April 15, 1992

Mary Anne Hruby  
Director, Legislative Commission to  
Review Administrative Rules  
Room 55, State Office Building  
100 Constitution Avenue  
St. Paul, Minnesota 55155

Re: Ammonia Piping and Installation Proposed Rules

Dear Ms. Hruby:

Pursuant to M. S. § 176.131, enclosed is a copy of the Statement of Need and Reasonableness in the above matter.

Sincerely,

Kathryn Berger  
Compensation Attorney  
KB/cb
STATEMENT OF NEED AND REASONABLENESS
AMENDMENTS TO MINNESOTA RULES CHAPTER 5230
AMMONIA RULES

INTRODUCTION

The rules for installing high-pressure ammonia systems were drafted initially by a task force of personnel active in ammonia installation established by the Department of Labor and Industry. The department contracted with an independent contractor to review and edit the draft prepared by the task force. The primary source documents used to develop the draft were: American National Standards Institute/International Institute of Ammonia Refrigeration (ANSI/IIAR) AR-2 EQUIPMENT; DESIGN AND INSTALLATION OF AMMONIA MECHANICAL REFRIGERATION SYSTEMS; 1989 American Society of Mechanical Engineers (ASME) American National Standards Institute Standard B31.5 REFRIGERATION PIPING; and 1990 American National Standards Institute/American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ANSI/ASHRAE) HANDBOOK ON REFRIGERATION SYSTEMS AND APPLICATIONS.

Pertinent parts of these documents have been incorporated into the rules, or in some cases, rephrased for clarification. Where the background documents differ in actual language, or are perceived to differ, the language of these rules is intended to govern the installation and use of ammonia refrigeration systems. A tabulation of sources is attached as an appendix to this document.

The list of source documents used to prepare the rules are used in the context cited in the rules. These documents are recommended source materials for anyone designing and installing high-pressure ammonia systems. These rules are not intended to be a design manual.

To assure a consensus of opinion on these rules, a draft was mailed to over 60 of the department's constituents who are active in the design and installation of ammonia systems. These firms and individuals account for an estimated 90% or more of the known business entities working with high-pressure ammonia systems in Minnesota. Each of these parties was asked to review and comment on the rules. Approximately 10 parties contributed over 75 comments.

The comments or recommendations were reviewed by the task force, who advised the commissioner on the acceptability of each.

If these rules require an administrative hearing, the following individuals will testify on behalf of the department:

B. James Berg, Director Code Administration and Inspection Services
Department of Labor and Industry
443 Lafayette Road
St. Paul, Minnesota 55155-4304

Vern Worms, Owner
Cool Air Mechanical
1441 Rice Street
St. Paul, Minnesota 55117
Mr. Berg will describe the process for development of the rules, involvement in the process of all parties identified by the agency as being involved in ammonia installation, and discuss critical issues. Messrs. Worms, Zitzmann and Hendrickson will discuss their involvement in national associations related to ammonia, the basis for the adopted codes based on their experience and knowledge, and the suitability of the rules to safe ammonia installation.

The need for the rules mirrors changes in the ammonia industry. The restrictions on the use of--and eventual banning of--chloro-floro-carbon-type (CFC) refrigerants, or FREON™, due to ozone concerns is causing significant changes in the ammonia industry. CFC-type refrigerants are currently the heat transfer medium for the majority of refrigeration systems. In the search for substitute refrigerants, it is anticipated that ammonia will be used in more applications and designs to protect the ozone layer and the rest of the environment.

Designers are studying ammonia for its use in systems in large office buildings that use indirect "chilled-water" type cooling systems. These types of systems may lend themselves to the substitution of ammonia for the currently used CFC-type refrigerant, as ammonia is environmentally safer.

The rules have been drafted in light of such anticipated conversions. The refrigeration industry is converting from an industrial-type system to a more general utility for ammonia refrigerant. Also, the department is responding to industry comments requesting amendments that accurately reflect conditions and practices in Minnesota.

Ammonia is a compound formed by a combination of gaseous nitrogen and hydrogen. Ammonia exists naturally and is bio-degradable when exposed to sunlight, air and water. Ammonia has been used as a refrigerant since the beginning of the refrigeration industry, but was superseded for most uses by FREON™, except for industrial cooling uses.

Ammonia installation and usage was subject to partial regulation from 1972 to about 1982 as part of the State Mechanical Code, Minnesota Rules Chapter 1345. Chapter 1345 has since been repealed (15 SR 71). Since local governments are not equipped to regulate ammonia installations, statewide regulation of ammonia systems by the Department of Labor and Industry was approved in 1989 by the Legislature (M.S. 326.461).

Ammonia refrigeration is used most frequently in large food-processing and food-storage facilities located primarily in rural settings.
SMALL BUSINESS IMPACT OF THE RULES

The customers of ammonia refrigeration equipment are mostly larger businesses, as opposed to small businesses. The impact of these rules will allow customers to contract for construction with qualified, licensed installation companies that will assure safe installation consistent with code.

Under these rules, contractor firms that install ammonia refrigerant equipment are small businesses that will find an increased level of regulation. Most of the installation contractors currently in the refrigeration marketplace qualify under these rules to do ammonia installation. Any costs arising from additional regulation will be offset by the uniformity it brings the marketplace. Uniformity allows contractors to bid and install work to a single, mandatory statewide standard instead of working under several standards that may be different at each job--even within the same city. Therefore, no significant cost impact to small business is anticipated.

Contractors were given the opportunity to address those parts of these rules which might not have a clear safety or consumer-protection intent. These rules represent a consensus of those in the ammonia industry in Minnesota. The document provides an objective, needed framework for designers, contractors, workers and customers to develop and install systems with confidence that the installation will comply with code requirements. The document also allows more consistent communication between parties.

The factors identified in M.S. 14.115, subp. 2 (a)-(e) have been considered. Because the rules address safety issues, less stringent standards for small businesses are not feasible.

Likewise, compliance timelines will be the same for all installers. Reporting requirements are currently limited to a request for a permit, an application for inspection, and filing of testing results. Therefore, reducing the reporting requirements further is not possible.

The requirements of the rules cannot be reduced from what they are currently. The rules specify performance standards and, as safety issues, cannot be modified further or exempted for small businesses.

AGRICULTURE IMPACT OF THE RULES

There is no agricultural impact by these rules as defined in M.S. 17.81.

LOCAL GOVERNMENT IMPACT OF THE RULES

The impact on local government entities is not expected to exceed $100,000 in either of the next two fiscal years following adoption of the rules.
NEED FOR AND REASONABILITY OF RULES

Part 5230.5000 MINIMUM STANDARDS
This part identifies these rules as the code for ammonia refrigeration systems and clarifies the scope of these rules by providing an explanation of the material to be regulated. The rules are not intended to be a system design manual. It is important that designers of ammonia systems be familiar with the requirements, but they should not rely on the rules for systems design requirements. Specific subparts refer to design requirements for those clearly delineated portions of these rules, but they do not form the basis for a total system design requirement. In the context of the rules, "design requirements" refer to the structural capabilities of a piece of equipment rather than the engineering design of the system.

If any component of a system is designed to operate below -20° Fahrenheit (-28.9° Centigrade), then the entire system must meet the test requirements for that temperature, or the material may comply with one of the exceptions of the American Society of Mechanical Engineers Standard B31.5, Sect. 532.2.

The testing, known as Charpie testing, is commonly used for low temperature systems and is not the same as for other types of systems that are unexposed to these extreme temperatures. B31.5 provides several options for Charpie testing. With proper documentation, any alternative to Charpie testing outlined in B31.5 may be used. Documentation is to be submitted to the Department of Labor and Industry.

The Charpie test is an impact test, specifically used to test component integrity at lower temperatures. The standard sets -20° Fahrenheit (-28.9° Centigrade) as the point for requiring Charpie testing. The requirement to test any component of a system designed to operate at lower temperatures is necessary because, if there is a failure of part of the system, other parts may be exposed to a lower temperature. As temperatures drop, many metals become brittle, and thereby subject to failure if exposed to an impact.

The American Society of Mechanical Engineers/American National Standards Institute B31.5 Safety Code for Pressure Piping, which is used as a primary source document for piping requirements rules, states that impact testing is required for temperatures below -20° Fahrenheit (-28.9° Centigrade).

Part 5230.5010 INCORPORATION BY REFERENCE
This part references the documents used to develop ammonia rules. It lists documents and provides locations where they may be reviewed or purchased. The list of incorporated documents that is required by law is necessary for designers and installers to refer to more detailed language than appears in these rules, when another code is incorporated. It is reasonable for all designers and installers to locate these references quickly. Documents from ASME, the American Welding Society, and ANSI are those that the installer of an ammonia system must know to comply with the requirements of these rules.
Part 5230.5015 AMMONIA TASK FORCE

This part provides that the commissioner of labor and industry may appoint a task force to provide advice on incorporation of significant changes in the documents used as source material for these rules. This allows the commissioner a forum to receive recommendations regarding changes in industry standards prior to adopting changes in the rules.

It is necessary and reasonable to provide the commissioner with a source of informed recommendations regarding changes in industry standards and professional advice on rule changes to comport with such changes.

Part 5230.5020 DEFINITIONS

Subp. 1, Scope. Provides definitions of the terms used throughout these rules to provide consistent language for all parties. It is necessary to have definitions to ensure consistent use of all technical terms by all parties. Specifically, the definitions cover such categories as ammonia; equipment required for ammonia systems; building requirements; safety requirements; and regulatory terms. The terminology is based on definitions used in the ammonia industry to guide installers, designers, and users of ammonia.

The definitions are reasonable, as they are derived from the source documents identified in part 5230.5010, and they are standard definitions in the trade.

INDUSTRY DEFINITIONS: The following subparts of part 5230.5020 have definitions of technical terms that are standard to the ammonia refrigeration industry. Technical definitions are found in the following subparts:

Subp. 4, 5, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 28, 29, 30, 31, 32, 34, 36, 37, 38, 39, 44, 45, 46, 48, 49, 50, 51, 52, 53, 54, 55, 56, 58, 59, 60, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74.

The remaining subparts of part 5230.5020 are definitions that are not necessarily of a technical nature. Although they may be standard in the ammonia refrigeration industry, they could be interpreted differently by professionals not in the industry. Therefore, each of the following subparts require further explanation for need and reasonableness:

Subp. 2, Defines "accessible". Ability to access a site is needed to assure service of the equipment and proper safety inspection. It is reasonable to define with consistency what it means for all parties to have accessibility.

Subp. 3, Defines "administrative authority". Parties need to know who will perform the inspection by state law. It is reasonable to specify with consistency who is the administrative authority.

Subp. 6, Defines "anhydrous ammonia". Ammonia is defined to provide users with a definition of what chemical compound, and its properties are being discussed. The definition is needed to provide consistency of language. It is reasonable to provide the definition as a convenience for users so other references will not be required.
Subp. 7, Defines "approved". Parties need to know how the word is consistently defined. Because other state rules are referenced, it is reasonable to identify the other enforcement agencies involved in electrical, building, plumbing and other code inspections.

Subp. 8, Defines "an approved nationally recognized testing laboratory". The requirement for an approved nationally recognized testing laboratory is necessary to assure that testing is done in a properly documented manner by an appropriate, neutral testing laboratory, under consistent and documented testing procedures. Parties need to know the criteria that comprise an approved nationally recognized testing laboratory in order to acquire labels of approval to pass inspections and testing.

Subp. 26, Defines "exit". A definition is necessary and reasonable to identify an emergency evacuation route. It is reasonable to assure a safe evacuation of a building or machinery room where an ammonia refrigeration system is installed.

Subp. 27, Defines "field test". A definition is needed and reasonable to provide consistency of language.

Subp. 33, Defines "inaccessible". Ability to access a site is needed to assure service of the equipment and proper safety inspection. It is reasonable for parties to know whether a site meets the standards of accessibility.

Subp. 35, Defines "listed". A definition is needed to recognize equipment that has been tested and deemed acceptable by an appropriate, nationally recognized testing laboratory. It is reasonable for parties to know how to identify acceptable equipment.

Subp. 40, Defines "machinery". A definition is needed to provide consistency of language. The definition is reasonable to establish that all components of the entire ammonia refrigerant system are considered machinery, regardless of whether or not they involve mechanical operation.

Subp. 41, Defines "machinery room". A definition is necessary and reasonable to identify the space called the machinery room, assuring that those standards applying to a machinery room are properly applied.

Subp. 42, Defines "machinery room, class T". A machinery room, class T has tighter standards than a machinery room. This definition requires a minimum fire separation from the rest of the building and the use of fire rated assemblies. It is necessary to assure safety of the general public who will be in the adjacent space by restricting the potential for transfer of ammonia from the machinery room to the occupied space. It is reasonable to assure the safety of the general public by limiting the likelihood of a person's exposure to ammonia.

Subp. 43, Defines "manufacturer". The definition is needed and reasonable to ensure that all parties use consistent language.

Subp. 47, Defines "nameplate". Requirements that certain information be provided on a nameplate is universal for inspectors and users. It is reasonable to assure that the equipment is proper for the application.
Subp. 57, Defines "readily accessible". A definition is needed to provide consistency of language. The term reasonably specifies that the safety of those who inspect equipment requires intact and stationary equipment, while not having to use portable access equipment and tools. Overall, the term assures safer conditions for inspectors than does the more general term, "accessible".

Subp. 61, Defines "rupture member". A rupture member allows uncontrolled flow of ammonia from a system whenever pressure exceeds a predetermined limit. Prohibiting rupture members is needed to prevent this uncontrolled flow and to assure the safety of people in the area. It is reasonable that pressure relief devices that accomplish the same purpose without uncontrolled flow are allowed by these rules.

Part 5230.5025 AMMONIA GOVERNED AND DEFINED
This part identifies requirements and standards for ammonia used in refrigerant systems. This part is necessary because it sets standards for the proper grades of ammonia allowed for use in refrigeration systems. This part is reasonable because the use of unacceptable grades of ammonia with unacceptable levels of impurities may result in improper operations or unsafe conditions.

Information on flammable limits and ignition temperature is necessary to assure that users are aware of the points at which users and the public are exposed to ammonia and a hazard is prevalent.

Part 5230.5250 LOCATIONS GOVERNED AND DEFINED
This part provides descriptions of various types of building occupancies for use with parts 5230.5350 and 5230.5400. It is necessary to define the types of occupancies when determining the permissible quantities of ammonia and kinds of ammonia systems in each type of occupancy.

This part also identifies locations where ammonia piping is not allowed and provides limits for the safe location of the ammonia piping. These descriptions are derived from the Uniform Building Code. As the Uniform Building Code and other source documents have changing definitions for types of occupancies, a specific definition was established to provide consistent phrasing.

It is necessary and reasonable to identify each type of occupancy, because each type has different safety standards.

Subp. 1, Establishes locations governed by parts 5230.5000 to 5230.6200, in which ammonia piping systems may be placed, and groups locations by occupancy.

Subp. 2, Defines "institutional occupancy". A definition is needed to inform parties of what is considered in the industry to be "institutional" occupancy. It is reasonable to cite examples of such occupancy for further understanding by all parties.

Subp. 3, Defines "public assembly occupancy". A definition is needed to inform parties of what is considered in the industry to be "public assembly" occupancy. It is reasonable to cite examples of such occupancy for further understanding by all parties.
Subp. 4, Defines "residential occupancy". A definition is needed to inform parties of what is considered in the industry to be "residential" occupancy. It is reasonable to cite examples of such occupancy for further understanding by all parties.

Subp. 5, Defines "commercial occupancy". A definition is needed to inform parties of what is considered in the industry to be "commercial" occupancy. It is reasonable to cite examples of such occupancy for further understanding by all parties.

Subp. 6, Defines "industrial occupancy". A definition is needed to inform parties of what is considered in the industry to be "industrial" occupancy. It is reasonable to cite examples of such occupancy for further understanding by all parties.

Subp. 7, Defines "mixed occupancy". A definition is needed to inform parties of what is considered in the industry to be "mixed" occupancy. It is reasonable to cite examples of such occupancy for further understanding by all parties.

Subp. 8, Specifies how it is decided that an adjacent location with refrigeration equipment, other than piping, is governed. This subpart clarifies the characteristics necessary for an adjacent location containing refrigeration equipment either to be governed by the occupancy classification of the building or on its own. This subpart is reasonable to assure that other equipment is covered under the appropriate occupancy classification. As a result, safety is not compromised.

Part 5230.5300 REFRIGERATING SYSTEM CLASSIFICATION BY TYPE.
Defines and provides a schematic line drawing of various types of ammonia systems for clarification. When used in conjunction with location descriptions and parts 5230.5350 and 5230.5400, this part provides direction in selecting an ammonia system for each occupancy type and use. The drawings are derived from the 1990 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. HANDBOOK ON REFRIGERATION SYSTEMS AND APPLICATIONS. EQUIPMENT, DESIGN AND INSTALLATION OF AMMONIA MECHANICAL REFRIGERATION SYSTEMS.

Subp. 1, Introduces the classifications of refrigerating systems. This subpart is necessary to explain that refrigerating systems are classified by the type of method employed for extracting heat and to indicate how part 5230.5300 will be outlined.

Subp. 2, 3, 4, Define "direct system," "double direct system," and "indirect system." These subparts have definitions of technical terms that are standard to the ammonia refrigeration industry. These definitions are necessary and reasonable to establish language consistent with industry definitions.

Subp. 5, Illustrates direct, double direct and indirect systems. It is necessary to provide the diagrams to clarify the meanings of terms used in the refrigeration industry and in these rules, and to ensure no user of these rules suffers any confusion as to types of refrigeration systems referred to in these rules. The diagrams, derived from IIAR sources, are reasonable, contemporary industry usage.
Part 5230.5350 RESTRICTIONS ON PLACEMENT OF AMMONIA PIPING, LIMITATIONS ON SYSTEM SIZING, AND PRESSURE RELIEF VENTING REQUIREMENTS

This part regulates the location and maximum quantities of ammonia piping within all occupancies and types of systems except industrial occupancies. It provides specific regulations regarding location of ammonia systems and piping, and specific requirements for location of ammonia cooling coils.

This detail is necessary to ensure that, in areas where the general public and untrained personnel congregate, system design will prevent accidental exposure to ammonia. This part is reasonable because it reflects contemporary industry usage.

Subp. 1, Scope explains that restrictions for placement of ammonia piping are included in subparts 2 to 16.

Subp. 2, Provides that an ammonia piping system cannot be installed in public stairways, stair landings, entrances or exits.

This subpart is needed to regulate the location and maximum quantity of an ammonia piping system within all occupancies and types of systems except industrial occupancies. This detail is reasonable because it assures that, in areas where the general public and untrained personnel congregate, the design will prevent accidental exposure to ammonia or to the results of a catastrophic failure of the system.

Subp. 3, Prohibits ammonia piping systems from being installed in public hallways or lobbies; limits the amount of ammonia refrigerant in an ammonia piping system installed in residential and commercial occupancies.

This subpart is needed to regulate the location and maximum quantity of an ammonia piping system within residential and commercial occupancies. This detail is reasonable because it assures that, in areas where the general public and untrained personnel congregate, the design will prevent accidental exposure to ammonia or to the results of a catastrophic failure of the system.

Subp. 4, Provides regulations regarding permissible quantities of refrigerant in the ammonia piping system allowed in enclosed places other than the machinery room; provides regulations regarding permissible quantities of refrigerant in the ammonia piping system allowed in individual stories of a building served by evaporator coils.

This subpart is needed to regulate the maximum quantity of an ammonia piping system within enclosed spaces. This detail is reasonable because it assures that, in areas where the general public and untrained personnel congregate, the design will prevent accidental exposure to ammonia or to the results of a catastrophic failure of the system.

Subp. 5, Provides regulations regarding permissible quantities of refrigerant in the ammonia piping system served by evaporator coils allowed in occupied space served by air ducts.
This subpart is needed to regulate the maximum quantity of an ammonia piping system within air ducts. This detail is reasonable because it assures that, in areas where the general public and untrained personnel congregate, the design will prevent accidental exposure to ammonia or to the results of a catastrophic failure of the system.

Subp. 6, Provides regulations regarding permissible quantities of refrigerant in the ammonia piping system served by evaporator coils where the return air space above a suspended ceiling is one continuous space and not an enclosed air duct in which return air is confined.

This subpart is needed to regulate the maximum quantity of an ammonia piping system within occupied space. This detail is reasonable because it assures that, in areas where the general public and untrained personnel congregate, the design will prevent accidental exposure to ammonia or to the results of a catastrophic failure of the system.

Subp. 7, Specifies requirements for external venting with direct expansion coils or evaporators used for air conditioning in institutional and public assembly occupancies. This subpart is needed to identify the circumstances for which external venting is not required in institutional and public occupancies. The subpart is reasonable because it presents a tested formula to assure a distinction between those systems that require venting and those that do not.

Subp. 8, Provides regulations regarding permissible quantities of ammonia allowed in each occupancy; prohibits air conditioning for human comfort using the direct ammonia system. Prohibition of a direct system for air conditioning for human comfort provides protection of the public from an accidental release of ammonia if there is a system failure.

Subp. 9, Provides information regarding permissible quantities of ammonia for direct systems in each type of occupancy.

Subp. 10, Indirect systems may have the maximum quantity of ammonia increased where there is a class T machinery room. The maximum permissible quantity of ammonia refrigerant may be increased where there is a class T machinery room, and the other requirements of the subpart are complied with. The increase in the amount of ammonia refrigerant—under these conditions—is reasonable, as it allows more refrigerant. However, the restrictions provide adequate safety to the public.

Subparts 8 through 10 are necessary and reasonable to provide specific information relative to maximum permissible quantities of ammonia in each type of occupancy. Maximum quantity is based on industry standard, ANSI/ASHRAE SAFETY CODE FOR MECHANICAL REFRIGERATION, Chapter 15, Sect. 6.3.

Subp. 11, Requires a CLASS T machinery room for institutional, public assembly, residential and commercial occupancies as specified; prohibits devices with open flames inside a CLASS T machinery room; sets requirements for electrical equipment in a CLASS T machinery rooms; references the National Fire Protection Act standard used for life safety and fire exits. The subpart is necessary and reasonable to assure safety in each type of occupancy.
Subp. 12, Requires that ammonia piping that crosses an open space and affords passageway in a building be installed at least 7-1/2 feet above the floor unless it is against the ceiling of the space. The subpart is necessary to specify an adequate overload clearance. The subpart is reasonable because 7-1/2 feet provide clearance under most circumstances.

Subp. 13, Prohibits locations where ammonia piping can be placed. The limitations are necessary and reasonable to prevent obstruction of passageway by ammonia piping in a building.

Subp. 14, Establishes that part 5230.5350 applies to all occupancies except that the maximum quantity of ammonia allowed does not apply to industrial occupancy; specifies that in areas of public assembly, the more restrictive requirements of this part apply. It is necessary to specify separate requirements for occupancies other than industrial, because those requirements must assure the safety of individuals who may be exposed to ammonia.

Subp. 15, Specifies that ammonia piping may not be installed vertically through floors from one story to another, except in certain stated cases. The subpart is necessary to prevent smoke, gases and fire from travelling from one floor level to another. The subpart is reasonable to protect people in such occupancies.

Subp. 16, Specifies requirements for installing ammonia piping horizontally in closed floors including concrete and open joist spaces. The subpart is necessary to identify where and how piping may be placed when it is installed horizontally. The subpart is reasonable because it provides for placement of piping in protected environments.

Part 5230.5400 REQUIREMENTS FOR INDUSTRIAL OCCUPANCIES
This part identifies requirements for industrial occupancies. Standards for industrial occupancies are not as stringent as those for other types of occupancies, because employees in industrial occupancies generally have proper training and equipment not available to those in other types of occupancies. Furthermore, those in other types of occupancies could be part of the general public and would not have the necessary safety training.

It is necessary to specify separate requirements for occupancies other than industrial, because those requirements must assure the safety of individuals who may be exposed to ammonia. It is reasonable to assume that personnel in occupancies other than industrial are not trained in safety, and therefore, have more stringent requirements than personnel in industrial occupancies.

Subp. 1, Specifies that there is no maximum quantity of ammonia refrigerant in an industrial occupancy. Other requirements of 5230.5350 apply. The subpart is necessary and reasonable to clarify a difference in the amount of ammonia allowed for industrial occupancies, as compared to other occupancies.
Subp. 2, Specifies cross-reference requirements for machinery room in industrialized occupancies. This subpart is needed and reasonable because industrial occupancy standards are different from other types of occupancies, due to a lesser hazard to the general public. However, minimum standards for the machinery room are required to assure safety of those who may be in the work area.

Subp. 3, Specifies characteristics of a refrigerant storage area, including: the degree of its being a hazard; what parts should be protected; and when the area is considered a refrigerant storage area. The subpart is needed to provide for safe installation and protection for those in the work area. The subpart is reasonable to provide minimum standards for installation of ammonia.

INTRODUCTION to parts 5230.5605 to 5230.5650
This part provides standardized criteria and labeling regulations for the parts of equipment in the ammonia refrigeration system. Equipment requirements in these parts are based on the American National Standards Institute/ International Institute of Ammonia Refrigeration AR-2 EQUIPMENT, DESIGN AND INSTALLATION OF AMMONIA MECHANICAL REFRIGERATION SYSTEMS. Relevant portions of this document have been used in these rules.

Rephrasing of the AR-2 standard is needed for clarity. Rephrasing is reasonable, as it allows for less technical, more readily understandable language.

Occupational Safety and Health Administration (OSHA) safety requirements are cited to assure compliance with appropriate employee safeguards.

Part 5230.5605 AIR COOLED CONDENSERS
This part describes design criteria for air cooled condensers that are applied to closed-circuit ammonia refrigeration systems.

Subp. 1, Establishes that part 5230.5605 refers to air cooled condensers that are applied to closed-circuit ammonia refrigeration systems.

Subp. 2, Lists the design criteria for use of air cooled condensers for ammonia service.
   A. Provides a pressure to be contained safely by the condenser.
   B. Provides a wind velocity to be withstood safely by the condenser.
   C. Requires compliance with OSHA standards for employee protection.
   D. Requires that fan speeds be limited to safe speed as recommended by the manufacturer for the specific application and temperatures.
   E. Specifies the minimum data that manufacturers must provide on a nameplate to be placed on an air cooled condenser for ammonia service.

This part is necessary and reasonable to assure minimum manufacturing and safety standards for air cooled condensers and to provide for documentation of compliance with the standards.

Part 5230.5610 AIR COOLED DESUPERHEATERS
This part provides that this equipment, which is similar to air cooled condensers, be designed and tested to the same criteria as those required for air cooled condensers.
This part is needed and reasonable to assure minimum manufacturing and safety standards for air cooled desuperheaters and to provide for documentation of compliance with the standards.

Part 5230.5615 COMPRESSORS
This part describes ammonia compressors that are applied to closed-circuit ammonia refrigeration systems.

Subp. 1. Establishes that part 5230.5615 refers to compressors that are applied to closed-circuit ammonia refrigeration systems. The subpart also identifies other types of compressor equipment that compress gas.

Subp. 2. Describes the minimum standards which guide the designers and builders of ammonia compressors.
   A. Provides the minimum value for the internal pressure withstood safely by the high-stage, or high-side, compressor for water, air and evaporative condensing applications.
   B. Provides the minimum value for the internal pressure that the booster compressor can withstand safely.
   C. Requires that the compressor be equipped with a pressure relief device. The device is used to relieve excess ammonia pressure and discharge it to a safe location without damage to the equipment or injury to personnel.
   D. Requires controls to assure interlock protection to the compressor for listed conditions; provides direction for setting these controls.
   E. Establishes standards for startup and requires adequate electrical service and controls for startup and operation.
   F. Provides protection for the compressor from excessive on-and-off operation.
   G. Requires guards and protection for parts of the compressor which rotate to protect employees under established OSHA standards.
   H. Requires that compressors with parts used to rotate in only one direction have a rotation arrow showing the proper direction. The arrow must be affixed permanently to the compressor or cast in as a permanent part of the compressor.
   I. Provides an alternate method for the manufacturer to certify equipment which is not listed.
   J. Specifies the minimum data that manufacturers must provide on a nameplate to be placed on an evaporative compressor for ammonia service.

This part is necessary and reasonable to assure minimum manufacturing and safety standards for compressors and to provide for documentation of compliance with the standards.

Part 5230.5620 EVAPORATIVE CONDENSERS
This part describes the various types of evaporative condensers that are applied to closed-circuit ammonia refrigeration systems.

Subp. 1. Establishes that part 5230.5620 refers to evaporative condensers that are applied to closed-circuit ammonia refrigeration systems.

Subp. 2. Describes the minimum standards that guide designers and builders of evaporative condensers.
A. Provides a pressure to be contained safely by the condenser.
B. Provides a wind velocity that the condenser can withstand safely.
C. Requires that fan speeds must be limited to safe speed as recommended by the manufacturer for the specific application and temperatures.
D. Requires compliance with manufacturers' design-fan speed requirements.
E. Specifies the minimum data that manufacturers must provide on a nameplate to be placed on an evaporative condenser for ammonia service.

This part is necessary and reasonable to assure minimum manufacturing and safety standards for evaporative condensers and to provide for documentation of compliance with the standards.

Part 5230.5625 SHELL AND TUBE CONDENSERS
This part describes shell and tube condensers that are used in closed-circuit ammonia refrigeration systems.

Subp. 1. Establishes that part 5230.5625 refers to shell and tube condensers that are used in closed-circuit ammonia refrigeration systems.

Subp. 2. Describes the minimum standards that guide designers and builders of shell and tube condensers.
A. Provides a pressure to be contained safely by the shell and tube condenser.
B. Requires that the condenser provide a pressure relief device.
C. Requires that adequate nozzles be provided in the condenser shell to attach pressure relief devices.
D. Specifies the minimum data that manufacturers must provide on a nameplate to be placed on shell and tube condensers for ammonia service.

This part is necessary and reasonable to assure minimum manufacturing and safety standards for shell and tube condensers and to provide for documentation of compliance with the standards.

Part 5230.5630 PRESSURE VESSELS
This part describes pressure vessels that are used in closed-circuit ammonia refrigeration systems.

Subp. 1. Establishes that part 5230.5630 refers to pressure vessels that are used in closed-circuit ammonia refrigeration systems.

Subp. 2. Describes the minimum standards for pressure vessels and provides guidelines for designers and builders of ammonia pressure vessels.
A. Provides a pressure to be contained safely by the high-side pressure vessel when using water or evaporative condensing and air-cooled condensing.
B. Provides a pressure to be contained safely by the low-side pressure vessel.
C. Requires that pressure vessels larger than a minimum size comply with the ASME BOILER AND PRESSURE VESSEL CODE, SECTION VIII, DIVISION 1, 1983 in the design, fabrication, inspection and testing of such unfired vessels under construction.
D. Requires that pressure vessels be provided with adequate openings for the attachment of safety relief devices as required in part 5230.5655.
E. Specifies the minimum data that manufacturers must provide on a nameplate to be placed on pressure vessels for ammonia service.

Pressure vessels are closely regulated by the American Society of Mechanical Engineers Boiler and Pressure Vessel Code. The standards have been used effectively for over 70 years in assuring that vessels are constructed in a safe manner and will meet the pressure requirements of the systems for which they are designed.

These standards are necessary and reasonable because the low side may become over-pressurized if the high side releases excess ammonia to the low side. All pressure vessels on the low side are required to meet the same standards as those on the high side of the system.

Part 5230.5635 EVAPORATORS
This part describes evaporators that are used in closed-circuit ammonia refrigeration systems.

Subp. 1, Establishes that part 5230.5635 refers to evaporators that are used in closed-circuit ammonia refrigeration systems.

Subp. 2, Describes the minimum standards that guide builders and designers of forced-air evaporator coils for ammonia service.

A. Provides a pressure to be contained safely by an ammonia forced-air evaporator coil.

B. Requires guards and protection for parts of the compressor which rotate to protect employees under established OSHA standards.

C. Requires that fan speeds be limited to a safe speed as recommended by the manufacturer for the temperature and nature of the application.

D. Specifies the minimum data that manufacturers must provide on a nameplate to be placed on forced-air evaporator coils for ammonia service.

The subpart is necessary and reasonable to require minimum standards to guide the designers and builders of ammonia forced-air evaporator coils.

Subp. 3, Describes the design criteria for flooded-type refrigerant in shell.

A. Requires that the shell side in the pressure vessel be provided with adequate openings to attach safety relief devices.

B. Provides a pressure to be contained safely in shell and tube evaporators.

C. Specifies the minimum data that manufacturers must provide on a nameplate to be placed on shell and tube evaporators for refrigerants in the shell.

Subp. 4, Describes the design criteria for direct expansion type with refrigerant in tubes.

A. Requires that tube material and fabrication comply with national standards cited.

B. Provides a pressure to be contained safely by the ammonia tubes.

C. Specifies the minimum data that manufacturers must provide on a nameplate to be placed on shell and tube evaporators for refrigerants in the tube.
Subparts 3 and 4 are necessary and reasonable to assure minimum manufacturing and safety standards for evaporators and to provide for documentation of compliance with the standards.

Part 5230.5640 REFRIGERANT PUMP

This part describes refrigerant pumps that are used in closed-circuit ammonia refrigeration systems.

Subp. 1, Establishes that part 5230.5640 refers to refrigerant pumps that are used in closed-circuit ammonia refrigeration systems.

Subp. 2, Describes the minimum standards that guide builders and designers of refrigerant pumps for ammonia service.
   A. Requires that a pressure relief device suitable for liquid applications be installed; specifies location and other requirements.
   B. Provides a pressure to be contained safely by pump casing.
   C. Requires guards and protection for parts of the pump drives and motors, which rotate to protect employees under established OSHA standards.
   D. Requires that a pump be provided with controls that provide starting only when the pump is unloaded, and that pumps are installed with adequate electrical service and controls to operate in conformity with manufacturers' recommendations.
   E. Specifies the minimum data that manufacturers must provide on a nameplate to be placed on refrigeration pumps.

The subpart is necessary and reasonable to require minimum standards to guide the designers and builders of refrigerant pumps. It also assures minimum manufacturing and safety standards for refrigerant pumps and to provide documentation of compliance with the standards.

Part 5230.5645 REFRIGERATION CONTROL VALVES

This part describes control valves that contain, or that are directly and automatically actuated by, the ammonia refrigerant or its associated lubricating oil.

Subp. 1, Establishes that part 5230.5645 refers to control valves that contain or that are directly and automatically actuated by the ammonia refrigerant or its associated lubricating oil; lists products covered in this part.

Subp. 2, Describes the minimum standards that guide builders and designers of refrigeration control valves. The subpart is necessary to require minimum standards to guide the designers and builders of refrigerant pumps.
   A. Provides a pressure to be contained safely for refrigeration control valves for water-cooled condensing systems.
   B. Provides a pressure to be contained safely for refrigeration control valves for air-cooled condensing systems.
   C. Provides requirements for pressure and temperature ranges that guide the design of refrigeration control valves.
   D. Provides direction for temperature ranges below those listed by referencing ANSI/ASME B31.5 -1974, CODE FOR REFRIGERANT PIPING.
E. Provides that this part does not apply to any system with temperatures exceeding 450° F. Typical systems will not operate at temperatures exceeding 450° F. At 450° F the temperature exceeds the capabilities of ammonia refrigeration materials. Specially designed materials will be required for systems requiring operations at higher temperatures.

F. Requires that connection stylet design and fabrication for main and auxiliary connection permit leak-tight field installation, without reducing the pressure requirements of this part and parts 5230.5900 and 5230.5960.

G. Specifies the minimum data that manufacturers must provide on a nameplate to be placed on refrigeration control valves.

The subpart is necessary and reasonable to require minimum standards to guide the designers and builders of refrigerant control valves. It also assures minimum manufacturing and safety standards for refrigerant control valves and to provide documentation of compliance with the standards.

Subp. 3, Requires that completely assembled control valves undergo a manufacturer's bench test, simulating field performance for function.

Subp. 4, Requires that completely assembled control valves undergo a manufacturer's bench test, simulating field performance for tight shut-off.

Subp. 5, Requires that completely assembled control valves undergo an internal pressure test by the manufacturer. Establishes test protocol and requirements.

Subparts 3 to 5 are necessary to assure minimum manufacturing and safety standards for control valves and provide documentation of compliance with the standards. Subparts 3 to 5 are reasonable because functional, leakage and pressure testing are required to finalize the installation with a label from an approved, nationally recognized testing laboratory. Each installation is uniquely designed for the application at the site, because prelabeled pump systems are not available.

Part 5230.5650 CONTROLS; ELECTRIC; PNEUMATIC
This part describes sensing devices that initiate control pulses or signals applied for use in ammonia closed-circuit refrigeration systems.

Subp. 1, Establishes that part 5230.5650 applies to sensing devices that initiate control pulses or signals applied for use in ammonia closed-circuit refrigeration systems.

Subp. 2, Specifies the minimum high-side design pressure for water-cooled condensing and air-cooled condensing. This subpart is necessary and reasonable to assure minimum manufacturing and safety standards for controls and to provide for documentation of compliance with the standards.

A. Specifies the minimum high-side design pressure for water-cooled condensing.

B. Specifies the minimum high-side design pressure for air-cooled condensing.
Subp. 3, Specifies the minimum data that manufacturers must provide on a
nameplate to be placed on electrical and pneumatic controls. This subpart is
necessary and reasonable to assure minimum manufacturing and safety standards for
electrical and pneumatic controls, and provide documentation of compliance with
the standards.

Part 5230.5655 PRESSURE RELIEF DEVICES
This part describes pressure relief devices installed on ammonia closed-circuit
refrigeration systems for the purpose of relieving excess pressure due to fire
or other abnormal conditions.

Subp. 1, Establishes that part 5230.5655 refers to pressure relief devices
installed on ammonia closed-circuit refrigeration systems for the purpose of
relieving excess pressure due to fire or other abnormal conditions; highlights
that rupture members are not allowed.

A rupture member allows an uncontrolled flow of ammonia from a system whenever
pressure exceeds a predetermined limit. Prohibiting rupture members is needed
to prevent this uncontrolled flow. Prohibiting rupture members is reasonable to
assure the safety of people in the area. It is also reasonable that pressure
relief devices accomplishing the same purpose without uncontrolled flow are
allowed by these rules.

Subp. 2, Requires that a pressure-relief device be provided for the ammonia
system; describes a complying pressure relief device; provides direction on
ammonia system pressure-relief protection requirement; refers to other parts of
these rules for further information; requires reheating-type relief devices for
this service; prohibits the use of rupture-member type relief devices.

The subpart is necessary and reasonable because pressure-relief devices are
required to prevent accidental release of ammonia into the work area or the
atmosphere. A failure of a rupture relief safety device will result in loss of
the entire charge of ammonia into the work area or into the atmosphere.
Accordingly, these devices are not accepted. Pressure relief devices limit
release of ammonia to the amount required to reduce the pressure into the system
to a safe level.

Subp. 3, Limits pressure relief to devices that are only pressure activated.
Requires that all components that can be valved off have a valve to protect from
over-pressurization. This subpart is necessary to protect against any part of
the system developing pressure.

This subpart, in conjunction with the remainder of this part and parts 5230.5660,
5230.5665 and 5230.5945, form an integral package to protect from over-
pressurization.

It is necessary and reasonable to assure that all components are protected from
over-pressurization; that proper standards for safety devices are used and met;
and that appurtenances are included in the protection and conform to safety
standards.
Subp. 4. Prohibits stop valves between the device being protected and the pressure relief device; provides exception for three-way-type stop valve connecting two parallel pressure relief devices. It is necessary and reasonable to assure that there are no pressure points created that are not protected.

Subp. 5. Provides direction to the manufacturer, designer and installer of the ammonia system on the proper placement of the safety device. This subpart is necessary and reasonable for inspection convenience and pressure relief in proper parts of the system. Releasing gas rather than liquid into the atmosphere is less harmful. Gas provides more pressure than does liquid in the same amount of space.

Subp. 6. Provides direction for hydrostatic relief. Refers to another part for specific requirements.

Part 5230.5660 SETTING OF PRESSURE RELIEF DEVICES

Subp. 1. Requires that pressure relief devices begin to function at a preset pressure. This subpart is needed to assure that properly designed and installed pressure relief devices act to safeguard the affected parts of the ammonia system from rupture and bursting caused by abnormal conditions. This subpart is reasonable because such bursting would lead to spillage of ammonia refrigerant.

Subp. 2. Requires that a pressure relief valve for refrigerant-containing components be set and sealed by the manufacturer. This subpart ensures that markings on the device conform to “American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Division 1 standards.

This subpart is necessary to ensure a relatively safe operating environment for the ammonia refrigerating system by providing information about the safety devices forming part of the ammonia system. The subpart requires the manufacturer to mark the device that supplies minimum data to the installer. The data gives direction to the installer for safe installation; the owner for safe use of the equipment; and service personnel for safe and expeditious repair of the equipment.

This subpart is reasonable to require that the manufacturer, as a highly informed party, provides settings consistent with national standards, rather than installers and users using settings that might cause a safety hazard.

Part 5230.5665 PRESSURE VESSEL PROTECTION

Subp. 1. Provides for pressure vessel protection. The language is derived from the national standard for ammonia that is the most current and which represents the state of the art in the ammonia industry: AMERICAN NATIONAL STANDARD FOR EQUIPMENT DESIGN AND INSTALLATION OF AMMONIA MECHANICAL REFRIGERATION SYSTEMS ANSI/IllAR 2-1984. These standards require that the pressure vessel be provided with pressure relief protection, in accordance with applicable portions of ASME BOILER AND PRESSURE VESSEL CODE, VIII.
Properly designed and installed pressure relief devices act to safeguard the affected parts of the ammonia system from rupture and bursting caused by abnormal conditions. Such bursting would lead to spillage of ammonia refrigerant.

Subp. 2, Provides direction for installation of relief devices on pressure vessels of less than ten cubic feet, and requires that such a relief devices be of a predetermined capacity to assure adequate relieving capacity.

Subp. 3, Provides direction for installation of relief devices on pressure vessels of more than ten cubic feet, and requires that such a relief devices be of a predetermined capacity to assure adequate relieving capacity.

Subparts 2 and 3 are necessary and reasonable to provide different standards for two different sizes of pressure vessels.

Subp. 4, Provides direction for an alternate method of providing needed pressure-relief protection; prohibits use of rupture-member type relief device for this service. It is necessary and reasonable to allow a single relief valve to provide an alternative that otherwise would be restricted under subparts 3 and 5.

Subp. 5, Provides direction for the use of relief devices in parallel, in order to match the required capacity; provides that such an arrangement is considered to be one pressure relief device. It is necessary and reasonable to provide clarification in this part. For vessels in parallel and that require pressure relief, each parallel run will require two or more pressure relief devices. Pressure relief devices at parallel placements must be considered one pressure relief device. It is reasonable to provide protection for parallel structures, as protection on one parallel run would not necessarily provide protection for the other parallel run of the system.

Subp. 6, Allows an evaporator to be shut off from other parts of the system. Because the evaporator can be separated from the system, it still requires pressure relief protection, but the requirement for a second parallel pressure relief value does not apply. Shutting off the evaporator from other parts of the system removes the evaporator from the system. The subpart is necessary and reasonable because the evaporator is isolated from the remainder of the system, and provides adequate pressure relief protection.

Subp. 7, Provides a formula used to calculate the required discharge capacity for the relief device, in order to determine the relief device sizing. The subpart is necessary and reasonable to assure adequate discharge. Ammonia discharge requirements vary from other types of high pressure piping discharge requirements. Therefore, providing an appropriate formula restricts using other formulas.

Subp. 8, Provides a basis for estimated rated discharge capacity and sets size requirements for pipe and fittings between the pressure relief valve and the parts of the system that are protected.
Subp. 9, Requires that the discharge from the ammonia pressure relief device must terminate outside the building in a safe, approved location to avoid accidental release in an occupied area.

Subp. 10, Provides that under certain circumstances pressure relief devices may discharge into a properly protected low side; provides direction for compliance.

Subp. 11, Sets standards for manifolding; provides an alternative method for the design of pressure relief discharge piping; requires minimum size.

Subparts 8 through 11 are necessary and reasonable to assure there is no public exposure to ammonia discharge.

Subp. 12, Provides a formula for determining the maximum length of piping which may be attached to a pressure relief device outlet for discharge to a safe location. This subpart if necessary and reasonable to assure accuracy in making this determination.

Subp. 13, Provides a chart using various discharge capacities for determining the maximum length of piping which may be attached to a pressure relief device outlet for discharge to a safe location. This subpart if necessary and reasonable to assure accuracy in making this determination.

Part 5230.5675 TESTING
This part provides for testing of all ammonia components used in the system. This part is needed because testing is required to assure the integrity of the system particularly for welded components. This part is reasonable because documentation may be required by the administrative authority to provide a record of the actual testing, since representatives of the administrative authority would not be at the manufacturer's worksite.

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

Subp. 1, Describes the specific type of equipment that this part regulates; provides direction regarding types of materials suitable for ammonia service; prohibits certain materials for ammonia service. This subpart is necessary and reasonable to delineate clearly the materials that are suitable for ammonia service and will not deteriorate under normal operating conditions.

Subp. 2, 3, 4, 5, 6, Provides direction for usage of other materials acceptable for ammonia service. These subparts are necessary and reasonable to: identify which materials may not be used ammonia service; allow other materials that are acceptable for use; and prohibit use of materials that cannot be used safely for ammonia service.

Properly designed and installed piping systems are necessary for the safe containment of the ammonia refrigerant and for use of ammonia refrigerant. Separate subparts appear for liquid lines and vapor lines, since there are differences in pressures between the two states of ammonia.

Part 5230.5690 ULTIMATE STRENGTH REQUIREMENT
This part requires all pressure-containing components of the system to be listed by a nationally recognized testing laboratory or be designed, constructed and assembled to have an ultimate strength equal to three times the design pressure of the intended system.

This part is needed and reasonable to assure minimum manufacturing standards and to provide for documentation of compliance with the standards for pressure-containing components.

Part 5230.5700 BUILDING STRUCTURE AND MACHINE ROOM DESIGN

The requirements of this part provide for safety in the design and construction of the machine room housing the ammonia equipment. Also included in this part are safety features for installation of the ammonia equipment within the room. Subparts 1 through 15 are necessary and reasonable to assure that the site is safe for the equipment and for the safety of those who may have to be in the machine room.

Subp. 1, Requires the minimum clearances provided to allow repair and maintenance personnel sufficient space around the equipment to perform the tasks needed to keep the ammonia system in a safe and efficient condition.

Subp. 2, Provides requirements for safe access to ammonia equipment located on the roofs of buildings; provides direction to persons designing such access; provides for roof access to allow repair and maintenance personnel to carry tools and parts to the equipment located on the roof.

Subp. 3, Requires the roof access opening to be a minimum distance from the edge of the roof or similar hazards unless a rail or guard is provided. The requirement is necessary and reasonable to protect employees entering or exiting the area.

Subp. 4, Requires ammonia equipment to have an accessible electrical disconnect; requires that the ammonia equipment have a 110-volt convenience outlet for workers' tools and equipment; provides for electrical disconnect to allow workers to safely shut-off the equipment before service and maintenance. The provision for electrical outlet is necessary and reasonable to allow the use of electrical tools without potentially dangerous field-expedient wiring.

Subp. 5, Provides that ammonia equipment be installed so that vibrations from the equipment will not damage the building or equipment adjacent to the building. Furthermore, the subpart prevents the system from being damaged by unnecessary vibration.

Subp. 6, Requires manual shut-off valves and sets standards for location, accessibility and identification. This part provides for shut-off valves to allow workers the ability to shut off the equipment safely before service and maintenance, isolating the ammonia-containing parts of the system.

Subp. 7, Requires that piping not be located above electrical equipment, with a specific requirement to prevent water from dripping onto the electrical equipment.
Subp. 8, Provides direction for the strength of the building and structure to support ammonia equipment.

Subp. 9, Provides direction for the strength of the foundations to support ammonia equipment.

Subp. 10, Provides for the strength of the roof to support related ammonia equipment.

Subp. 11 and 12, Requires that adequate drains be provided for safe and sanitary disposal of waste water. The requirement for sanitary disposal is consistent with plumbing regulations. It is necessary and reasonable that, in the event of a leak, the water that may contain ammonia is safely disposed to assure safe removal from the work area.

Subp. 13, Provides requirements for the means of egress. In the event of a leak or a spill, safe and timely evacuation of the machinery room is a necessity. The doors also provide access to emergency responders, hazardous material response teams and/or repair personnel.

Subp. 14, Requires that a means be provided for removal of ammonia equipment, so the integrity of the structure is not compromised during repair or replacement. It provides for removal of heavy equipment and reduces chances of personnel being injured during removal and replacement.

Subp. 15, Requires a separate location for the ammonia machinery room. Because ammonia is a hazardous inhalant, it is reasonable to require a machinery room location separate from places where people might congregate.

Part 5230.5705 OPEN FLAMES
This part prohibits open flames or the apparatus to produce such a flame. It provides exceptions for portable sources of ignition. These restrictions are necessary and reasonable to reduce ignition sources, which can come in contact with the flammable ammonia refrigerant.

Part 5230.5710 VENTILATION FOR MACHINERY ROOMS

Subp. 1, Establishes that part 5230.5710 refers to ventilation standards that govern protection of the environment; this part does not cover human occupancy standards.

Subp. 2, Provides that the temperature rise shall be limited to a maximum value stated. This subpart is necessary and reasonable to control the maximum temperature value, which reduces equipment failure and lengthens the life of electrical controls and interlocks, enhancing the ability of safety and operating controls to operate properly.
Subp. 3. Provides direction for machinery room ventilation by offering alternative methods to meet ventilation requirements; provides for machinery room ventilation and requires an alarm; provides for manual controls of a specified type. This subpart is necessary and reasonable to assure: required ventilation; alarming in case of failure of mechanical ventilation; and alarming when vapor approaches the lower explosive limit.

Subp. 4. Requires that ducts which serve the machinery room serve no other area or purpose in the building and be dedicated to the ammonia system.

Subp. 5. Provides a requirement for a minimum quantity of natural ventilation and openings into the machinery room, based on the quantity of ammonia refrigerant in the system. Requirements are listed in tabular form in subpart 9.

Subparts 5 and 9 are necessary and reasonable to provide standards for proper ventilation.

Subp. 6. Provides direction for location of a ventilation air inlet and outlet.

Subp. 7. Provides direction for air discharge outside of the building. This subpart is necessary and reasonable to assure proper dispersion.

Subp. 8. Provides direction for use of water wash of exhaust from the ammonia machinery room. This subpart is necessary and reasonable for those limited circumstances when atmospheric dispersion is impractical or unsafe.

Subp. 9. Sets standards for the quantity of natural ventilation and openings into the machinery room based on the quantity of ammonia refrigerant in the system. Requirements are listed in tabular form.

Part 5230.5820 ELECTRICAL STANDARDS FOR AMMONIA INSTALLATIONS

Subp. 1. Requires that the electrical system comply with the applicable safety standards and State Electrical Code (M.S. 326.241 to 326.248).

Subp. 2. Requires that a heavy-wall, galvanized conduit be used for electrical installation.

Subparts 1 and 2 are necessary and reasonable to set a consistent standard for electrical wiring, because it is flammable.

Subp. 3. Sets a minimum safe level of lighting needed in the machinery room for service and maintenance; provides direction for location of an electrical disconnect switch for refrigeration equipment; requires that an electrical outlet be installed for safe use of equipment needed to service, repair and maintain the ammonia system.
The requirement for adequate lighting is necessary and reasonable to provide
workers with sufficient lighting to accomplish the service and maintenance of the
ammonia system efficiently. Provides for electrical disconnect to allow workers
ability to safely shut-off the equipment before service and maintenance. Provides
for electrical outlet to use electrical tools without the use of potentially
dangerous field-expedient wiring.

Part 5230.5825 INSULATION

Subp. 1, Requires that piping which can become cold enough to develop
condensation dripping be insulated to prevent such condensation.

Subp. 2, Requires that surfaces adjacent to piping, such as suction lines,
accumulators and surge drums, be insulated to prevent condensation.

Subparts 1 and 2 are necessary and reasonable because condensation not controlled
by insulation has the potential to damage equipment and create hazard for
personnel by creating slippery conditions on floors and walkways.

Subp. 3, Requires that piping which can become hot be insulated. This subpart
is necessary and reasonable to prevent burns and other injuries to personnel.

Part 5230.5915 PIPING JOINTS

Subp. 1, 2, 3, Provides direction regarding types of material suitable for
ammonia service; provides the minimum standards for such material and piping
joints, threaded pipe, welded pipe, flanges for ammonia service, ammonia gaskets
and unions for ammonia service. Subparts 1 through 3 are necessary and
reasonable to set very specific standards for piping joints to prevent failures.
Properly designed and installed piping systems are necessary for the safe
containment of the ammonia refrigerant.

Subp. 4, Restricts the pressure allowed for pipe, fittings and components to a
percentage of the component design working pressure. This subpart is necessary
and reasonable to prevent components from operating at design pressure, because
the system should routinely operate below that temperature to provide a safety
margin.

Subp. 5, Requires that the assembly of ammonia components must comply with these
rules. This subpart is necessary and reasonable to clarify whether work is done
as pre-fabrication in a shop or onsite as field erection. The completed work,
in either case, must be done consistent with requirements of these rules.
Part 5230.5925 WELDING

Subp. 1, Requires that welders be certified under job procedure; places responsibility of performance and testing on the employer. This subpart is necessary because improper welding is one of the most significant causes of accidents involving ammonia systems. Ammonia refrigeration systems are composed of pipe with many welded joints. Welding is a highly skilled, labor-intensive method of joining piping that requires detailed regulations and specifications necessary to control the workmanship and inherent safety of the ammonia refrigeration system.

Subp. 2, Scope indicates that part 5230.5925 applies to the installation and repair of ammonia piping systems and component parts, such as pipe, hangers, braces and supports.

Subparts 3 through 19 are needed to clarify requirements for welding certification, procedures and qualifications, and for destructive and nondestructive testing of test weldments. These subparts are reasonable because most high pressure piping consists of welded pipe and components. Proper documentation is required to assure quality of the welding.

Subp. 3, Describes the minimum standards required by welders to weld ammonia systems and provides direction to designers and installers of ammonia equipment described, using the procedures as listed.

Subp. 4, Provides direction for the applicability of the welding standards in the ammonia system.

Subp. 5, Provides a uniform expiration date for welding certifications and direction for recertification.

Subp. 6, Requires that welders on projects for ammonia piping systems must submit welding procedure specification and procedure qualification records, and a permit application for approval before the beginning of project.

Subp. 7, Prohibits welding on ammonia piping systems without welding procedures specification and welding procedures qualification in place.

Subp. 8, Requires that welding of an ammonia piping system's components meet the requirements of the welding procedures specification and procedure qualification record.

Subp. 9, Requires that a certified welding procedure for each project be a welding procedure specification supported by the procedure qualification record.

Subp. 10, Requires that the administrative authority objectively evaluate the welding procedure specification and procedure qualification.

Subp. 11, Requires that welders of a certain project be certified according to the certified welding procedure for that project.
Subp. 12, Requires mandatory documents for the welding procedure specification, 
welding procedure qualification, and procedure qualification record to be 
available at the worksite.

Subp. 13, Requires that the welds for the ammonia system be identifiable, and 
provides direction and recommendations for meeting this requirement and direction 
in providing documentation of the individual welder qualification; provides a 
method to use to for such qualification; provides alternatives for a program that 
measures individual qualification for each project; and a method of non-
destructive testing to assure quality control and quality assurance; and 
requirements for repair welding.

Subp. 14, Requires that a welder certified for a project be assigned an 
identification number unique to that welder; requires that welds be stamped or 
marked; requires the use of a welding log.

Subp. 15, Requires the contractor to establish and maintain the necessary 
documents contained in the above subparts: welding procedure specification; 
welding procedure qualification; procedure qualification record; identification 
number of the welder; and welding log.

Subp. 16, Requires a guide bend test to be used when certifying the welding 
procedure specification and welder qualification of a gas metal arc welding or 
a submerged arc welding.

Subp. 17, Allows the administrative authority to perform nondestructive testing, 
including radiography for inspections of the welding of ammonia piping systems, 
at the expense of the installing contractor.

Subp. 18, Provides that repair welds meet the requirements of this part.

Part 5230.5930 STOP VALVES
This part sets requirements for manual shut-off valves used to service ammonia 
equipment.

Subp. 1, Requires that stop valves for stopping flow of refrigerant for service 
be located at the inlet and outlet of each component of the system, including 
compressor, condenser, receiver, evaporator, vessels, pumps and other items. 
This subpart is necessary and reasonable for safe and proper operation of the 
system.

Subp. 2, Sets requirements for the design of manual valves; provides direction 
regarding types of materials suitable for ammonia service; prohibits certain 
materials for ammonia service. This subpart is necessary and reasonable to 
assure that valves used do not create unsafe conditions, as restrictions are 
placed on quick-closing valves that would create pressure spikes (pressure 
change).
Subp. 3, Requires that a sufficient number of stop valves be installed. This
subpart is necessary and reasonable to locate valves properly to allow equipment
to be isolated for routine service and maintenance. Valves are also used by
emergency responders, hazardous material response teams and/or repair personnel
to isolate the system during leaks, spills and emergencies.

Part 5230.5935 MISCELLANEOUS MATERIALS

Subp. 1, Scope establishes that part 5230.5935 will address standards for
miscellaneous materials.

Subp. 2, Sets standards for pressure gauge lines.

Subp. 3, Sets standards for factory-installed accessories.

Subparts 2 and 3 are necessary and reasonable, as compression-type fittings with
a 2,000-pound-per-square-inch rating are accepted as this type of fitting and
will withstand most operating conditions. Engineering equivalencies are
accepted, with the certification of a registered professional engineer, to allow
for other types of materials or newer technologies. The sign-off by the
registered professional engineer is to assure that adequate documentation of the
equivalency is developed.

Part 5230.5940 PIPING HANGERS AND SUPPORTS

Subp. 1, Specifies the function of piping hangers and supports. This subpart is
necessary and reasonable because proper hangers and supports are essential to an
ammonia refrigeration system to provide protection for the system from pressure
spikes (pressure changes), which can damage the piping system and create the
possibility of a leak or rupture.

Subp. 2, Provides in tabular form criteria for the supporting systems for ammonia
piping and equipment. This subpart is necessary and reasonable to provide
direction for supporting high pressure piping.

Part 5230.5945 PRESSURE RELIEF PROTECTION

Subp. 1, Requires pressure relief protection as a part of the ammonia
refrigeration system. This subpart is necessary and reasonable, as properly
designed and installed pressure-relief devices act to safeguard the affected
parts of the ammonia system from rupture and bursting caused by abnormal
conditions. Such bursting would lead to spillage of ammonia refrigerant.

Subparts 2 through 6 are necessary and reasonable, in conjunction with parts
5230.5655, 5230.5660 and 5230.5665, to protect from over-pressurization.

Subp. 2, Provides that part of the criteria for the provision of pressure-relief
protection should include the requirements for pressure-relief devices and the
requirements for equipment.

Subp. 3, Sets requirements to prevent recirculation of ammonia.
Subp. 4. Requires that a shut-off valve not be installed in the relief piping between the device and atmosphere.

Subp. 5. Requires that termination of the discharge piping be accomplished in a manner which does not endanger either personnel on the site or emergency responders coming to the site.

Subp. 6. Provides a method of providing multiple relief devices discharging into a common manifold piping system to a safe location.

Part 5230.5950 INSTALLATION REQUIREMENTS

Subp. 1. Requires that foundations and supports for condensing units or pressure units be of substantial and noncombustible construction. This subpart is necessary and reasonable to assure protection of the system.

Subp. 2. Provides, and is necessary and reasonable, for protection of personnel from moving machinery parts to reduce injury during maintenance and service of the equipment.

Subp. 3, 4. Requires that condensing units or compressor units with enclosures be readily accessible for servicing and inspection. These subparts are necessary and reasonable because the clearances provided allow repair and maintenance personnel sufficient space around the equipment to perform the tasks needed to keep the ammonia system in a safe and efficient condition.

Subp. 5. Requires that water supply and discharge connections be made according to safety and health standards of the Minnesota Plumbing Code (M.S. 326.27 to 326.45) and requirements of the Minnesota Pollution Control Agency (M.S. Chapter 116). This subpart is necessary and reasonable to protect the water supply from contamination and allow the sanitary disposal of the discharge. It is necessary that in the event of a leak, any water that contains ammonia is safely disposed.

Subp. 6. Sets requirements for water discharge lines; requires that these lines not connect directly to the waste or sewer system. This subpart is necessary and reasonable because the requirement for sanitary disposal is consistent with other public health regulations. It is important that in the event of a leak, any water that contains ammonia is safely disposed.

Subp. 7. Requires that adequate lighting be provided for workers. This subpart is needed and reasonable to provide workers with sufficient lighting to accomplish service and maintenance of the ammonia system safely and efficiently.

Subp. 8. Provides that the electrical portions of the ammonia system comply with the applicable portions of the State Electrical Code (M.S. 326.241 to 326.248). This subpart is necessary and reasonable to set a specific standard for electrical equipment and wiring.

Subp. 9. Requires that air ducts are installed to comply with approved standards for installation. This subpart is necessary to guide the designer when duct work must pass through a class T machinery room. This subpart is reasonable to ensure integrity of a class T machinery room.
Subp. 10, Provides requirements that act as a criteria for the installation of piping that must pass through ductwork; requires that such piping and materials withstand a minimum temperature without leakage. This subpart is necessary and reasonable to assure there is no migration of refrigerant into occupied spaces.

Subp. 11, Requires that piping erected on a premise be visible for inspection before being covered or enclosed. This subpart is necessary and reasonable to assure proper safety inspection.

Part 5230.5960 FOUNDATIONS AND EQUIPMENT

Subp. 1, Requires that supports and foundations be adequate to prevent vibration and movement of equipment.

Subp. 2, Requires that supports conform to the manufacturer's recommendations.

Subparts 1 and 2 are necessary and reasonable to assure the system is protected from vibration and movement.

Part 5230.6100 SYSTEM TESTING

Subp. 1, Requires that a contracting pipefitter be responsible for system tightness and for system testing to assure tightness. The requirement is necessary to assure proper, safe operation of the installed system. This subpart is necessary and reasonable because properly designed and installed piping systems are necessary for the safe containment of the ammonia refrigerant and for the efficient utilization of the ammonia refrigerant. Detailed regulations and specifications are reasonable to control the quality of installation and ultimately, the inherent safety of the ammonia refrigeration system.

Subp. 2, Requires that a testing program for ammonia refrigeration systems be designed, using requirements provided in subparts 3 to 5; requires that parts of the testing be done sequentially. This subpart is necessary and reasonable to assure system tightness and reliability, and to prevent loss of the refrigerant.

Subp. 3, Requires that tests be performed to assure system tightness. This requirement is necessary and reasonable to prevent loss of the refrigerant and assure reliability.

Subp. 4, Prohibits using combustible gases, carbon dioxide or halogen materials as a testing gas in the ammonia piping system. Requires that only dry nitrogen or air be used for system testing; provides a detailed list of precautions to be used during the testing procedure.

Subp. 5, Requires a test of introducing ammonia into the system for pressure testing; provides measures to reduce hazards while the system is in operation; requires that all costs of tests be borne by the installing contractor. This is necessary and reasonable to clarify who is responsible for covering testing costs.
Subparts 4 and 5 are necessary and reasonable to assure the integrity of the system, and that there be no danger of explosion or introduction of hazardous materials into the atmosphere. The subparts also identify a method of changing the system and correcting leaks.

Subp. 6, Provides for witnessing of tests by high pressure piping inspectors. Witnessing of testing is needed when the administrative authority requires additional assurance regarding the integrity of the system. It is reasonable to assure the additional documentation of observation by a third party, independent inspector. It is also reasonable for the administrative authority to waive witnessing when no significant safety concern is involved in the testing.

Part 5230.6110 SIGNS

Subp. 1, Requires that an ammonia piping system have a sign attached to the piping; requires identification of the installer, test pressures sustained by the system, and the number pounds of ammonia in the system. Signs are necessary to provide emergency responders and hazardous material response teams with basic information in the event of an emergency or spill.

Subp. 2, Requires that signs identifying ammonia piping and equipment display a list of specified components of the equipment; provides requirements for labeling high pressure and low pressure piping. Signs are necessary and reasonable to provide emergency responders and hazardous material response teams with basic information in the event of emergency or spill.

Subp. 3, Requires color identification of controls and pieces of equipment. The requirement is necessary to allow emergency responders to identify easily the controls needed to shut-down a system and/or shut-off ammonia in the event of an emergency or spill. The requirement is reasonable to provide for shut-off valves to allow workers to shut off the equipment safely before service and maintenance, which isolates the parts of the system that contain ammonia.

Part 5230.6115 REFRIGERANTS

Subp. 1, Establishes warning requirements when charging and/or discharging refrigerants in the ammonia refrigerant system; prohibits leaving a service container connected to a system while charging or withdrawing a refrigerant; prohibits heating ammonia cylinders. The subpart is necessary and reasonable to provide direction to personnel during the transfer of ammonia refrigerant in and out of the system. Compliance with the cautionary requirements will reduce the leakage and/or spillage of ammonia during the transfer operation.

Subp. 2, Requires that refrigerants withdrawn from refrigerating systems be transferred only to approved containers.

Subp. 3, Requires that containers used for refrigerants withdrawn from a refrigerating system not be filled more than the rated capacity weight for the containers and the type of refrigerant used.

Subparts 2 and 3 are necessary and reasonable to assure the refrigerant is not contaminated and there is no loss of refrigerant.
Subp. 4. Provides for a maximum amount of refrigerant to be stored in the machinery room. It is necessary to reduce the amount of ammonia, which potentially could be involved in an emergency or a spill. It is reasonable to reduce the exposure for emergency responders and hazardous material response teams and/or repair persons who would be called upon to deal with the emergency.

Part 5230.6120 MASKS OR HELMETS

Subp. 1. Requires that two masks or helmets to be used by personnel, be located adjacent to each machinery room. The requirement is necessary to protect personnel when responding to ammonia system spills, leaks or emergencies during the transfer of ammonia. This subpart is reasonable to reduce the hazards involved in the maintenance, repair and service of the ammonia system, and reduces the hazards involved in transferring and charging the ammonia refrigerant. It also provides personnel with a minimum level of personal protective equipment necessary to deal with ammonia spills, leaks and or emergencies.

Subp. 2. Requires that only complete helmets or masks suitable for ammonia be used. This subpart is necessary and reasonable to assure that proper equipment is used.

Subp. 3. Requires that canisters or cartridges of helmets or masks be renewed or replaced immediately after being used or having the seals broken; provides a requirement for renewal of canisters that have expired dates. The regulations are necessary and reasonable to assure that helmets or masks remain protective at all times.

Subp. 4. Sets standards for masks and helmets. The requirement is necessary and reasonable for eye and face protection.

Part 5230.6125 MAINTENANCE AND OPERATION

Subp. 1. Requires the user of an ammonia refrigerating system to keep it clean and accessible. This subpart is necessary and reasonable to reduce public exposure to the refrigerant and keep the system operating most efficiently.

Subp. 2. Requires that an ammonia piping system containing more than 50 pounds have a sign placed near the ammonia compressor that gives directions for how to operate the system. The sign is necessary and reasonable to aid emergency responders and hazardous-material response teams who may have to shut down the system or shut off the ammonia.

In addition to directions, the sign must include information on how to contact the nearest municipal or state authority with jurisdiction, in the event of an emergency or spill. This is necessary to provide a minimum level of aid to emergency responders, hazardous-material response teams or repair personnel to handle leaks, spills or emergencies. It is reasonable to provide the information needed to shut off ammonia or shut down the system.

Part 5230.6130 DECLARATION OF TEST
This part requires an official declaration of testing to be completed for all ammonia piping systems. It must be signed by a licensed contractor. An inspector, if present, should also sign it. Testing and documentation is necessary to verify quality of installation.

Part 5230.6200 AMMONIA HANDLING AND STORAGE

Subp. 1, This part summarizes types of containers currently available for storage and shipment of ammonia; describes applicable regulations for such containers; requires openings for charging ammonia into the system in a safe and efficient manner. Properly designed and installed piping systems are necessary and reasonable for the safe containment of ammonia refrigerant.

Subp. 2, Specifies requirements for pipes used as unloading lines from larger tanks and containers. This subpart is necessary and reasonable because such piping must conform to requirements for liquid lines.

Subp. 3, Requires a maximum storage capacity for ammonia storage tanks; provides a minimum pressure to be used to guide designers and installers of an ammonia storage system; describes standards used to construct a storage vessel. It is necessary and reasonable to assure that storage tanks are large enough and built to proper standards to hold the refrigerant.

Subp. 4, Requires that the ammonia storage capacity be filled to a specified percentage. The requirement is necessary to allow for expansion of ammonia. Prohibits the use of mercury-filled manometers for ammonia service. This subpart is necessary and reasonable to protect from mercury being released to the atmosphere in the case of an accident.

Also, the subpart requires that gauge glasses have excess flow valves. The requirement is necessary and reasonable to protect personnel in the event of breakage.

Subp. 5, Describes procedures to transfer ammonia safely; specifies material to be used for such transfer; requires continuous supervision during the transfer. This subpart is necessary and reasonable to assure that transferring of ammonia is done under safe conditions.

Subp. 6, Requires that two masks or helmets, to be used by personnel, be located adjacent to the unloading or charging operation. The requirement is reasonable to protect personnel when responding to ammonia system spills, leaks or emergencies during the transfer of ammonia. This subpart is necessary to reduce the hazards involved in the maintenance, repair and service of the ammonia system and reduces the hazards involved in transferring and charging the ammonia refrigerant. It also provides personnel with a minimum level of personal protective equipment necessary to deal with ammonia spills, leaks and or emergencies.
DEPARTMENT OF LABOR AND INDUSTRY

APPENDIX
Reference Document
for
Rules Relating to Ammonia Refrigeration Systems

The references below will be abbreviated as follows throughout this document:

ANSI  =  American National Standards Institute (ANSI)/American Society of Heating, Refrigerating and Air Conditioning Engineers
ASHRAE = American Society of Heating, Refrigerating and Air Conditioning Engineers
IIAR  =  ANSI/International Institute of Ammonia Refrigeration (IIAR)
B 31.5 = Refrigeration Piping Manual
Section IX  =  American Society of Mechanical Engineers, Boiler and Pressure Vessel Code

5230.5020 DEFINITIONS.
   Subp. 1-74  ANSI/ASHRAE, Chapter 15.
               Minnesota Rules Chapter 1305

5230.5025 AMMONIA GOVERNED AND DEFINED.
   ANSI/IIAR; Chapter 2.

5230.5250 LOCATIONS GOVERNED AND DEFINED.
   Subp. 2-8  ANSI/ASHRAE, Chapter 3.

5230.5300 REFRIGERATING SYSTEM CLASSIFICATION BY TYPE.
   Subp. 1-5  ANSI/ASHRAE, Chapter 4.

5230.5350 RESTRICTIONS ON PLACEMENT OF AMMONIA PIPING, LIMITATIONS ON SYSTEM SIZING, AND PRESSURE RELIEF VENTING REQUIREMENTS.
   Subp. 9-16.  ANSI/ASHRAE, Chapter 6.3; and ANSI/IIAR, Chapter 4.

5230.5400 REQUIREMENTS FOR INDUSTRIAL OCCUPANCIES.

5230.5605 AIR COOLED CONDENSERS through 5230.5650 CONTROLS; ELECTRIC; PNEUMATIC.
   Subp. 1-2.  ANSI/IIAR, Chapter 2, Sect. 3.

5230.5655 PRESSURE RELIEF DEVICES; 5230.5660 SETTING OF PRESSURE RELIEF DEVICES; and 5230.5665 PRESSURE VESSEL PROTECTION.

5230.5665 PRESSURE VESSEL PROTECTION.
   Subp. 13.  ANSI/IIAR, Sect. 3.11.4.13.,
5230.5675 TESTING.
   ANSI/IIAR, Chapter 2, Sect. 5.6.

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

5230.5690 ULTIMATE STRENGTH REQUIREMENT.
   ANSI/IIAR, Chapter 2, Sect. 3.

5230.5700 BUILDING STRUCTURE AND MACHINE ROOM DESIGN.

5230.5705 OPEN FLAMES.
   ANSI/ASHRAE, Chapter 6.2.3.

5230.5710 VENTILATION FOR MACHINERY ROOMS.
   Subp. 1-9. ANSI/ASHRAE, Chapter 7.4; and ANSI/IIAR, Chapter 2, Sect. 4.3.

5230.5915 PIPING JOINTS.
   Subp. 1-5. ANSI/IIAR, Chapter 2, Sect. 5.2; and B31.5.

5230.5925 WELDING.

5230.5930 STOP VALVES.
   Subp. 1-3. ANSI/ASHRAE, Chapter 8.6.5; and B31.5.

5230.5940 PIPING HANGERS AND SUPPORTS; and 5230.5945 PRESSURE RELIEF PROTECTION.
   ANSI/IIAR, Chapter 2, Sect. 5.3.

5230.5950 INSTALLATION REQUIREMENTS; 5230.5960 FOUNDATIONS AND EQUIPMENT; and
5230.6100 SYSTEM TESTING.
   Subp. 1-11. ANSI/IIAR, Chapter 2, Sect. 5.5.

5230.6110 SIGNS; 5230.6115 REFRIGERANTS; and 5230.6120 MASKS OR HELMETS.
   through Subp. 3. ANSI/ASHRAE, Chapter 13.

5230.6120 MASKS OR HELMETS.
   Subp. 4. ANSI/ASHRAE, Chapter 14.

5230.6125 MAINTENANCE AND OPERATION.

5230.6130 DECLARATION OF TEST.
   ANSI/ASHRAE, Chapter 12.3.

5230.6200 AMMONIA HANDLING AND STORAGE.
   Subp. 1. ANSI/ASHRAE, Chapter 13.5.

5230.6200 AMMONIA HANDLING AND STORAGE.
   Subp. 2-6. ANSI/IIAR, Chapter 2, Sect. 5.7.