrative authority.** "Administrative authority" means the inspection agency authorized to inspect high pressure piping under Minnesota Statutes, sections 326.46 and 326.47, subdivision 2.

Subp. 4. **Air cooled condenser.** "Air cooled condenser"

Approved
by Revisor _____

means a condenser, including methods for forcing air circulation over the external surface of the condenser coil, for the heat removal necessary to liquify refrigerant vapor on the inside of the tubes.

Subp. 5. **Air cooled desuperheater.** "Air cooled desuperheater" means that part of the system designed to cool the ammonia refrigerant vapor after it is discharged from the compressor and before it enters the condenser with a means of forcing air circulation over the external surface of the desuperheater coil for the heat removal necessary to cool the refrigerant vapor on the inside of the tubes. It does not include desuperheaters that are integral components of condensers.

Subp. 6. **Anhydrous ammonia.** "Anhydrous ammonia," as used in parts 5230.5000 to 5230.6200, refers to the compound formed by a combination of two gaseous elements, nitrogen and hydrogen. Anhydrous ammonia may be in either gaseous or liquid form. It does not include aqua ammonia (unless as part of a mechanical refrigeration system) which is a solution of ammonia gas in water. When the term ammonia appears, it refers to refrigerant grade anhydrous ammonia, refrigerant 717 (R 717). Anhydrous ammonia also includes mixtures of ammonia and other substances which may act to dilute the ammonia for refrigeration.

Subp. 7. **Approved.** "Approved" means acceptable to the administrative authority having jurisdiction under Minnesota Statutes, sections 326.46 and 326.47, subdivision 2, the building inspector under Minnesota Statutes, sections 16B.61 and 16B.62, the electrical inspector under Minnesota Statutes, section 326.241, or the plumbing inspector under Minnesota Statutes, section 326.37.

Subp. 8. **An approved nationally recognized testing laboratory.** "An approved nationally recognized testing laboratory" means a laboratory that provides uniform testing and examination procedures under established standards, has personnel with recognized credentials, is properly organized, equipped, and qualified for testing, and has a follow-up

Approved
by Revisor _____

inspection service of the current production of the listed products.

Subp. 9. **Automatic expansion valve.** "Automatic expansion valve" means a controlling device that regulates the flow of volatile liquid refrigerant into an evaporator of a refrigeration system and that is actuated toward opening by a lowering of the evaporator pressure below the setting of the valve spring.

Subp. 10. **Automatic liquid refrigerant drain valve.** "Automatic liquid refrigerant drain valve" has the meaning given a high side float valve in subpart 31.

Subp. 11. **Brine.** "Brine" means any liquid used for the transmission of heat without a change in its state.

Subp. 12. **Check valve.** "Check valve" means a control device that permits fluid to flow through the device in one direction, but prevents return of the fluid in the opposite direction.

Subp. 13. **Companion valve or block valve.** "Companion valve" or "block valve" means pairs of mating stop valves, valving off sections of systems, arranged so that the sections may be joined before opening the valves or separated after closing them.

Subp. 14. **Compressor.** "Compressor" means a specific machine, with or without accessories, for compressing refrigerant vapor. A booster compressor is a compressor, with or without accessories, for compressing ammonia refrigerant vapor and discharging to the suction system of a higher stage compressor.

Subp. 15. **Compressor unit.** "Compressor unit" means a condensing unit less the condenser and liquid receiver.

Subp. 16. **Condenser.** "Condenser" means that part of the system designed to liquify refrigerant vapor by removal of heat.

Subp. 17. **Condenser coil.** "Condenser coil" means that part of a condenser constructed of pipe or tubing other than a shell and tube or shell and coil type.

Subp. 18. **Condensing unit.** "Condensing unit" means a

specific refrigerating machine combination consisting of one or more power-driven compressors, condensers, liquid receivers when required, and the regularly furnished accessories.

Subp. 19. **Container.** "Container" means a cylinder for the transportation of ammonia refrigerant.

Subp. 20. **Design pressure.** "Design pressure" means the maximum allowable working pressure for which a specific part of a system is designed.

Subp. 21. **Downstream pressure regulator.** "Downstream pressure regulator" means a controlling device that regulates the flow of refrigerant gas or liquid or oil through the device from a section of the system to a lower pressure section of the system and that is actuated toward open by a pressure falling below regulator set-point downstream of the regulator orifice.

Subp. 22. **Duct.** "Duct" means a tube or conduit used for conveying air. The air passages of self-contained systems are not air ducts.

Subp. 23. **Evaporator.** "Evaporator" means that part of the system designed to vaporize liquid refrigerant to produce refrigeration effect.

Subp. 24. **Evaporative condenser.** "Evaporative condenser" means a condenser that obtains cooling effect by the evaporation of water in an air stream on the external surface of the tubes for the heat removal necessary to liquify refrigerant vapor on the inside of the tubes.

Subp. 25. **Evaporator pressure regulator.** "Evaporator pressure regulator" means a controlling device that regulates the flow of primarily gaseous refrigerant from an evaporator section of the system into a lower pressure section and that is actuated toward open by a pressure above set-point ahead of the valve.

Subp. 26. **Exit.** "Exit" means a confined passageway immediately adjacent to the door through which people leave a building.

Subp. 27. **Field test.** "Field test" means a test performed in the field to prove system tightness.

Approved
by Revisor _____

Subp. 28. **Forced feed oil lubrication.** "Forced feed oil lubrication" means that oil is positively provided for lubrication by internal or external mechanical oil pump. It does not include splash-type or drip-type compressor lubrication systems.

Subp. 29. **Flow regulator.** "Flow regulator" means a controlling device that regulates the flow of liquid refrigerant through the device from a section of the system to a lower pressure section of the system and that is actuated by flow rate changes to maintain a predetermined flow rate.

Subp. 30. **High side.** "High side" means the parts of an ammonia refrigerating system subjected to condenser pressure.

Subp. 31. **High side float valve.** "High side float valve" means a controlling device that regulates the flow of volatile liquid refrigerant from a higher pressure section of the system into a lower pressure section and that is actuated toward open by a rising liquid level upstream of the valve.

Subp. 32. **Hot gas bypass regulator.** "Hot gas bypass regulator" means a controlling device that regulates the flow of refrigerant hot gas through the device from a higher pressure section of the system to a lower pressure section of the system and that is actuated toward open by a pressure falling below regulator set-point downstream of the regulator orifice.

Subp. 33. **Inaccessible.** "Inaccessible" means those sections of piping systems installed in walls, floors, ceiling, or other areas where access cannot be made without the removal of permanent construction.

Subp. 34. **Internal gross volume.** "Internal gross volume" means the volume determined from internal dimensions of the container as if the internal parts of the container were not there.

Subp. 35. **Listed.** "Listed" means equipment that has been tested and is identified as acceptable by an approved nationally recognized testing laboratory.

Subp. 36. **Liquid receiver.** "Liquid receiver" means a pressure vessel permanently connected to a refrigerating system

by inlet and outlet pipes for storage of liquid refrigerant.

Subp. 37. **Low side.** "Low side" means the parts of a refrigerating system subjected to evaporator pressure.

Subp. 38. **Liquid line.** "Liquid line" means the parts of the system subjected to condenser pressure including those parts where the piping is partly or wholly filled with liquid refrigerant.

Subp. 39. **Low side float valve.** "Low side float valve" means a controlling device that regulates the flow of volatile liquid refrigerant into an evaporator pressure section of the system from a higher pressure section and that is actuated toward closed by a rising liquid level downstream of the valve.

Subp. 40. **Machinery.** "Machinery" means the refrigerating equipment forming a part of the refrigerating system, including but not limited to any or all of the following:

A. compressor;

B. condenser;

C. liquid receiver;

D. connecting piping; or

E. evaporator.

Subp. 41. **Machinery room.** "Machinery room" means a room in which a refrigerating system is permanently installed and operated with a one-hour fire separation from the rest of the building, but not including evaporators located in a cold storage room, refrigerator box, air-cooled space, or other enclosed space. A machinery room is defined as being in a building, part of a building, attached to a building, adjacent to a building, or detached and separate from a building. An independent mechanical ventilation system that complies with part 5230.5710 must be provided.

Closets solely contained within, and opening only into, a room are not considered to be machinery rooms, but must be considered a part of the machinery room in which they are contained or open into. Spaces in which a self-contained system is located are not classified as a machinery room.

Machinery rooms must comply with part 5239.5705. Machinery

rooms must have a floor drain and backflow preventer that complies with the Minnesota State Plumbing Code, chapter 1355. For the purposes of parts 5230.5000 to 5230.6200, machinery room and equipment room have the same meaning.

Subp. 42. **Machinery room, class T.** "Machinery room, class T" means a machinery room as defined by subpart 41 that complies with the specific requirements of items A to H:

A. any doors opening into the building must be approved self-closing, tight-fitting fire doors;

B. the walls, floor, and ceiling must be tight and of not less than one-hour fire-resistive construction and all penetrations must be fire stopped;

C. it must have an exit door that opens directly to the outer air or through a vestibule-type exit equipped with self-closing, tight-fitting doors;

D. exterior openings, if present, must not be under any fire escape or any open stairway;

E. pipes piercing the interior walls, ceiling, or floor of a room must be tightly sealed and fire stopped to the walls, ceiling, or floor through which they pass;

F. emergency remote controls to stop the action of the refrigerant compressor must be provided and be located immediately outside the machinery room;

G. emergency remote controls for the mechanical means of ventilation must be provided and be located outside the machinery room; and

H. no permanently installed flame-producing device or hot surface above 800 degrees Fahrenheit (426.5 degrees centigrade) shall be permitted in the class T machinery room. ~~The electrical equipment in the class T room must conform to the requirements of hazardous locations class I, division 2, of the Minnesota State Electrical Code.~~

Subp. 43. **Manufacturer.** "Manufacturer" means the company or organization that affixes its name or nationally registered trademark or trade name to the refrigeration equipment concerned.

Subp. 44. **Mechanical joint.** "Mechanical joint" is a

Approved
by Revisor _____

gas-tight joint, obtained by the joining of metal parts through a positive holding mechanical construction that is designed and manufactured as suitable for ammonia service.

Subp. 45. **Mechanical refrigeration system.** "Mechanical refrigeration system" means a combination of interconnected refrigerant containing parts constituting one closed refrigerant circuit in which a refrigerant is circulated to extract heat and in which a compressor is used for compressing the ammonia refrigerant vapor.

Subp. 46. **Motorized valve.** "Motorized valve" means a device that regulates the flow of fluid through the device by a motor that moves a plug with respect to an orifice.

Subp. 47. **Nameplate.** "Nameplate" means a metallic plate, suitably and legibly etched or stamped. The size of type must be no smaller than ten point and the plate must be permanently attached in a readily accessible location. The nameplate must contain the information required in parts 5230.5615 to 5230.5640.

Subp. 48. **Nonpositive displacement compressor.** "Nonpositive displacement compressor" means a compressor in which an increase in vapor pressure is attained without changing the internal volume of the compression chamber.

Subp. 49. **Oil drain float valve.** "Oil drain float valve" has the meaning given high side float valve in subpart 31. This reference does not cover control of oil in the system.

Subp. 50. **Pilot operated valve.** "Pilot operated valve" means the valve that regulates flow in response to a signal from a pilot.

Subp. 51. **Piping.** "Piping" means the pipe or tube mains for interconnecting the various parts of a refrigerating system. Piping means the piping system, including:

A. pipe;

B. flanges;

C. bolting;

D. gaskets;

E. valves;

F. fittings;

G. the pressure containing parts of other components such as expansion joints, strainers, and devices that serve such purposes as mixing, separating, snubbing, distributing, metering, or controlling flow;

H. piping supporting fixtures; and

I. structural attachments.

Subp. 52. **Positive displacement compressor.** "Positive displacement compressor" means a compressor in which an increase in pressure is attained by changing the internal volume of the compression chamber.

Subp. 53. **Pressure imposing element.** "Pressure imposing element" means any device or portion of the equipment used to increase the refrigerant vapor pressure.

Subp. 54. **Pressure relief device.** "Pressure relief device" means a reseating type pressure actuated valve designed to automatically relieve excessive pressure.

Subp. 55. **Pressure relief valve or safety valve.** "Pressure relief valve" is also called a "safety valve" and means a reseating type pressure actuated valve held closed by a spring or other means and designed to automatically relieve pressure in excess of its setting.

Subp. 56. **Pressure vessel.** "Pressure vessel" means any refrigerant containing receptacle of a refrigerating system other than evaporators, where each separate section of the evaporator does not exceed one-half foot^3 (0.014 meter^3) of refrigerant containing volume, evaporator coils, compressors, condenser coils, controls, headers, pumps, and piping.

Subp. 57. **Readily accessible.** "Readily accessible" means capable of being reached safely and quickly for operation, repair, or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles, or to resort to the use of portable access equipment and tools.

Subp. 58. **Refrigerant.** "Refrigerant" means a substance used to produce refrigeration by its expansion or vaporization.

Subp. 59. **Refrigerant pressure activated condenser water regulator.** "Refrigerant pressure activated condenser water

Approved
by Revisor _____

regulator" means a device that regulates the flow of cooling water through the device to or from a water-cooled condenser and that is actuated toward open by refrigerant high side pressure rising above the regulator set point.

Subp. 60. **Refrigerant pump.** "Refrigerant pump" means a mechanical device for moving liquid ammonia refrigerant within a closed circuit mechanical refrigeration system.

Subp. 61. **Rupture member.** "Rupture member" means a device designed to rupture at a predetermined pressure. Rupture members are prohibited.

Subp. 62. **Saturation pressure.** "Saturation pressure" of a refrigerant is the pressure at which there is stable coexistence of the vapor and liquid or the vapor and solid phase.

Subp. 63. **Self-contained system.** "Self-contained system" means a complete factory-made and factory-tested system in a suitable frame or enclosure that is fabricated and shipped in one or more sections and in which no refrigerant-containing parts are connected in the field other than by companion or block valves.

Subp. 64. **Shell and tube condenser.** "Shell and tube condenser" means a type of condenser where tubes in a bundle with each end secured in a tube sheet are enclosed in a shell with refrigerant in the shell. A shell and tube condenser with refrigerant in the shell is a pressure vessel.

Subp. 65. **Shell and tube evaporator.** "Shell and tube evaporator" means a type of evaporator where tubes or coils are enclosed in a shell. Flooded type has the evaporating ammonia in the shell. Direct expansion type has the evaporating ammonia in the tubes or coils.

Subp. 66. **Solenoid valve.** "Solenoid valve" means a valve that is opened or closed by the magnetic action of an electrically energized coil. The opposite action is accomplished by gravity, pressure, or spring action.

Subp. 67. **Stop valve.** "Stop valve" means a device to shut off the flow.

Subp. 68. **Test pressure.** "Test pressure" means the

Approved
by Revisor _____

minimum pressure, pounds per square inch gage, to which a specific part is subjected under test condition.

Subp. 69. **Thermostatic expansion valve.** "Thermostatic expansion valve" means a controlling device that regulates the flow of volatile refrigerant into an evaporator of a refrigeration system and which is actuated by changes in evaporator pressure and superheat of the refrigerant gas leaving the evaporator. Its basic response is to superheat.

Subp. 70. **Three-way type stop valve.** "Three-way type stop valve" means a manually operative valve with one inlet that alternately can stop flow to either of two outlets.

Subp. 71. **Ultimate strength.** "Ultimate strength" means the highest stress level that the component can tolerate without rupture.

Subp. 72. **Unprotected tubing.** "Unprotected tubing" means tubing that is not protected by enclosure or suitable location so that it is exposed to crushing, abrasion, puncture, or similar mechanical damage under installed conditions.

Subp. 73. **Upstream pressure regulator.** "Upstream pressure regulator" means a controlling device that regulates the flow of refrigerant gas or liquid or oil through the device from a section of the system to a lower pressure section of the system and that is actuated toward open by a pressure rising above regulator set-point upstream of the regulator orifice.

Subp. 74. **Welded joint.** "Welded joint" means a gas-tight joint, obtained by the joining of metal parts in molten state.

5230.5025 AMMONIA GOVERNED AND DEFINED.

Ammonia is defined in part 5230.5020, subpart 6. Only refrigerant grade ammonia may be used in ammonia refrigerant systems. The maximum allowable concentration of ammonia in refrigeration systems is 50 parts per million ambient. The ammonia must be clear, colorless liquid or gas free from visible impurities. Refrigeration grade anhydrous ammonia must contain at least 99.95 percent pure ammonia for charging both new and old refrigeration systems.

Approved
by Revisor _____

The flammable limits at atmospheric pressure are 16 percent and 25 percent by volume of ammonia in air. An ammonia-air mixture in an iron flask does ignite at 1204 degrees Fahrenheit (651 degrees centigrade). The addition of refrigerant oil to ammonia, when released from the system, can act to increase the hazard of combustion.

At 50 parts per million, its odor is detectable by most people. Since ammonia gas is lighter than air, adequate ventilation is the best means of preventing an accumulation of ammonia.

The physical properties and specifications of refrigerant grade ammonia are:

PHYSICAL PROPERTIES OF AMMONIA

	ENGLISH	COMMON METRIC	SI
A.	Molecular symbol		
	NH_3	NH_3	NH_3
B.	Molecular weight		
	1.7.032	1.7.032	1.7.032
C.	Boiling point at one atmosphere*		
	-28 degrees F	(-33.3 degrees C)	(239.85 degrees K)
D.	Freezing point at one atmosphere*		
	-108 degrees F	(-77.6 degrees C)	(195.55 degrees K)
E.	Critical temperature		
	271.4 degrees F	(133 degrees C)	(406.15 degrees K)
F.	Critical pressure		
	1657 psig	(116.2 kg/cm)	(11.42 M Pa)
G.	Latent heat at -28 degrees Fahrenheit (-33.3 degrees centigrade) and one atmosphere*		
	589.3 Btu/lb	(332.4 cal/gm)	(13.92 MJ/kg)
H.	Relative density of vapor compared to dry air at 32 degrees Fahrenheit (0 degrees centigrade) and one atmosphere*		
	0.5963	0.5963	0.5963
I.	Vapor density at -28 degrees Fahrenheit (-33.3 degrees centigrade) and one atmosphere*		
	0.05555 lb/ft^3	(0.889 kg/m)	(0.889 kg/m)
J.	Specific gravity of liquid at -28 degrees Fahrenheit (-33.3 degrees centigrade) compared to water at 39.2 degrees Fahrenheit (4 degrees centigrade)		

Approved
by Revisor _____

0.6821	0.6821	0.6821

K. Liquid density at -28 degrees Fahrenheit (-33.3 degrees centigrade) and one atmosphere*

42.56 lb/ft	(6.819 kg/m)	(6.819 kg/m)

L. Specific volume of vapor at 32 degrees Fahrenheit (0 degrees centigrade) and one atmosphere*

20.78 ft/lb	(1.29 m/kg)	(1.29 m/kg)

M. Flammable limits by volume in air at atmospheric pressure

16% to 25%	16% to 25%	16% to 25%

N. Ignition temperatures

1204 degrees F	651 degrees C	(924.15 K)

O. Specific heat, gas 59 degrees Fahrenheit (15 degrees centigrade) one atmosphere*

(1) at constant pressure, Cp

0.519 btu/lb deg F	0.519 cal/gm C	(2189.0 J/kgK)

(2) at constant volume, Cv

0.3995 Btu/lb deg F	0.3995 cal/gm C	(1672 J/kgK)

* One atmosphere equals:

14.71 psia	(1.033 Kg/cm)	(101.4 KPa)

Refrigerant grade ammonia must meet the following purity requirements:

(1) ammonia content determined by evaporative residue test, 99.95 percent minimum;

(2) nonbasic gas in vapor phase, 25 parts per million maximum;

(3) nonbasic gas in liquid phase, ten parts per million maximum;

(4) water, 33 parts per million maximum;

(5) oil as soluble in petroleum ether, two parts per million maximum;

(6) salt calculated as NaCl, none; and

(7) pyridine, hydrogen sulfide, naphthalene, none.

5230.5250 LOCATIONS GOVERNED AND DEFINED.

Subpart 1. **Locations governed.** Locations governed by parts 5230.5000 to 5230.6200 in which ammonia piping systems may be placed are grouped by occupancy, as defined in subparts 2 to

Approved
by Revisor _____

8.

Subp. 2. **Institutional occupancy.** "Institutional occupancy" applies to that portion of a premise in which persons are confined to receive medical, charitable, education, or other care or treatment, or in which persons are held or detained by reason of public or civic duty, including hospitals, nursing homes, asylums, sanitariums, police stations, jails, courthouses with cells, and similar occupancies.

Subp. 3. **Public assembly occupancy.** "Public assembly occupancy" applies to that portion of a premise in which persons congregate for civic, political, educational, religious, social, or recreational purposes, including armories, assembly rooms, auditoriums, ballrooms, bath houses, bus terminals, broadcasting studios, churches, colleges, courthouses without cells, dance halls, department stores, exhibition halls, fraternity halls, libraries, lodge rooms, mortuary chapels, museums, passenger depots, schools, skating rinks, subway stations, theaters, enclosed portions of arenas, racetracks, and stadiums and similar occupancies.

Subp. 4. **Residential occupancy.** "Residential occupancy" applies to that portion of a premise in which sleeping accommodations are provided, including clubhouses, convents, dormitories, hotels, lodging houses, multiple story apartments, residences, studios, tenements, and similar occupancies.

Subp. 5. **Commercial occupancy.** "Commercial occupancy" applies to that portion of a premise used for the transaction of business, for the rendering of professional services, for the supplying of food, drink, or other bodily needs and comforts, for manufacturing purposes, or for the performance of work or labor not included under subpart 6, industrial occupancy. Examples of commercial occupancy for work or labor not covered under industrial occupancy are bake shops, fur storage facilities, laboratories, loft buildings, markets, office buildings, professional buildings, restaurants, and stores other than department stores.

Subp. 6. **Industrial occupancy.** "Industrial occupancy"

applies to an entire building or premises or to that portion of a building used for manufacturing, processing, or storage of materials or products. Representative examples include chemical, food, candy and ice cream factories, ice-making plants, meat packing plants, refineries, perishable food warehouses and similar occupancies. In an industrial occupancy, when the number of persons in a refrigerated space, served by a direct system, on any floor above the first floor ground level or dock level, exceeds one person per 100 square feet (9.29 square meters) of floor area, the requirements of commercial occupancy apply unless that refrigerated space is provided with the required number of doors opening directly into building exits approved by the building inspector.

The refrigerated space must be cut off from the rest of the building by tight construction of at least one-hour fire rating with tight-fitting doors as required by the Minnesota State Building Code.

This subpart does not prohibit openings for the passage of products from one refrigerated space to another refrigerated space.

For the purpose of this subpart, "approved building exits" means approval according to the standards promulgated by the National Fire Protection Association and as approved by the building inspector having jurisdiction.

Subp. 7. **Mixed occupancy.** "Mixed occupancy" applies to a building occupied or used for different purposes in different parts. When the occupancies are cut off from the rest of the building by tight partitions, floors, ceilings, fire stopped, and protected by self-closing doors, the requirements for each type of occupancy apply for its portion of the building premises. For example, the cold storage spaces in retail frozen food lockers, hotels, and department stores might be classified under industrial occupancy, while other portions of the building would be classified under other occupancies. When the occupancies are not separated, the occupancy carrying the more stringent requirements governs.

Approved
by Revisor _____

Subp. 8. **Adjacent locations.** Placement of ammonia refrigeration equipment, other than piping, installed in locations adjacent to areas described in this part and located outside of, but less than 20 feet (6.10 meters) from any building opening is governed by the occupancy classification of the building. Equipment installed in a nonadjacent location, such as equipment in a separate building located 20 feet (6.10 meters) or more from an opening in any other building, is considered a separate building and is governed by this part.

5230.5300 REFRIGERATING SYSTEM CLASSIFICATION BY TYPE.

Subpart 1. **Refrigerating systems.** Refrigerating systems are classified by the method employed for extracting heat in subparts 2 to 4 and as the drawing in subpart 5.

Subp. 2. **Direct system.** A direct system is one in which the evaporator is in direct contact with the material or space refrigerated or is located in air-circulating passages communicating with these spaces.

Subp. 3. **Double direct system.** A double direct system means one in which an evaporative refrigerant is used in a secondary circuit to condense or cool a refrigerant in a primary circuit.

Subp. 4. **Indirect system.** An indirect system means one in which a brine, cooled by the refrigerant, is circulated to the material or space refrigerated or is used to cool air so circulated. Indirect systems that are distinguished by the type of method of application are described in items A to D.

A. "Indirect open-spray system" means one in which a brine, cooled by an evaporator located in an enclosure external to a cooling chamber, is circulated to a cooling chamber, and is sprayed in the cooling chamber.

B. "Indirect closed surface system" means one in which a brine, cooled by an evaporator located in an enclosure external to a cooling chamber, is circulated to and through a cooling chamber in pipes or other closed circuits.

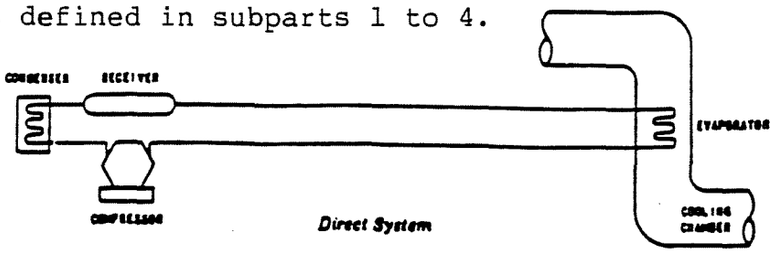
C. "Indirect vented closed surface system" means one

Approved
by Revisor _____

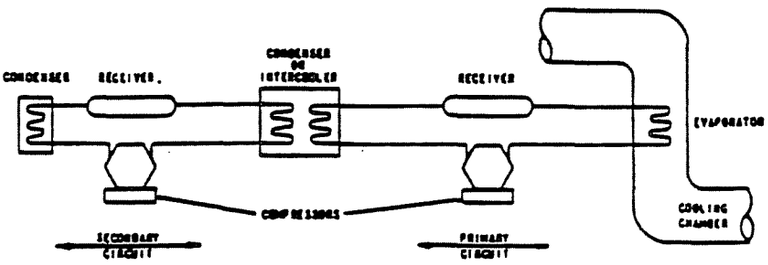
in which a brine, cooled by an evaporator located in a vented enclosure external to a cooling chamber, is circulated to and through a cooling chamber in pipes or other closed circuits.

D. "Double indirect vented open spray system" means one in which a brine, cooled by an evaporator located in a vented enclosure, is circulated through a closed circuit to a second enclosure where it cools another supply of a brine and this liquid in turn is circulated to a cooling chamber and is sprayed in the cooling chamber.

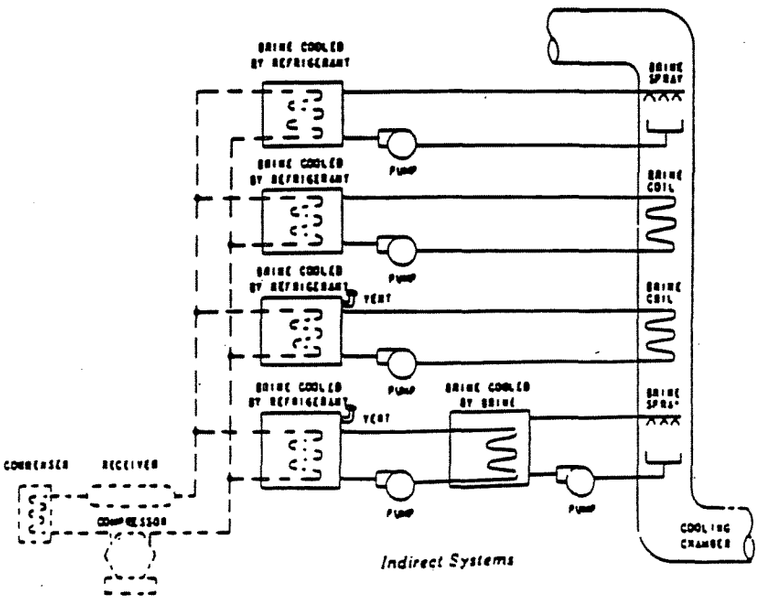
Subp. 5. **Direct and indirect systems diagram.** The following diagram illustrates direct and indirect refrigerating systems as defined in subparts 1 to 4.



Direct System



Double Direct System



Indirect Systems

5230.5350 RESTRICTIONS ON PLACEMENT OF AMMONIA PIPING, LIMITATIONS ON SYSTEM SIZING, AND PRESSURE RELIEF VENTING REQUIREMENTS.

Subpart 1. **Scope.** Placement of ammonia piping is

Approved by Revisor _____

restricted according to subparts 2 to 16.

Subp. 2. **Public stairway, stair landing, entrance, or exit.** No portion of an ammonia piping system is permitted to be installed in or on a public stairway, stair landing, entrance, or exit.

Subp. 3. **Public hallway or lobby.** No portion of an ammonia piping system must interfere with free passage through public hallways or lobbies. No portion of a refrigerating system containing ammonia piping is permitted in public hallways or lobbies of institutional or public assembly occupancies. Ammonia piping systems installed in a public hallway or lobby shall be limited to sealed absorption systems containing not more than three pounds (1.36 kilogram) of an ammonia refrigerant when in residential and commercial occupancies.

Subp. 4. **Enclosed space; refrigerant quantity limits.** When the refrigerant-containing parts of an ammonia piping system are located in one or more enclosed spaces, the cubic area of the smallest enclosed occupied space, other than the machinery room, must be used to determine the permissible quantity of refrigerant in the system. Where a refrigerating system has evaporator coils serving individual stories of a building, the story having the smallest volume must be used to determine the maximum quantity of refrigerant in the entire system.

Subp. 5. **Air duct.** When the evaporator is located in an air duct system, the cubic area of the smallest occupied enclosed space served by the air duct system must be used to determine the permissible quantity of refrigerant in the system.

Subp. 6. **Suspended ceiling.** Where the return air space above a suspended ceiling is one continuous space and not an enclosed air duct in which the return air is confined, this space may be included in calculating the cubic area of the occupied space.

Subp. 7. **External venting.** In institutional and public assembly occupancies, direct expansion coils or evaporators used for air conditioning and located downstream from and in

proximity to a heating coil, or located upstream within 18 inches (0.46 meter) of a heating coil, must be fitted with a pressure relief device discharging to the outside of the building; except that a relief device shall not be required on units or self-contained systems if the internal volume of the low side of the system that may be shut off by valves, divided by the total weight of refrigerant in the system, less the weight of refrigerant vapor contained in the other parts of the system at 110 degrees Fahrenheit (43.5 degrees centigrade) exceeds the specific volume of the refrigerant at critical conditions of temperature and pressure.

The exemption is stated in formula form as follows:

$$\frac{V1}{(W1-W2)}$$

*V1/W1-W2 shall be more than Vgc where V1 equals low side volume, cubic feet (cubic meter)

*Vgc equals specific volume at critical conditions of temperature and pressure, cubic feet per pound (cubic meter per kilogram)

*W1 equals total weight of refrigerant in system, pound (kilogram)

*V2 equals total volume of system less V1 cubic foot (cubic meter)

*Vgt equals specific volume of refrigerant vapor at 110 degrees Fahrenheit (43.5 degrees centigrade), $foot^3$/pound cubic (meter/kilogram)

*W2 equals V2/Vgt equals weight of refrigerant vapor in V2 at 110 degrees Fahrenheit (43.5 degrees centigrade)

Subp. 8. **Maximum quantities.**

A. Direct systems containing ammonia refrigerants must not be used for air conditioning for human comfort. For other applications, the maximum permissible quantity of ammonia refrigerants in a direct system must be as specified in subpart 9.

B. The maximum permissible quantity of an ammonia

Approved by Revisor _____

refrigerant in any indirect system must be as specified in subpart 10. As provided in this part, these systems must be of the following type:

(1) institutional and public assembly occupancies shall have indirect vented closed-surface, or double indirect vented open spray systems; and

(2) residential and commercial occupancies shall have indirect closed-surface, indirect vented closed-surface, or double indirect vented open-spray, or secondary circuit of double direct type systems.

Subp. 9. **Maximum permissible quantity of ammonia refrigerants for direct systems.** The maximum permissible quantity of ammonia refrigerants for direct systems for each type of refrigerating system with maximum pounds (kilograms) for various occupancies are contained in the following table:

	Type of Refrigerating System			
	Institutional	Public Assembly	Residential	Commercial
Sealed Absorption Systems				
A. In public hallways or lobbies	0 (0)	0 (0)	3 (1.36)	3 (1.36)
B. In other than public hallways or lobbies	0 (0)	6 (2.7)	6 (2.7)	20 (9.07)
Self-Contained or Unit Systems				
A. In public hallways or lobbies	0 (0)	0 (0)	0 (0)	0 (0)
B. In other than public hallways or lobbies	0 (0)	0 (0)	6 (2.7)	20 (9.07)

Subp. 10. **Maximum permissible quantities of ammonia refrigerants for indirect systems.** The maximum permissible quantities of ammonia refrigerants for indirect systems are contained in the following table:

Occupancy	Class T Machinery room maximums

Approved by Revisor _____

Institutional	500 pounds (226.8 kilograms)
Public assembly	1,000 pounds (453.6 kilograms)
Residential	500 pounds (226.8 kilograms)
Commercial	500 pounds (226.8 kilograms)

A class T machine room for indirect systems using ammonia refrigerants for institution, public assembly, residential, and commercial occupancies is required except as otherwise noted in items A, B, and D.

A. Indirect systems using ammonia refrigerants and conforming with this subpart, subparts 8, item A, and 9 for direct systems are permitted.

B. Indirect systems using ammonia refrigerants, not in excess of the quantities shown in subpart 10, other than systems conforming with items A and D, must have all refrigerant-containing parts, except piping, installed in class T machinery room as defined in part 5230.5500, subpart 42. Air-cooled or evaporative condensers may be installed outside the building. Piping must be installed according to part 5230.5945. The class T machinery room must be used for refrigerant equipment only.

C. Indirect systems using ammonia refrigerant may exceed the quantity limitations of subpart 10, and the limits in subpart 10 may be tripled only if there is a class T machinery room, and:

(1) There must be a separate building housing only the machinery room or a cut-off machinery room that cannot be entered except from outside, with no openings to the inside; including doors, windows, grills, ducts, chases, or other openings into the adjacent building. Where steel pipe penetrates a wall, the individual steel pipes must penetrate the wall through individual steel sleeves, sealed vapor tight, and fire stopped to a rating equal to the assembly being penetrated.

(2) The machinery room must have doors, walls, floors, and ceilings made up of components and assemblies with at least a two-hour fire rating and all penetrations must be fire stopped to this rating. Penetrations must be smoke stopped.

(3) The machinery room must have a water

sprinkler system actuated by fire, smoke, ammonia leak, or manual control. The manual control for the water sprinkler must have at least one switch readily accessible inside the machinery room and at least one switch readily accessible outside of the machinery room.

(4) The machinery room must be vapor and liquid tight on all sides contiguous to the main building.

(5) Electrical components in the machinery room must ~~be~~ comply with the Minnesota State Electrical Code~~,-class I,-division-2,-location-type-electrical-components~~.

(6) The machinery room must be provided with a ventilation system that complies with the requirements of part 5230.5710 and that provides ventilation that is at least twice the free area and volume that is required by part 5230.5710, subpart 9, for the quantity of refrigerant in the systems.

(7) The machinery room must have at least one floor drain and backflow preventer that complies with the Minnesota State Plumbing Code, chapter 1355.

(8) Only ammonia refrigeration equipment must be located in this machinery room and the machinery room must comply with the requirements for machinery rooms of applicable portions of parts 5230.5000 and 5230.6200.

D. A sealed ammonia-water absorption unit system containing not more than 20 pounds (9.07 kilograms) of ammonia and installed outdoors adjacent to a commercial or residential occupancy is not required to conform with this subpart.

Subp. 11. **Flame-producing devices, hot surfaces, and electrical equipment in class T machinery rooms.** Where a class T machinery room is provided to comply with subpart 10, item B, to house a refrigerating system containing any ammonia refrigerant, the machinery room must comply with part 5230.5705.

Subp. 12. **Ammonia piping height.** Ammonia piping crossing an open space that affords passageway in a building must be at least 7-1/2 feet (2.29 meters) above the floor unless against the ceiling of the space.

Subp. 13. **Prohibited locations.** Free passageway must not

Approved
by Revisor _____

be obstructed by ammonia piping. Ammonia piping must not be placed in any elevator, dumbwaiter, or other shaft containing a moving object, or in any shaft that has openings to living quarters or to main exit hallways. Ammonia piping must not be placed in public hallways, lobbies, or stairways except as noted in subpart 3.

Subp. 14. **Occupancy exception.** The provisions of this part apply to all occupancies; except that industrial occupancies as defined in part 5230.5250 are not subject to the limitations on permissible quantities. In areas of public assembly, the more restrictive requirements of this part apply.

Subp. 15. **Ammonia piping installed vertically.** Ammonia piping must not be installed vertically through floors from one story to another except as follows:

A. Ammonia piping may be installed from the basement to the first floor; from the top floor to a machinery penthouse or to the roof; or between adjacent floors served by the refrigerating system and the opening for the piping must be fire stopped;

B. To interconnect separate pieces of equipment not located as described in item A, ammonia piping may be carried in rigid and tight continuous fire resisting pipe duct or shaft having no openings into floors not served by the refrigerating system and a one-hour fire rating. The pipe duct or shaft must be vented to the outside and fire stopped when penetrated; or

C. Ammonia piping may be carried on the outside of the outer wall of the building.

Subp. 16. **Ammonia piping installed horizontally.** Ammonia piping may be installed horizontally in closed floors or in open joist spaces. Piping installed in concrete floors must be encased in pipe duct.

5230.5400 REQUIREMENTS FOR INDUSTRIAL OCCUPANCIES.

Subpart 1. **Quantity of refrigerant.** There is no maximum quantity of ammonia refrigerant in an industrial occupancy. Other requirements of part 5230.5350 apply.

Approved
by Revisor _____

Subp. 2. **Machinery room.** When ammonia is used in a refrigerating system, refrigerant containing parts, except piping and evaporators, and refrigerant containing components installed outside the building, shall be installed in a machinery room as defined in part 5230.5020, subpart 41 or 42, and the machinery room must comply with the applicable portions of parts 5230.5000 to 5230.6200.

Machinery room ventilation must be provided in compliance with the requirements of part 5230.5710.

Subp. 3. **Refrigerated storage areas and work areas.**

A. When ammonia is used, the refrigerant storage area ~~must be considered a hazardous class 1 location according to~~ shall be classified by type of location consistent with the requirements of the Minnesota State Electrical Code.

B. When any ammonia refrigerant is used, reasonable care must be taken to adequately safeguard piping, controls, and other refrigeration equipment in working areas to minimize the possibility of accidental damage or rupture from external sources.

C. Areas through which piping for an ammonia refrigerant is run shall be considered a refrigerated work area.

5230.5605 AIR COOLED CONDENSERS.

Subpart 1. **Generally.** This part refers to air cooled condensers that are applied to closed circuit ammonia refrigeration systems.

Subp. 2. **Design criteria.** The design criteria for air cooled condensers is as follows:

A. A minimum design pressure of 300 pounds per square inch gage (21.09 kilograms cm^2) (2068.0 kPa gage).

B. Air cooled condensers must be designed to withstand air velocities of 100 miles per hour (44.7 m/s).

C. Fans, drives, and motors must be protected with screens or guards according to Occupational Safety and Health Division, Department of Labor and Industry, general requirements for all machines, and mechanical power transmission apparatus,

Approved
by Revisor _____

chapter 5205.

D. Propeller, axial, or centrifugal fan speeds must not exceed the safe design speed recommended by the manufacturer for the temperature and nature of application.

E. Manufacturers producing ammonia air cooled condensers must provide the following minimum data on the name plate:

(1) manufacturer's name;

(2) year of manufacture;

(3) design pressure;

(4) electrical full load amps;

(5) volts, hertz, and phase;

(6) refrigerant ammonia;

(7) identification number; and

(8) model designation number.

5230.5610 AIR COOLED DESUPERHEATERS.

The requirements of part 5230.5605 apply to air cooled desuperheaters.

5230.5615 COMPRESSORS.

Subpart 1. **Generally.** This part applies to compressors that are applied to closed circuit ammonia mechanical refrigeration systems.

Other products covered by this part are rotary vane booster compressors, reciprocating booster and high stage compressors, rotary screw booster and high stage compressors, centrifugal booster and high stage compressors, or other devices that perform this function.

Subp. 2. **Design criteria, compressors.**

A. Minimum design pressures for high stage compressors are:

(1) Water or evaporative cooled condensing, 250 pounds per square inch gage (17.57 kilograms/cm^2 gage) (1724.0 kPa gage); and

(2) Air cooled condensing, 300 pounds per square inch gage (21.09 kilogram/cm^2 gage) (2068.0 gage).

Approved
by Revisor _____

B. Minimum design pressures for booster compressors must be 150 pounds per square inch gage (10.54 kilograms/cm^2 gage) (1034.0 kPa gage).

C. Positive displacement compressors must be equipped by the manufacturer with a pressure relief device of adequate size and pressure setting to prevent rupture of the compressor. The device must be located between the compressor and stop valve on the discharge and may be of the internal or external type relief device. The pressure relief device must discharge into the low pressure side of the system, or to the atmosphere at a location at least 15 feet (4.57 meter) above the adjoining ground level and at least 20 feet (6.1 meter) from any window, ventilator opening, or entrance of any building.

D. A compressor must be provided with a low pressure interlock control and a pressure-limiting, high pressure, interlock device. Compressors using forced feed oil lubrication must be provided with a lubrication failure interlock control. The pressure-limiting device, except for booster compressors, must be of the manual reset type. The setting of the pressure-limiting device must not exceed the lower of the compressor manufacturer's recommendations or 90 percent of the high side pressure relief device setting. The setting of the low pressure control must be according to the compressor manufacturer's recommendations.

E. Compressors must be provided with controls that provide for the compressor starting only when the compressor is unloaded. Compressors must be installed with adequate electrical service and controls to start and run safely and operate in conformity with the manufacturers recommendations.

F. Compressors with motors in excess of 250 horsepower must be equipped with antirecycle timers to prevent short cycling.

G. Compressor coupling guards and belt, pulley, and flywheel guards must be provided in compliance with safety standards set by Occupational Safety and Health Division, Department of Labor and Industry, general requirement for all

Approved
by Revisor _____

machines, chapter 5205.

H. If rotation is to be in only one direction, a rotation arrow must be cast-in or permanently attached to the compressor frame.

I. For ultimate strength see part 5230.5690.

J. Manufacturers producing compressors shall provide the following minimum data on the nameplate:

(1) maximum design pressure;

(2) maximum permissible speed;

(3) refrigerant ammonia;

(4) year of manufacture;

(5) manufacturer's name;

(6) manufacturer's model number;

(7) manufacturer's identification number or serial number; and

(8) maximum permissible crankcase pressure.

5630.5620 EVAPORATIVE CONDENSERS.

Subpart 1. **Generally.** This part applies to evaporative condensers that are applied to closed circuit ammonia refrigeration systems.

Subp. 2. **Design criteria, evaporative condensers.** The design criteria for evaporative condensers is as follows:

A. Minimum design pressure must be 250 pounds per square inch gage (17.57 kilograms/cm^2 gage) (1724.0 kPa gage).

B. Evaporative condensers must be designed to withstand air velocities of 100 miles per hour (44.7 meters/s).

C. Fans, drives, and motors must be protected with screen or guards according to safety standards set by Occupational Safety and Health Division, Department of Labor and Industry, general requirements for all machines, and mechanical power transmission apparatus, chapter 5205.

D. Propeller, axial, or centrifugal fan speeds must not exceed the safe design speed recommended by the manufacturer for the temperature and nature of application.

E. Manufacturers producing ammonia evaporative

Approved by Revisor _____

condensers must provide the following data on the nameplate:

(1) manufacturer's name;

(2) year of manufacture;

(3) manufacturer's identification number;

(4) manufacturer's model number; and

(5) design pressure.

5230.5625 SHELL AND TUBE CONDENSERS.

Subpart 1. **Generally.** This part applies to shell and tube condensers used in ammonia closed circuit refrigeration systems. Products covered by this part are horizontal and vertical shell and tube condensers with closed water passes and vertical shell and tube condensers with open water passes.

Subp. 2. **Design criteria, shell and tube condensers.** The design criteria for shell and tube condensers are as follows:

A. Minimum design pressure must be 250 pounds per square inch gage (17.57 kilograms/cm^2 gage) (1724.0 kPa gage).

B. Pressure vessels must be provided with pressure relief protection according to part 5230.5655.

C. Adequate nozzles must be provided in the condenser shell for the attachment of pressure relief devices required in part 5230.5655.

D. The manufacturers producing shell and tube condensers must provide the following minimum data on the name plate:

(1) manufacturer's name;

(2) year of manufacture;

(3) national board number where applicable;

(4) serial number;

(5) American Society of Mechanical Engineers stamp;

(6) shell maximum allowable working pressure ..... at ..... temperature;

(7) tube maximum allowable working pressure ..... at ..... temperature; and

(8) manufacturer's model number.

Approved
by Revisor _____

5230.5630 PRESSURE VESSELS.

Subpart 1. **Generally.** This part applies to high pressure and low pressure vessels used in ammonia closed circuit refrigeration systems.

Subp. 2. **Design criteria, pressure vessels.** The design criteria for pressure vessels is as follows:

A. Minimum design pressure high side using water cooled or evaporative condensing must be 250 pounds per square inch (17.57 kilograms/cm^2 gage) (1724.0 kPa gage) and using air cooled condensing must be 300 pounds per square inch gage (21.09 kilogram/cm^2 gage) (2068.0 kPa gage).

B. Minimum design pressure low side must be 150 pounds per square inch gage (10.59 kilogram/cm^2 gage) (1034.0 kPa gage).

C. Pressure vessels exceeding six inches (152.4 millimeters) inside diameter must comply with the rules of American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section VIII, Division 1, covering the requirements for design, fabrication, inspection, and testing during construction of unfired pressure vessels.

D. Pressure vessels must be provided with adequate openings for the attachment of safety relief devices as required in part 5230.5655.

E. Manufacturers producing pressure vessels must provide the following minimum data on the nameplate:

(1) manufacturer's name;

(2) maximum allowable working pressure ..... at ..... temperature;

(3) manufacturer's serial number;

(4) year of manufacture;

(5) national board number where applicable; and

(6) an additional pressure and temperature stamping is required for vessels used below minus 20 degrees Fahrenheit (minus 28 degrees centigrade) that are not impact tested.

Approved
by Revisor _____

5230.5635 EVAPORATORS.

Subpart 1. **Generally.** This part applies to evaporators that are used in ammonia closed circuit refrigeration systems.

Subp. 2. **Design criteria, forced air evaporator coil.** The design criteria for forced air evaporator coil is as follows:

A. minimum design pressure must be 150 pounds per square inch gage (10.54 kilograms/cm^2 gage) (1034.0 kPa gage);

B. fans, drives, and motors must be protected with screens or guards according to safety standards set by Occupational Safety and Health Division, Department of Labor and Industry, general requirement for all machines, and mechanical power transmission apparatus, chapter 5205;

C. propeller, axial, or centrifugal fan speeds must not exceed the safe design speed recommended by the manufacturer for the temperature and nature of the application;

D. manufacturers producing evaporator coils with fans and motors must provide the following minimum data on the nameplate:

(1) manufacturer's name and trademark;

(2) year of manufacture;

(3) design pressure;

(4) electrical full load amps for all components;

(5) volts, hertz, and phase;

(6) refrigerant ammonia;

(7) identification number; and

(8) model designation number.

Subp. 3. **Design criteria, shell and tube evaporators, flooded type.** The design criteria for flooded type refrigerant in shell is as follows:

A. the shell side in the pressure vessel must be provided with adequate openings for the attachment of safety relief devices according to parts 5230.5660 and 5230.5665;

B. minimum design pressure must be 150 pounds per square inch gage (10.54 kilogram/cm^2 gage) (1034.0 kPa gage);

C. the manufacturer's producing shell and tube

Approved
by Revisor _____

evaporators for refrigerants in the shell must provide the following minimum data on the nameplate:

(1) manufacturer's name;

(2) shell maximum allowable working pressure ..... at ..... temperature;

(3) tube maximum allowable working pressure ..... at ..... temperature;

(4) manufacturer's serial number;

(5) year of manufacture;

(6) national board number where applicable;

(7) American Society of Mechanical Engineers stamp;

(8) an additional pressure and temperature stamping is required for vessels used below minus 20 degrees Fahrenheit (minus 28.9 degrees centigrade) that are not impact tested; and

(9) manufacturer's model number.

Subp. 4. **Design criteria, shell and tube evaporators, direct expansion type with refrigerant in tubes.** The design criteria for direct expansion type with refrigerant in tubes is as follows:

A. tube must comply with rules of American Society of Mechanical Engineers Boiler and Pressure Vessel Code, section VIII, or American National Standards Institute B31.5, whichever applies;

B. tube side minimum design pressure must be 150 pounds per square inch gage (10.54 kilogram/cm^2 gage) (1034.0 kPa gage); and

C. manufacturers producing shell and tube evaporators for refrigerants in the tube must provide the following minimum data on the nameplate:

(1) manufacturer's name;

(2) shell maximum allowable working pressure ..... at ..... temperature;

(3) tube maximum allowable working pressure ..... at ..... temperature;

Approved by Revisor _____

(4) manufacturer's serial number;

(5) year of manufacture;

(6) national board number where applicable;

(7) American Society of Mechanical Engineers stamp;

(8) an additional pressure and temperature stamping is required for vessels used below minus 20 degrees Fahrenheit (minus 29.9 degrees centigrade) that are not impact tested; and

(9) manufacturer's model number.

5230.5640 REFRIGERANT PUMP.

Subpart 1. **Generally.** This part applies to mechanical pumps used in closed circuit ammonia refrigeration systems.

Subp. 2. **Design criteria, refrigerant pumps.** The design criteria for refrigerant pumps is as follows:

A. A hydrostatic or differential pressure relief device or noncloseable vent pipe must be used for pressure protection of a liquid pump and its associated piping. The inlet connection for the relief device or vent pipe must be located on the pump casing or piping between the stop valves at the pump inlet and outlet, except that when a check valve is located between the pump and its outlet stop valve, the relief device or vent pipe inlet must be connected to the pipe between the discharge check valve and stop valve. No check valve may be installed that will isolate a liquid line solenoid in the pump discharge from the relief valve.

The relief device or vent pipe must connect either to the pump suction line upstream of the pump suction stop valve or to the vessel to which the pump suction is connected. This relief device or vent pipe must be external to the pump housing.

B. The pump casing minimum design pressure must be 150 pounds per square inch gage (10.54 kilogram/cm^2 gage) (1034.0 kPa gage) for low side service and 250 pounds per square inch gage (17.57 kilogram/cm^2 gage) (1724.0 kPa gage) for high side service with water cooled condensing and 300 pounds per

Approved by Revisor _____

square inch gage (21.09 kilogram/cm^2 gage) (2068.9 kPa gage) with air cooled condensing.

C. Pump drives and motors must be protected with screens or guards according to the standards of Occupational Safety and Health Division, Department of Labor and Industry, general requirements for all machines, and mechanical power transmission apparatus, chapter 5205.

D. A pump must be provided with controls that provide for the starting only when the pump is unloaded. Pumps must be installed with adequate electrical service and controls to start and run safely and operate in conformity with manufacturers recommendations.

E. Manufacturers producing ammonia pumps must permanently affix to the pump a nameplate providing the following minimum data on the nameplate:

(1) manufacturer's name;

(2) refrigerant ammonia;

(3) maximum working pressure;

(4) minimum allowable refrigerant temperature;

(5) maximum speed of pump;

(6) maximum horsepower of pump; and

(7) manufacturer's model number.

5230.5645 REFRIGERATION CONTROL VALVES.

Subpart 1. **Generally.** This part applies to control valves that contain or that are directly and automatically actuated by the ammonia refrigerant or its associated lubricating oil.

Products covered are solenoid valves, thermostatic expansion valves, automatic expansion valves, high side float valves, low side float valves, oil drain float valves, automatic liquid refrigerant drain valves, evaporator pressure regulators, downstream pressure regulators, hot gas bypass regulators, check valves, motorized valves, flow regulators, pilot operated and refrigerant pressure actuated condensing water regulators.

Refrigeration control valves contained within the refrigerant containing envelope for other equipment such as

slide valves in screw compressors are not covered in this part.

Subp. 2. **Design criteria, refrigeration control valves.** The design criteria for refrigeration control valves are as follows:

A. The minimum design pressure for refrigeration control valves for water cooled condensing systems is 250 pounds per square inch gage (17.57 kilograms/cm^2 gage) (1724.0 kPa gage).

B. The minimum design pressure for refrigeration control valves for air cooled condensing systems is 300 pounds per square inch gage (21.09 kilogram/cm^2 gage) (2068.0 kPa gage).

C. The pressure requirements of this part apply to fluid and ambient temperatures of minus 20 degrees Fahrenheit (minus 28.9 degrees centigrade) to 450 degrees Fahrenheit (232.2 degrees centigrade).

D. For temperatures below minus 20 degrees Fahrenheit (minus 28.9 degrees centigrade), use American National Standards Institute B31.5, Code of Refrigerant Piping.

E. This part does not apply to any system with temperatures exceeding 450 degrees Fahrenheit (323.2 degrees centigrade).

F. Connection style, design, and fabrication for main and auxiliary connections must permit leaktight field installation without reducing the pressure requirements of this part and parts 5230.5900 to 5230.5960.

G. Manufacturers producing refrigeration control valves shall provide the following minimum data on the nameplate:

(1) manufacturer's name;

(2) serial number;

(3) volts;

(4) amperes;

(5) hertz;

(6) manufacturer's model number;

(7) pressure rating; and

(8) ammonia service.

Subp. 3. **Functional test.** A completely assembled control

Approved by Revisor _____

valve must be given a bench test by the manufacturer using air or other suitable fluid that simulates the field performance of the moving parts of the valve in a manner that will determine that the completed device actually functions.

Subp. 4. **Leakage test.** A completely assembled control valve must be given a bench test by the manufacturer using air or other suitable fluid that enables observation of the leakage through the device when in a nominally closed position.

Subp. 5. **Pressure test.** A completely assembled control valve must be given a pressure test by the manufacturer at not less than the pressure required in parts 5230.6000. The entire envelope of the device must exhibit zero leakage under this pressure when subject to inspection under clean water or other suitable liquid or other leakage detection method of equal or greater sensitivity.

5230.5650 CONTROLS; ELECTRIC; PNEUMATIC.

Subpart 1. **Generally.** This part applies to sensing devices that initiate control pulses or signals applied for use in ammonia closed circuit refrigeration systems.

Subp. 2. **Design criteria.** The minimum high side design pressure is:

A. Water cooled or evaporative condensing: 250 pounds per square inch gage (17.57 kilograms/cm^2 gage) (1724.0 kPa gage).

B. Air cooled condensing: 300 pounds per square inch gage (21.09 kilograms/cm^2 gage) (2068.0 kPa gage). Minimum design pressure low side: 150 pounds per square inch gage (10.54 kilogram/cm^2 gage) (1034.0 kPa gage).

Subp. 3. **Nameplate data.** Manufacturers producing electrical and pneumatic controls must provide the following minimum data on the nameplate:

A. manufacturer's name;

B. volts;

C. amperes;

D. hertz;

Approved
by Revisor _____

E. any special characteristics of a control device is to be noted either on the nameplate or in the accompanying literature; and

F. manufacturer's model or serial number.

5230.5655 PRESSURE RELIEF DEVICES.

Subpart 1. **Generally.** This part applies to pressure relief devices installed on ammonia closed circuit refrigeration systems, for the purpose of safely relieving excess pressure due to fire or other abnormal conditions. Rupture members are not allowed under this chapter.

Subp. 2. **Standards for valves.** An ammonia refrigerating system must be protected by a pressure relief device and also must comply with the specific requirements in parts 5230.5900 to 5230.5960. They must be reseating type only. No rupture members shall be used.

Subp. 3. **Pressure actuation required.** A pressure relief device must be directly pressure actuated. Each part of a refrigerating system that can be valved off, and that contains one or more pressure vessels having internal diameters greater than three inches (76 millimeters) and containing liquid refrigerant, must be protected by a pressure relief device.

Subp. 4. **Stop valves.** Stop valves must not be located between the means of pressure relief and the part or parts of the system protected, except when the stop valve is of the three-way type connected in series to two parallel relief devices in a manner that both relief devices cannot be shut off from the system at the same time.

Subp. 5. **Pressure relief devices.** A pressure relief device must be connected above the liquid refrigerant level, and as nearly as practicable, directly to the pressure vessel or other parts of the system protected. The device must be installed so that it is readily accessible for inspection and repair. Condensers must be protected by relief devices on circuits that could be valved off.

Subp. 6. **Hydrostatic pressure relief.** Hydrostatic

pressure relief devices must meet the requirements of part 5230.5945.

5230.5660 SETTING OF PRESSURE RELIEF DEVICES.

Subpart 1. **Pressure relief valve setting.** Pressure relief valves must be set to start to function at a pressure not more than the design pressure of the parts of the system protected.

Subp. 2. **Marking of relief devices.** A pressure relief valve for refrigerant containing components shall be set and sealed by the manufacturer. A pressure relief valve must be marked by the manufacturer with the data required in the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section VIII, Division 1, except that relief valves for systems with design pressures of 15 pounds per square inch gage (10.54 kilograms/cm^2 gage) (103.4 kPa gage) or less may be marked by the manufacturer with the pressure setting and capacity and comply with part 5230.5945.

5230.5665 PRESSURE VESSEL PROTECTION.

Subpart 1. **Provision for pressure relief protection pressure.** Pressure vessels must be provided with pressure relief protection according to American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section VIII, Division 1. Piping requirements are governed by part 5230.5945.

Subp. 2. **Design criteria, pressure vessels of less than ten $feet^3$ (0.28 $meter^3$) internal gross volume.** Except as specified in this part, a pressure vessel containing liquid ammonia refrigerant with internal gross volume less than ten $feet^3$ (0.28 $meter^3$), which may be shut off from the other parts of a refrigerating system, must be protected by a pressure relief device having sufficient capacity to prevent the pressure in the vessel from rising more than ten percent above the setting of the pressure relief device.

Subp. 3. **Design criteria, pressure vessels of more than ten $feet^3$ (0.28 $meter^3$) internal gross volume.** A pressure vessel ten $feet^3$ (0.28 $meter^3$) gross or over must be protected by two parallel pressure relief devices connected to a three-way

Approved
by Revisor _____

type stop valve as required by part 5230.5655. A pressure relief valve must have sufficient capacity to prevent the pressure in the pressure vessel from rising more than ten percent above the setting of the pressure relief valve.

Subp. 4. **High side to low side pressure relief protection, pressure relief valves discharging into low side of the system.** A single relief valve, not rupture member, of the required relieving capacity may be used on vessels of ten feet^3 (0.28 meter^3) or over.

Subp. 5. **Parallel pressure relief devices on large vessels.** Except as specified in this part in cases where large pressure vessels containing liquid refrigerant require the use of two or more pressure relief devices in parallel to obtain the capacity required, the battery of pressure relief devices must be considered as a unit and as one pressure relief device.

Subp. 6. **Pressure relief protection for evaporator pressure vessels.** A pressure relief device for a pressure vessel used as, or as part of, an evaporator pressure vessel that has an internal diameter greater than six inches (152 millimeters) that is used in whole or in part as an evaporator and is insulated or installed in an insulated space, and that may be shut off by a valve from the other parts of the refrigerating system, must be protected by a pressure relief device according to this part. The requirement for a second parallel pressure relief valve does not apply.

Subp. 7. **Required capacity formula.** The minimum required discharge capacity of the pressure relief device for a pressure vessel must be determined by the following:

$C = 0.5DL$ (lb/min.) $C = 2.44DL$ (kg/min.)

Where:

C = minimum required discharge capacity of the relief device in pounds of air per minute (kilograms per minute)

D = outside diameter of the vessel in feet (meters)

L = length of vessel in feet (meters)

When one pressure relief device is used to protect more than one pressure vessel, the required capacity is the sum of

Approved by Revisor _____

the capacities required for each pressure vessel.

Subp. 8. **Determining discharge capacity.** The rated discharge capacity of a pressure relief valve expressed in pounds of air per minute, must be determined according to American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section VIII, Division 1. Pipe and fittings between the pressure relief valve and the parts of the system it protects must have at least the area of the pressure relief valve inlet.

Subp. 9. **Discharge to a safe location.** Discharge of pressure relief devices on systems containing ammonia refrigerant must be to the outside of the building.

Subp. 10. **Discharge into low side.** Pressure relief valves may discharge into the low side of the system, if the pressure relief devices are of a type not significantly affected by back pressures and if the low side of the system is equipped with pressure relief devices. The relief devices on the low side of the system must have sufficient capacity to protect the pressure vessels that are relieved into the low side of the system, or to protect all pressure vessels on the low side of the system, whichever relieving capacity is the largest, as computed by the formula in subpart 7. The low side pressure relief device must be set and vented to the outside of the building according to this part.

Subp. 11. **Manifolding of relief discharges.** The size of the discharge pipe from the pressure relief device must not be less than the size of the pressure relief device outlet. The discharge from more than one relief device may be run into a common header, the area of which must not be less than the sum of the areas of the pipe connected to the common header, and as required by part 5230.5945.

Subp. 12. **Maximum discharge piping length.** The maximum length of the discharge piping permitted to be installed on the outlet of a pressure relief device must be determined as follows: $L = 9P_1^2D^5/16C^2$ ($L = 7 \times \pm\theta^{11}\ \underline{10^{-11}}\ P_1^2D^5/C^2$)

Approved
by Revisor _____

Where:

C = minimum required discharge capacity in pounds of air per minute (kilograms per minute)

D = internal diameter of pipe in inches (millimeters)

L = length of discharge pipe in feet (meters)

P_1 = rated pressure (pounds per square inch) x 1.10 + 14.7 rated pressure (kPa gage) x (1.10 + 101)

See part 5230.5665, subpart 13, for computation derived from the preceding formula.

Subp. 13. **Maximum equivalent length discharge piping (length in feet) for pressure-relief devices at various discharge capacities.**

A. Relief valve setting at 150 pounds per square inch:

Stamped Discharge Capacity C #Air/Min.	Relief Valve Setting 150 PSIG Standard Wall Iron Pipe Size in Inches					
	1/2	3/4	1	1-1/4	1-1/2	2
5	68	276				
10	17	69	231			
15	7	31	102			
20	4	17	58	226		
25	3	11	37	145		
30	2	8	26	100	218	
40		4	14	57	122	
50		3	9	36	78	274
60		2	6	25	54	190
70			5	18	40	140
80			4	14	31	105
90			3	11	24	84
100			2	9	20	68
125				6	12	44
150				4	9	30
175				3	6	22
200				2	5	17

B. Relief valve setting at 200 pounds per square inch:

Stamped Discharge Capacity C #Air/Min.	Relief Valve Setting 200 PSIG Standard Wall Iron Pipe Size in Inches					
	1/2	3/4	1	1-1/4	1-1/2	2
5	115	470				
10	29	118	394			
15	13	52	175			
20	7	29	98			
25	5	19	63	248		
30	3	13	44	172		
40	2	7	25	97	210	
50		5	16	62	134	
60		3	11	43	93	

Approved by Revisor _____

70	2	8	32	68	238	
80	2	6	24	52	182	
90		5	19	41	144	
100		4	15	33	117	
125		2	10	21	75	
150			7	15	52	
175			5	11	38	
200			4	8	29	

C. Relief valve setting at 250 pounds per square inch:

Stamped Discharge Capacity C #Air/Min.	Relief Valve Setting 250 PSIG Standard Wall Iron Pipe Size in Inches					
	1/2	3/4	1	1-1/4	1-1/2	2
5	176					
10	44	179				
15	20	80	267			
20	11	45	150			
25	7	29	96			
30	5	20	67	263		
40	3	11	37	147		
50	2	7	24	94	204	
60		5	17	66	142	
70		4	12	48	104	
80		3	9	37	80	
90		2	7	29	63	220
100		2	6	24	51	178
125			4	15	33	114
150			3	11	23	79
175			2	8	17	58
200			2	6	13	44

D. Relief valve setting at 300 pounds per square inch:

Stamped Discharge Capacity C #Air/Min.	Relief Valve Setting 300 PSIG Standard Wall Iron Pipe Size in Inches					
	1/2	3/4	1	1-1/4	1-1/2	2
5	248					
10	62	254				
15	28	114				
20	15	54	212			
25	10	41	136			
30	7	28	94			
40	4	16	53	208		
50	3	10	34	134		
60	2	7	24	93	200	
70		5	17	68	147	
80		4	13	52	113	
90		3	10	41	89	
100		2	8	33	72	252
125		2	5	21	46	162
150			4	15	32	112
175			3	11	24	82
200			2	8	18	63

5230.5675 TESTING.

A refrigerant containing component must be tested and proved tight by the manufacturer at not less than the design

Approved by Revisor _____

pressure for which it is rated. Documentation of testing may be requested by the administrative authority.

5230.5680 CONSTRUCTION MATERIAL SELECTION; PIPE, VALVES, FITTINGS, ACCESSORIES.

Subpart 1. **Suitability, standards for materials.** Materials used in the construction of the equipment must be suitable for ammonia refrigerant at the coincident temperature and pressure to that the component may be subjected. No materials may be used that will deteriorate because of the presence of ammonia refrigerant or lubricating oil, or a combination of both, or any normal contaminant such as air or water. Where external surfaces of the equipment are exposed to corrosive effects of air, water, or other media, the exposed materials must be suitable for the application.

Subp. 2. **Ferrous materials.** Cast iron, malleable iron, nodular iron, steel, cast steel, and alloyed steel may be used as governed by American Society of Mechanical Engineers Boiler and Pressure Vessel Code, section VIII, division 1.

Subp. 3. **Other metals.**

A. Cooper or zinc must not be used with ammonia.

B. Aluminum may be used in tubing, valves, and gaskets. It is the responsibility of the installer of an aluminum component to provide protection from electrolysis including di-electric isolation as needed.

C. Lead may be used for packing, gaskets, and joint compounds.

D. Tin and lead tin alloys may be used but their use is not allowed at temperatures below 14 degrees Fahrenheit (minus 10 degrees centigrade).

E. Consideration must be given to the possibility of stress corrosion cracking occurring in vessels and piping exposed to ammonia.

Subp. 4. **Nonmetallic materials.** Packings, glass, plastics, and rubber may be used if they conform to this part.

Subp. 5. **Components.** Components in direct contact with

ammonia must not contain copper, brass, mercury, or alloys of these materials.

Subp. 6. **Pipe.** Pipe must be carbon steel that complies with this part, or a metallic material equal for safety and pressure and temperature rating and wall thickness. Nonmetallic pipe must not be used for ammonia service. Items A to F are the minimum standards for carbon steel pipe.

A. Diameter of pipe and minimum wall thickness of liquid lines, regardless of pressure:

(1) 1-1/2 inches and smaller, American Society for Testing and Materials schedule 80 seamless pipe;

(2) two inches through ten inches, American Society for Testing and Materials schedule 40 seamless pipe;

(3) 12 inches through 24 inches, standard weight seamless pipe, three-eighths inch wall thickness minimum; and

(4) exceeding 24 inches, standard weight pipe, three-eighths inch wall thickness minimum.

A liquid line through 24 inches must use American Society for Testing and Materials A-106 Grade B seamless piping.

B. Diameter of pipe and minimum wall thickness of vapor lines, regardless of pressure:

(1) ten inches and smaller, American Society for Testing and Materials schedule 40 pipe; and

(2) 12 inches and larger, standard weight pipe, three-eighths inch wall thickness minimum.

C. Threaded pipe must be American Society for Testing and Materials schedule 80 seamless minimum. Threaded fitting must be 2,000 pounds per square inch rating minimum.

D. Fittings must match pipe schedules. Threaded fittings must be forged steel. Socket weld fittings must be forged steel.

E. Carbon steel pipe must be:

(1) American Society for Testing and Materials A-53 Grade B seamless;

(2) American Society for Testing and Materials A-106 Grade B seamless; or

Approved
by Revisor _____

(3) American Society for Testing and Materials A-53 Grade B (Electrical Resistance Welded).

F. Mill test reports must be provided for the inspector at the inspector's discretion to verify heat numbers on the pipe and to verify compliance with this part.

5230.5690 ULTIMATE STRENGTH REQUIREMENT.

A pressure containing component of an ammonia piping system other than pressure vessels, piping, pressure gages, and control mechanisms, must be listed either individually or as part of refrigeration equipment by an approved nationally recognized testing laboratory or must be designed, constructed, and assembled to have an ultimate strength sufficient to withstand at least three times the design pressure for which it is rated.

5230.5700 BUILDING STRUCTURE AND MACHINE ROOM DESIGN.

Subpart 1. **Room layout and access.** Machinery must be located in a manner that provides at least the minimum clearances for maintenance operations called for in the equipment manufacturer's instructions, and not less than 36 inches in front of access doors for components requiring service or maintenance.

Machinery installed in or on an exterior wall of a building, that is designed so that the controls must be serviced from the outside of the building, must be accessible as provided in this part.

Subp. 2. **Roof access to ammonia equipment.** Machinery located on the roof of any building must be accessible as provided in items A and B.

A. Access must be a stairway that complies with the requirements of the Minnesota State Building Code, chapters 1301 to 1365.

B. Access must be a stair leading to a scuttle or bulkhead in the roof having the equipment. The stair leading to the scuttle or bulkhead must be placed at an angle of not more than 60 degrees measured from the horizontal with flat treads at least six inches in width and a minimum length of 24 inches at

the tread. No riser may be more than nine inches and handrails must be provided on both sides of the access stairs. The opening of the scuttle or bulkhead must not be less and nine square feet in area with the minimum dimension being two feet.

The required access must not be located in or pass through the elevator shaft or elevator machine room.

Subp. 3. **Roof access openings.** The roof access opening and equipment must be located with at least six feet of clearance from the edge of the roof or similar hazards, unless a suitable rail or guard at least 42 inches high is provided.

Subp. 4. **Convenience outlet.** A unit of equipment must have an accessible disconnect switch within sight line. A 20-ampere 110-120 volt AC ground-type convenience outlet must be installed on or adjacent to the unit or equipment. The outlet must have ground-fault circuit-interrupter protection and must not be connected to the equipment circuit.

Subp. 5. **Vibration elimination.** Machinery must be mounted to prevent excessive vibration from being transmitted to the building structure or to connected equipment.

Subp. 6. **Shutoff valves.** Valves must be readily accessible for operation and be clearly identified. Valves above floor level must be operated only from fixed platforms, ladders, or be chain operated. Isolating valves that stop the flow of liquid and discharge gas to the low side of the plant must be readily accessible and operable from the floor or a fixed platform.

Subp. 7. **Condensation.** Machinery or piping that may cause condensation or drips must not be located over electrical facilities.

Subp. 8. **Building structure.** The building structure housing the machine room must be designed to provide adequate strength and rigidity to safely house and support compressors, accumulators, pumps, and other related equipment.

Subp. 9. **Equipment foundation.** The compressor and other heavy equipment foundations must be designed according to manufacturer's recommendations and other parameters dictated by

subsoil and structural conditions and vibrations.

Subp. 10. **Roof structure.** The roof or ceiling structure must be designed to safely support the weight of suspended piping, oil traps, and other equipment.

Subp. 11. **Hub drains.** Adequate hub drains must be provided to properly dispose of wastewater according to the Minnesota State Plumbing Code, chapter 1355. The accumulation or the running of wastewater across the floor is not permitted.

Subp. 12. **Floor drains.** Adequate floor drains in a machinery room must be provided according to the Minnesota State Plumbing Code, chapter 1355, with all floors pitched toward the drains. A slick floor surface must be avoided.

Subp. 13. **Egress.** Machinery rooms and ammonia compressor rooms must be provided with a means of egress near each end of the room. Doors must swing outward and be provided with panic-type hardware.

Subp. 14. **Means of removal.** A means must be provided to allow for removal and replacement of any heavy motors or equipment from the building.

Subp. 15. **Separate location.** A separate location, separated from production or office facilities, is required for the machinery room.

5230.5705 OPEN FLAMES.

No open flames, or apparatus that may produce an open flame, may be installed in a machinery room where ammonia is used as a refrigerant. The use of matches, cigarette lighters, leak detectors, welding equipment, or other portable spark or current producing devices are not to be considered a violation of this part except that no uses of open flames or electrical current producing devices are permitted when ammonia or oil are being charged into or discharged from the system.

5230.5710 VENTILATION FOR MACHINERY ROOMS.

Subpart 1. **Scope.** Ventilation standards govern the ventilation protection of the equipment. Human occupancy standards are separate and are not covered in this part.

Subp. 2. **Ventilation to outside air.** An ammonia machinery room must be provided with means for ventilation to the outside air that complies with this part. The ventilation must consist of windows or doors opening to the outer air, of the size shown in this part or of mechanical means capable or removing the air from the room according to this part. The amount of ventilation for refrigerant removal purposes must be determined by the refrigerant content of the systems in the machinery room.

The ventilation system must provide sufficient hot weather ventilation to limit the temperature rise in the machinery room to a maximum of 20 degrees Fahrenheit (11.2 degrees centigrade) above outdoor ambient temperature. The temperature is to be measured five feet above floor level.

Subp. 3. **Required ventilation.**

A. The total required ventilation must be based on the requirements of subpart 9. One of the ventilation alternatives described in item B must be provided. Natural ventilation must be provided in all cases as required in item C.

B. One of the following mechanical ventilation alternatives must be provided.

(1) The room must be provided with a continuously operated, independent mechanical ventilation system. ~~The room must be considered a hazardous class I location according to the Minnesota State Electrical Code.~~ Failure of the mechanical ventilation system must initiate a supervised alarm so corrective action can be initiated. Ventilation requirements for air flow and duct area must be at least the minimums listed in subpart 9 for the quantity of refrigerant in the systems.

(2) The independent mechanical ventilation system must be actuated automatically by a vapor detector when the concentration of ammonia in the room exceeds 40,000 parts per million, 25 percent of lower explosive limit (LEL), and also be operable manually. The vapor detectors must also initiate a supervised alarm so corrective action can be initiated. Periodic tests of the detectors, alarms, or mechanical ventilation systems must be performed.

Approved by Revisor _____

C. In addition to mechanical ventilation required in this part, the machinery room must also be provided with openings for natural ventilation as provided in subpart 9 for the quantity of refrigerant in the systems. Opening square footage may include windows and doorway openings. The opening area in subpart 9 must be the unobstructed, openable, free area of the windows and doors in the machinery room that open to the outside.

Subp. 4. **Air supply.** Air supply and return ducts used for machinery room ventilation must serve no other area or other purpose.

Subp. 5. **Mechanical ventilation.** Mechanical ventilation must consist of one or more power driven exhaust fans, which must be capable of removing from the refrigerating machinery room the amount of air specified in subpart 9. The inlet and outlet to the fan or fans, or air duct connection must terminate outside of the building. When air ducts are used either on the inlet or discharge side of the fan, or fans, they must have an unobstructed free area not less than specified in subpart 9. Provision must be made for the introduction of tempered make-up air to replace that being exhausted in a volume equal to that being exhausted.

Subp. 6. **Air inlets.** The relative location of air inlets and discharge must be located as not to cause short circuiting.

Subp. 7. **Air discharge.** Air discharge must be directed to provide the best dispersion, taking into account natural air flow around the building, prevailing wind, and surrounding structures.

Subp. 8. **Water wash.** If dispersion is impractical, a water wash of the exhaust air may be used if approved by the building inspector. The water spray system must employ at least ten gallons per minute of water evenly distributed per 1,000 cubic feet per minute of exhausted air (1 meter^3/s water per 750 meter^3/s air).

Subp. 9. **Minimum air duct areas and openings.**

Approved
by Revisor _____

Weight of refrigerant in system, lb. (kg)	Mechanical discharge of air, cfm. (m^3/min)	Duct area sq. ft. (m^2)	Open areas of windows and doors, sq. ft. (m^2)
20 (9.07)	150 (4.2)	1/4 (2.3 x 10^{-2})	4 (37.2 x 10^{-2})
50 (22.7)	250 (7.1)	1/3 (3.1 x 10^{-2})	6 (55.7 x 10^{-2})
100 (45.4)	400 (11.3)	1/2 (4.6 x 10^{-2})	10 (92.9 x 10^{-2})
150 (68.0)	550 (15.6)	2/3 (6.2 x 10^{-2})	12-1/2 (1.16)
200 (90.7)	680 (19.2)	2/3 (6.2 x 10^{-2})	14 (1.30)
250 (113)	800 (22.6)	1 (9.3 x 10^{-2})	15 (1.39)
300 (136)	900 (25.5)	1 (9.3 x 10^{-2})	17 (1.58)
400 (181)	1,100 (31.2)	1-1/4 (11.6 x 10^{-2})	20 (1.86)
500 (227)	1,275 (36.1)	1-1/4 (11.6 x 10^{-2})	22 (2.04)
600 (272)	1,450 (41.1)	1-1/2 (13.9 x 10^{-2})	24 (2.23)
700 (318)	1,630 (46.2)	1-1/2 (13.9 x 10^{-2})	26 (2.42)
800 (363)	1,800 (51.0)	2 (18.6 x 10^{-2})	28 (2.60)
900 (408)	1,950 (55.2)	2 (18.6 x 10^{-2})	30 (2.79)
1,000 (454)	2,050 (58.0)	2 (18.6 x 10^{-2})	31 (2.88)
1,250 (567)	2,250 (63.7)	2-1/4 (20.9 x 10^{-2})	33 (3.06)
1,500 (680)	2,500 (70.8)	2-1/4 (20.9 x 10^{-2})	37 (3.44)
1,750 (794)	2,700 (76.5)	2-1/4 (20.9 x 10^{-2})	38 (3.53)
2,000 (907)	2,900 (82.1)	2-1/4 (20.9 x 10^{-2})	40 (3.72)
2,500 (1,134)	3,300 (93.4)	2-1/2 (23.2 x 10^{-2})	43 (4.00)
3,000 (1,361)	3,700 (105)	3 (27.9 x 10^{-2})	48 (4.46)
4,000 (1,814)	4,600 (130)	3-3/4 (34.8 x 10^{-2})	55 (5.11)
5,000 (2,268)	5,500 (156)	4-1/2 (41.8 x 10^{-2})	62 (5.76)
6,000 (2,722)	6,300 (178)	5 (46.4 x 10^{-2})	68 (6.32)
7,000 (3,175)	7,200 (204)	5-1/2 (51.1 x 10^{-2})	74 (6.87)
8,000 (3,629)	8,000 (226)	5-3/4 (53.4 x 10^{-2})	80 (7.43)
9,000 (4,082)	8,700 (246)	6-1/4 (58.1 x 10^{-2})	85 (7.90)
10,000 (4,536)	9,500 (269)	6-1/2 (60.4 x 10^{-2})	90 (8.36)
12,000 (5,443)	10,900 (309)	7 (65.0 x 10^{-2})	100 (9.29)
14,000 (6,350)	12,200 (345)	7-1/2 (69.7 x 10^{-2})	109 (10.1)
16,000 (7,258)	13,300 (377)	7-3/4 (72.0 x 10^{-2})	118 (11.0)
18,000 (8,165)	14,300 (405)	8 (74.3 x 10^{-2})	125 (11.6)
20,000 (9,072)	15,200 (430)	8-1/4 (76.6 x 10^{-2})	130 (12.1)
25,000 (11,340)	17,000 (481)	8-3/4 (81.3 x 10^{-2})	140 (13.0)
30,000 (13,608)	18,200 (515)	9 (83.6 x 10^{-2})	145 (13.5)
35,000 (15,876)	19,400 (549)	9-1/4 (85.9 x 10^{-2})	150 (13.9)
40,000 (18,144)	20,500 (580)	9-1/2 (88.2 x 10^{-2})	155 (14.4)
45,000 (20,412)	21,500 (609)	9-3/4 (90.6 x 10^{-2})	160 (14.9)

5230.5820 ELECTRICAL STANDARDS FOR AMMONIA INSTALLATIONS.

Subpart 1. **Installation standards.** Electrical equipment and wiring must be approved by the electrical inspector and installed consistent with the standards of the Minnesota State Electrical Code.

Subp. 2. **Electrical material.** Heavy-wall galvanized conduit must be used in machinery rooms.

Subp. 3. **Machinery room lighting.** A machinery room must be equipped with light fixtures to provide a minimum 30 foot-candles (322.8 lumen per meter^2) at the working level 36 inches above the floor or platform. Fixtures must be designed to prevent unauthorized replacement of the lights with lights of lesser voltage. Each unit of equipment must have an accessible disconnect switch within sight line. A 20-ampere 110-120 volt

Approved by Revisor _____

AC ground-type convenience outlet must be installed on or adjacent to the unit or equipment in the machinery room. The outlet must have ground-fault circuit-interrupter protection and must not be connected to the equipment circuit.

5230.5825 INSULATION.

Subpart 1. **Basic requirements.** Piping that operates at a temperature of less than 60 degrees Fahrenheit or more than 105 degrees Fahrenheit must be insulated with at least one inch of a suitable material having a thermal resistance of at least R4 to R4.6 per inch of thickness on a flat surface at a mean temperature of 75 degrees Fahrenheit except as provided in item A or B.

A. compressor discharge piping to the condenser does not require insulation if it is properly guarded to prevent accidental contact; or

B. control valves located inside or outside the machinery room do not require insulation if suitable means is provided for water (condensate) to be drained or disposed of safely consistent with the Minnesota State Plumbing Code, chapter 1355.

Subp. 2. **Prevention of condensation.** Suction lines, accumulators, surge drums, and similar surfaces that operate at or below the dew point temperature must be insulated to prevent the accumulation of condensation on surfaces adjacent to the piping according to the following minimum:

40 to 60 degrees = one inch of insulation

below 39 degrees = one and one-half inch of insulation

Subp. 3. **Hot piping.** Exposed hot water or hot gas discharge piping within seven feet of the floor or working platform or within 15 inches measured horizontally from stairways, ramps, or fixed ladders must be covered with an insulating material, or guarded in a manner to prevent contact with the piping.

5230.5915 PIPING JOINTS.

Subpart 1. **Design standards.** Piping joints must be

designed for ammonia service. Joints must be designed for the pressure temperature and mechanical strength requirements of ammonia service and items A to E.

A. One and one-quarter inch and smaller joints may be threaded or welded. Threaded pipe must be American Society for Testing and Materials schedule 80 seamless. Threaded fittings must be 2,000 pounds per square inch rating. Threaded fittings must be forged steel.

B. Joints one and one-half inch and larger must be welded. Fittings must match pipe schedule and material. Welded pipe one and one-half inch and smaller must be jointed with the use of socket weld fittings of at least 3,000 pounds per square inch ratings or butt weld fittings of the same wall thickness and material as the pipe. Socket weld fittings must be forged steel.

C. Flanges must be a tongue and groove type rated at least 300 pounds per square inch and designed for ammonia service and system pressure.

D. Gaskets must be designed for ammonia service and system pressure.

E. Unions must be at least 3,000 pounds per square inch forged steel ground joint unions, be used only for three quarters inch and smaller pipe, and must be socket weld.

Subp. 2. **Branch, run-outs, laterals, and saddles.** If the main piping is two inches and smaller, or the branch or run-out is two inches and smaller, branch or lateral connections must be forged steel TEE fitting, forged steel WELD-O-LET™ or THREAD-O-LET™, or engineering equivalent of at least 3,000 pounds per square inch rating. Engineering equivalency must be based on proper documentation signed by a registered professional engineer.

Where the main piping exceeds two inches, branch or lateral connections must be made by forged steel TEE fitting, be forged steel WELD-O-LET™, or THREAD-O-LET™ of at least 3,000 pounds per square inch rating; or in cases where the branch exceeds two inches (further providing that a branch lateral or saddle is two

pipe sizes smaller than the main piping it is connected to) the connection may be made by the use of a saddle or lateral connection that complies with the requirements of this part.

Branches or runouts the same size as the main must be connected using forged steel TEE fittings.

Welding of saddles and laterals must ~~result in a match of the inside diameters of the main and the branch~~ comply with the provisions of standard B31.5 and result in proper fusion through the weld and must be subjected to nondestructive testing including radiography at the discretion of the administrative authority.

The costs of nondestructive testing for labor and materials and all testing media must be at the expense of the installing contractor.

Subp. 3. **Welding of large joints.** Two inches and larger welded joints must be butt weld fittings that are of the same schedule as the piping and in no case less than the same wall thickness and material of the pipe.

Subp. 4. **Maximum pressure service.** Pipe, fittings, and components for ammonia service must be used only for pressure service that is 90 percent or less of component design working pressure.

Subp. 5. **Components.** The assembly of the various components, whether done in a shop or as a field erection, must be done so that the completely erected piping and equipment conform with the requirements of this chapter.

5230.5925 WELDING.

Subpart 1. **Certification.** Welders must be certified under a welding procedure for the job. An employer is responsible for the welding done by personnel of its organization, and must conduct any required tests and maintain necessary records of the tests.

Subp. 2. **Scope.** This part applies to the installation and repair of ammonia piping system and component parts, such as pipe, hangers, braces, and supports.

Approved by Revisor _____

Subp. 3. **Welding qualifications.** Standard qualifications for welding procedures, welders, and welding operators made according to American Society of Mechanical Engineers Boiler and Pressure Vessel Code, section IX, qualify for work under this part.

Subp. 4. **Welding qualifications for component parts.** Standard qualifications for welding procedures, welders, and welding operators made according to American Welding Society, Structural Welding Code-Steel, standards also qualify the welder for welding component parts such as hangers, braces, and supports.

Subp. 5. **Expiration of welder certification.** Welders certifications expire after three years from the original date of certification. Welders certified by the welding procedures specification must recertify by performing the original welding test used for certification in that process.

Subp. 6. **Document submission requirements.** Welding on projects for ammonia piping systems must have welding procedure specification and procedure qualification records submitted for each project with the permit applications for approval before work begins.

Subp. 7. **Weld procedure and qualification requirements.** No welding may be performed on ammonia piping systems without welding procedures specification, and welding procedures qualification. Welding performed on ammonia piping systems must be performed using only welders properly certified according to the welding procedure submitted.

Subp. 8. **Welding requirements.** Welding of ammonia piping systems components must meet the requirements of the welding procedures specification and procedure qualification record.

Subp. 9. **Welding procedures required.** A certified welding procedure for each project must be a welding procedure specification supported by the procedure qualification record. <u>If the certified welding procedure is on file with the Department of Labor and Industry and no changes are necessary, a new filing is not required. At a minimum, certified welding</u>

Approved
by Revisor _____

procedures must be updated after each revision.

Subp. 10. **Evaluation standards.** The welding procedure specification and procedure qualification record must be objectively evaluated by and acceptable to the administrative authority.

Subp. 11. **Welders certification.** Welders must be certified according to the certified welding procedure for that project.

Subp. 12. **Documentation required.** Welding for ammonia piping systems must be supported by the mandatory documents of welding procedure specification, welding procedure qualification, and procedure qualification record. These documents must be available at the work site.

Subp. 13. **Weld identification.** Welds on ammonia piping must be identifiable.

Subp. 14. **Welder identification number and log requirement.** A welder certified for a project must be assigned an identification number unique to that welder. Welds must be stamped or marked. The use of a welding log is required.

Subp. 15. **Contractor responsibility.** The contractor is responsible for establishing and retaining the needed documents to conform to the requirements of this part.

Subp. 16. **Guide bend test.** When the welding processes in item A or B are indicated on the welding procedure specification, the guide bend test is required when certifying the welding procedure specification and for individual welder qualification:

A. gas metal arc welding; or

B. submerged arc welding.

The use of a guide bend test-jig is mandatory. The jig must be approved by the administrative authority.

A guide bend test consists of at least two coupons for each of the following: face bend, root bend, ~~and side bend,~~ or four side bends. The use of part 5230.1080, subpart 6, shall apply provided the requirements of this part are met.

Subp. 17. **Nondestructive testing.** The administrative

Approved
by Revisor _____

authority ~~may at its discretion order~~ shall require the use of nondestructive testing including radiography for inspection of the welding of ammonia piping systems. Selection of nondestructive testing examination techniques shall be consistent with project design specifications, or with the requirements of standard B31.5 whichever is more restrictive. Where a weld fails examination, it will be the responsibility of the installing contractor to replace, repair, or prove the weld. The costs of nondestructive testing for labor and materials and all testing media shall be at the expense of the installing contractor.

Subp. 18. **Repair welds.** Repair welds must meet the requirements of this part. In emergency situations, work may commence immediately. However, the contractor must send a permit request to the department within one working day of commencement of the emergency work, provide the department with facsimile or telephone notice of the commencement of the emergency work within one working day of commencement of the emergency work, and request inspection of the work in conjunction with the notice of commencement of the work.

5230.5930 STOP VALVES.

Subpart 1. **Location of valves.** Stop valves for stopping flow of refrigerant for service must be located at the inlet and outlet of each component of the system, including:

A. compressor;

B. condenser;

C. receiver;

D. evaporator; and

E. vessels, pumps, and those items needed for safe and proper operation of the system.

Subp. 2. **Valve design.** Manual valves must be designed for ammonia service and made of materials suitable for ammonia service and shall be angle or globe type. Valves must be capable of backseating. Quarter turn valves must not be used for ammonia service.

Approved
by Revisor _____

Subp. 3. **Number and placement of stop valves.** Sufficient stop valves must be installed to expedite service and repair and to allow isolation of ammonia components by emergency responders.

5230.5935 MISCELLANEOUS MATERIALS.

Subpart 1. **Scope.** Standards for miscellaneous materials are as stated in this part.

Subp. 2. **Gauge lines.** Gauge lines for ammonia not more than one-fourth inch outside diameter or less must be constructed of materials that comply with the requirements of this chapter. These may be compressive type fittings, such as "SwageLock™," or 2,000 pounds per square inch rated engineering equivalent. Engineering equivalency must be based on proper documentation signed by a registered professional engineer.

Subp. 3. **Accessories.** Factory assembled accessories may use tubing of a larger size which must be of a material designed for ammonia service and joined by compressive type fittings, such as "Swagelock™," or engineering equivalent based on proper documentation signed by a registered professional engineer, or 2,000 pounds per square inch rated equivalent.

5230.5940 PIPING HANGERS AND SUPPORTS.

Subpart 1. **Hangers and supports specifications.** The supports must carry the weight of the pipe, including contents and insulation, and, if necessary, provide sway bracing to minimize vibration.

Subp. 2. **Components.**

A. The required maximum spacing of hangers and minimum hanger rod size for steel pipe:

Nominal pipe

Maximum Size	Minimum Rod Space	Diameter
Up to 1 inch	7 feet	3/8 inch
1-1/4 to 1-1/2 inches	9 feet	3/8 inch
2 inches	10 feet	3/8 inch
3 inches	12 feet	1/2 inch
3-1/2 inches	13 feet	1/2 inch
4 inches	14 feet	5/8 inch
5 inches	16 feet	5/8 inch
6 inches	17 feet	3/4 inch
8 inches	19 feet	7/8 inch
10 inches	22 feet	7/8 inch
12 inches	23 feet	7/8 inch

Approved
by Revisor _____

B. This chart represents mandatory maximum requirements for hanger rod loading. Maximum loads are in pounds at 650 degrees Fahrenheit based on threaded hot rolled steel conforming to American Society for Testing and Materials A-107.

Rod Diameter in Inches	Max Load in pounds
3/8	610
1/2	1,130
5/8	1,810
3/4	2,710
7/8	3,770
1	4,960
1-1/8	6,230
1-1/4	8,000
1-1/2	11,630
1-3/4	15,700
2	20,700
2-1/4	27,200
2-1/2	33,500
2-3/4	41,600
3	50,600
3-1/4	60,500

5230.5945 PRESSURE RELIEF PROTECTION.

Subpart 1. **Scope.** A refrigeration system must be protected by a pressure relief device.

Subp. 2. **Protection required.** Refrigeration systems must be protected according to the requirements of this part and part 5230.5660.

Subp. 3. **Discharge piping.** The extremity of the relief valve discharge line when relieved to atmosphere must be above the roof, and not within 25 feet (7.6 meters) of any window, ventilation intake, or personnel exit, and must be fitted with suitable rain protection or an ammonia diffuser. A drip pocket the size of the discharge pipe and at least 24 inches (610 millimeters) in length must be installed below a vertical riser in the discharge pipe, and it must be fitted with a drain plug or valve.

Subp. 4. **Relief piping and devices requirements.** Relief devices and relief piping must meet the requirements of parts 5230.5900 to 5230.5960. A shutoff valve must not be installed in the relief piping between the device and atmosphere.

Subp. 5. **Liquid pressure relief device.** A liquid pressure relief device to relieve hydrostatic pressure to another part of

the system must be used on that portion of the liquid containing parts of the system that can be isolated from the system during operation or service and that may be subjected to dangerous pressures from hydrostatic expansion of the contained liquid due to temperature rise. It is the installers responsibility to provide hydrostatic relief protection.

Subp. 6. **Common atmospheric discharge piping.** When connecting relief valves of different pressure settings into a common atmospheric discharge pipe, the size and maximum equivalent length of the discharge pipe must be governed by the sum of the rated discharge capacities of all relief valves discharging into the pipe, at the lowest pressure setting of any relief valve discharging into the pipe.

5230.5950 INSTALLATION REQUIREMENTS.

Subpart 1. **Foundations and supports.** Foundations and supports for condensing units or compressor units must be of substantial and noncombustible construction.

Subp. 2. **Moving machinery.** Moving machinery must be guarded according to Occupational Safety and Health safety standards.

Subp. 3. **Clearances.** Clear space adequate for inspection and servicing of condensing units or compressor units must be provided.

Subp. 4. **Enclosures.** Condensing units or compressor units with enclosures must be readily accessible for servicing and inspection.

Subp. 5. **Water supply and discharge.** Water supply and discharge connections must be made according to safety and health standards of the Minnesota State Plumbing Code, chapter 1355, and the water pollution standards of the Minnesota Pollution Control Agency, contained in chapter 7050.

Subp. 6. **Discharge lines.** Discharge water lines must not be directly connected to the waste or sewer systems. The waste or discharge from this equipment must be through an approved air gap and trap according to safety and health standards of the

Minnesota State Plumbing Code, chapter 1355.

Subp. 7. **Illumination.** Illumination adequate for inspection and servicing of condensing units or compressor units must be provided.

Subp. 8. **Minnesota State Electrical Code.** Electrical equipment and wiring must be installed according to the Minnesota State Electrical Code.

Subp. 9. **Air ducts in class T construction.** Standards for air duct systems of air conditioning equipment for human comfort using refrigeration are not covered in this chapter. Air ducts passing through a class T machinery room must be of vapor tight construction and must have no openings in the room.

Subp. 10. **Joints and refrigerant containing parts in air ducts.** Joints and refrigerant containing parts of a refrigeration system located in an air duct carrying conditioned air to and from an occupied space must be constructed to withstand a temperature of 700 degrees Fahrenheit (353.3 degrees centigrade) without leakage into the air stream.

Subp. 11. **Piping joints to be visible.** Refrigerant pipe joints erected on a premise must be exposed to view for visual inspection before being covered or enclosed.

5230.5960 FOUNDATIONS AND EQUIPMENT.

Subpart 1. **Supports and foundations.** Supports and foundations must be adequate to prevent excessive vibration and movement of the equipment.

Subp. 2. **Manufacturer's recommendations.** The supports must conform to the manufacturer's recommendations.

5230.6100 SYSTEM TESTING.

Subpart 1. **Standards.** A contracting pipefitter is responsible for system tightness and system testing to assure tightness. The contracting pipefitter is responsible for initial system operation and system testing to assure proper and safe operation.

Subp. 2. **Sequential testing.** A testing program for ammonia refrigeration systems must be designed to assure a tight

Approved
by Revisor _____

system that will operate without any appreciable loss of refrigerant, a system that will be reliable with respect to the electric components, and a system that will function according to the design with respect to controls and capacities. The test requirements of subparts 3 to 5 must be done sequentially to meet the requirements of this part.

Subp. 3. **Field tests.** Upon the complete installation of an ammonia system, the system must be tested for leaks. The high side must be tested at 250 pounds per square inch gage (17.57 kilograms/cm^2 gage) (1724.0 kPa gage) for water cooled or evaporative cooled systems, 300 pounds per square inch gage (21.09 kilograms/cm^2 gage) (1034.0 kPa gage) for air cooled systems. The low side must be tested at 150 pounds per square inch gage (10.54 kilograms/cm^2 gage) (1034.0 kPa gage). Test duration must be a minimum of 12 hours. There is no permissible pressure loss during the time of this test. Before testing, refrigeration compressors, liquid pumps, and pressure switches must be valved off and isolated from any test pressures. Safety relief valves must be removed and openings capped or plugged. All solenoid, pressure regulating, check, or other control valves must be opened by their manual lifting stems. Other valves must be opened except those leading to the atmosphere. Valves leading to atmosphere must be capped or locked shut. The system's ammonia compressor must not be used for the pressure test.

Subp. 4. **Test medium and pressure testing.** Oxygen or any combustible gas or combustible mixture of gases must not be used within the system for testing. Carbon dioxide or halocarbon (CFC) refrigerants must not be used as a testing gas in an ammonia system. Dry nitrogen or air must be used to raise the pressure in the ammonia system to the proper level of the test. The gas must be put in the system through the charging valve or any other suitable opening using the necessary regulators and relief devices. Leaks must be repaired and defective material be replaced. After a system is thoroughly tested, the valves on the lower part of the system must be opened. The valves must be

quickly opened wide.

Subp. 5. **Leak testing.** Upon completion of the pressure testing and evacuation to minimum ten inches (25.40 centimeters) mercury (Hg) vacuum, sufficient ammonia must be introduced into the system and the system subjected to 100 pounds per square inch gage (7.03 kilograms/cm ^{2} gage) (689.5 kPa gage) ammonia pressure. During this period, the system must be carefully inspected for leaks using sulphur tapers or litmus paper.

A. Two ammonia gas masks must be available during this test in a readily accessible location immediately adjacent to the testing location in case of an emergency.

B. If any leaks are found, they must be repaired and rechecked before the system can be considered tight. No repairs may be made to welded joints while the system is under pressure. The costs of testing for labor and materials and all testing media must be at the expense of the installing contractor.

Subp. 6. **Witnessed test.** ~~Witnessed tests under this part may be witnessed by the administrative authority.~~ Where a test is required, and an inspector is present, a declaration of test shall be signed by the inspector. The installing contractor shall provide no less than one working day advance notice of the test to the administrative authority.

5230.6110 SIGNS.

Subpart 1. **Content of signs.** An ammonia piping system erected on a premises must be provided with an easily legible, readily accessible permanent metal sign that complies with subpart 2 and is securely attached to the piping. The sign must indicate the name and address of the installer, the total number of pounds (kilograms) weight of ammonia refrigerant required in the system for normal operations, and the field test pressure applied.

Subp. 2. **Equipment signs.** Metal signs for ammonia piping systems must be provided and have letters at least one-half inch (one millimeter) in height that designate:

Approved
by Revisor _____

A. the systems main shutoff valve king valve;

B. hot gas bypass;

C. liquid shutoff valves;

D. the main shutoff valves to each vessel;

E. main steam or electrical control;

F. equipment disconnects;

G. remote control switches; and

H. the pressure limiting device.

On all exposed high pressure and low pressure piping in each room where installed and adjacent to all valves must be signs, as specified in items A to H, with the name of the refrigerant and letters "HP" or "LP" and high side or low side, the piping painted in the complying colors, and arrows showing flow direction.

Subp. 3. **Pipe identification.** Pipe colored marking for the ammonia piping system must be yellow with black letters and black arrows. Signs must be yellow with black letters. Piping identification must conform with American National Standards Institute, American Society of Mechanical Engineers standard A13.1, standard for the identification of piping.

5230.6115 REFRIGERANTS.

Subpart 1. **Charging and discharging refrigerants.** When refrigerant is added to a system, it must be charged into the low pressure side of the system. Any point on the downstream side of the main liquid line stop valve is part of the low pressure side when operating with the stop valve in the closed position. No service container may be left connected to a system except while charging or withdrawing refrigerant. Heat must not be applied to the cylinder.

Subp. 2. **Transfer to approved cylinder.** Refrigerants withdrawn from refrigerating systems must be transferred only to containers approved by a nationally recognized testing laboratory.

Subp. 3. **Care of containers.** Containers used for refrigerants withdrawn from a refrigerating system must be

carefully weighed each time they are used for this purpose. The containers must not be filled in excess of the rated capacity weight for the containers and the type of refrigerant used.

Subp. 4. **Maximum storage.** Refrigerant stored in a machinery room must be not more than 300 pounds (136 kilograms) weight, in addition to the charge in the system. The refrigerant must be stored in a permanently attached receiver and only in storage containers approved by the administrative authority.

5230.6120 MASKS OR HELMETS.

Subpart 1. **Location.** At least two masks or helmets must be provided at a readily accessible location immediately adjacent to each machinery room.

Subp. 2. **Approved masks.** Only complete helmets or masks suitable for ammonia must be used and they must be kept in a suitable readily accessible cabinet immediately outside the machinery room or other readily accessible location.

Subp. 3. **Canister/mask renewal.** Canisters or cartridges of helmets or masks must be renewed immediately after having been used or the seal broken and, if unused, the canisters must be renewed not later than the date noted on the canister labels.

Subp. 4. **Reference standard.** For standards for masks refer to American National Standards Institute, standard Z87.1, practice for occupational and educational eye and face protection.

5230.6125 MAINTENANCE AND OPERATION.

Subpart 1. **Maintenance.** Ammonia refrigerating systems must be maintained by the user in a clean condition, free from accumulations of oily dirt, waste, and other debris, and must be kept accessible at all times.

Subp. 2. **System responsibility.** It is the responsibility of the person in charge of the premises on which an ammonia piping system containing more than 50 pounds (22.68 kilograms) weight of ammonia is installed, to conspicuously place in a readily accessible location as near as practicable to the

ammonia compressor, a sign that complies with part 5230.6110 and gives clearly written directions for the operation of the system, including precautions to be observed in case of a breakdown or leak as follows:

A. instruction for shutting down the system in case of emergency;

B. the name, address, and day and night telephone numbers to obtain service;

C. the name, address, and telephone number of the administrative authority, and instructions to notify the authority immediately in case of emergency;

D. an ammonia incident action plan that includes the following minimum instructions for dealing with an ammonia leak:

(1) sound an alarm;

(2) notify fire department/emergency responders immediately;

(3) muster plant personnel;

(4) isolate area;

(5) secure supply line to leak area;

(6) secure return line from leak area;

(7) shut down refrigeration system or transfer refrigerant to a receiver outside of affected area;

(8) investigate the use of proper safety equipment and proper procedures;

(9) make sure no flames or sparks enter leak area;

(10) provide water spray and ventilation to neutralize and reduce the concentration of ammonia;

(11) repair leak if possible;

(12) begin cleanup or neutralizing procedure; and

(13) notify the proper administrative authority of the problem.

Subp. 3. **Ammonia incident action plan.** An ammonia incident action plan is a mandatory document and must be available for implementation in the event of an ammonia spill or incident. The ammonia incident action plan governs the required

response to an ammonia spill or leak.

5230.6130 DECLARATION OF TEST.

A dated declaration of test must be prepared for ammonia piping systems. The declaration must give the name of the refrigerant and the field test pressure applied to the high side and the low side of the system. The declaration of test must be signed by the licensed contractor and, if an inspector is present at the tests, the inspector must also sign the declaration. When requested, copies of the declaration must be furnished to the administrative authority.

5230.6200 AMMONIA HANDLING AND STORAGE.

Subpart 1. **Charging lines.** The refrigeration system must be equipped with valved charging lines to allow anhydrous ammonia to be fed into either the liquid receiver, liquid line, or low side receiver line or receiver. Charging lines must comply with the liquid line requirements of part 5230.5900.

Subp. 2. **Unloading lines.** Unloading lines must be suitable for ammonia service and designed to be capable of withstanding 350 pounds per square inch gage (24.6 kilograms/cm^2 gage) (2413.0 kPa gage) working pressure. Pipe must conform with the liquid line requirements of part 5230.5900 and applicable portions of parts 5230.5000 to 5230.6310.

Subp. 3. **Storage tanks.** The maximum storage tank design capacity must be 50,000 gallons (189.25 $meter^3$) of anhydrous ammonia when held at atmospheric temperatures. Tanks must meet American Society of Mechanical Engineers Boiler and Pressure Vessel Code, section VIII, division 1, construction and be designed for 250 pounds per square inch gage (17.57 kilograms/cm^2 gage) (1724.0 kPa gage) working pressure minimum.

Subp. 4. **Storage tank capacity.** A storage tank capacity for anhydrous ammonia must be limited to 56 percent of water weight capacity at 60 degrees Fahrenheit (15.6 degrees centigrade). Gage glasses must be equipped with excess flow valves to stop the flow of ammonia if breakage occurs. Meters with mercury as the manometer liquid must not be used.

Subp. 5. **Procedures.** The unloading of either tank trunk or railroad tank car must be done by creating a pressure differential between the storage tank and the portable vessel or a direct transfer by suitable liquid ammonia pump. Flexible connections of ammonia design at 350 pounds per square inch gage (24.6 kilograms/cm^2 gage) (2413.0 kPa gage) working pressure rating must be used between the portable vessel and unloading rack. Cars must be blocked before connections are made and proper warning signs must be put in place on a railroad siding. The unloading operation must be under continuous supervision.

Subp. 6. **Masks and helmets.** Two safety masks approved under American National Standards Institute, standard Z87.1, must be located in a readily accessible location immediately adjacent to the unloading or charging operation.

TERM CHANGE. Whenever the term "class T" appears in parts 5230.5000 to 5230.6200, the term "restricted" shall be substituted.

Approved
by Revisor _____