Chapter Comm 45

MECHANICAL REFRIGERATION

Note: Chapter Ind 45 as it existed on September 30, 1983 was repealed and a new chapter ILHR 45 was created effective October 1, 1983; chapter ILHR 45 as it existed on August 31, 1994 was repealed and a new chapter ILHR 45 was created effective September 1, 1994. Chapter ILHR 45 was renumbered to be chapter Comm 45 under s. 13.93 (2m) (b) 1., Stats., and corrections made under s. 13.93 (2m) (b) 6. and 7., Stats., Register, October, 1996, No. 490.

Comm 45.01 Purpose. Pursuant to ss. 101.17 and 101.177, Stats., the purpose of this chapter is to specify minimum safety standards for the design, construction, installation, operation and inspection of mechanical refrigerating systems installed in public buildings and places of employment, and for preventing the release of ozone–depleting refrigerants to the atmosphere.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.02 Scope. This chapter establishes safeguards for life, limb, health and property.

Note: Most of the requirements of this chapter are taken from the American Society of Heating, Refrigerating and Air–Conditioning Engineers (ASHRAE) standard ASHRAE 15—Safety Code for Mechanical Refrigeration.

Note: Chapter Comm 5 contains requirements pertaining to the registration of persons engaged in the business of servicing refrigeration equipment or selling ozone depleting refrigerant and persons installing and servicing refrigeration equipment which may release an ozone–depleting refrigerant.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.03 Application. (1) SYSTEMS COVERED. After September 1, 1994, this chapter applies to:

(a) The installation of mechanical refrigerating systems and heat pumps;

(b) Parts or components added or a change to a refrigerant of a different number designation; and

(c) Parts or components replaced only if they are not identical in function.

(2) SYSTEMS NOT COVERED. This chapter does not apply to the use of water or air as the primary refrigerant.

(3) LISTED EQUIPMENT. Equipment listed by an approved nationally recognized testing laboratory is deemed to meet the design, manufacture and factory test requirements of this chapter for the refrigerants for which the equipment was designed. Listed refrigerating systems are not required to be field tested to comply with s. Comm 45.21.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.05 Definitions. In this chapter:

(1) "Alarm" means a device so arranged that upon any malfunction in the system an audible and visual trouble signal will be actuated instantly.

(2) "Approved" means acceptable to the department.

(3) "Approved nationally recognized testing laboratory" means one acceptable to the department, which provides uniform testing and examination procedures and standards for meeting design, manufacturing and factory test requirements of this chapter; is organized, equipped and qualified for testing; and has a follow–up inspection service of the current production of the listed products.

(4) "ASME" means the American Society of Mechanical Engineers.

(5) "Blends" means refrigerants consisting of mixtures of 2 or more different chemical compounds which are often used individually as refrigerants for other applications.

(6) "Brazed joint" means a gas–tight joint formed by joining metal parts with alloys that melt at temperatures higher than 800ºF., but less than the melting temperatures of the joined parts.

(7) "Companion or block valves" means pairs of mating stop valves that allow sections of a system to be joined before opening these valves or separated after closing them.

(8) "Compressor" means a machine used to compress refrigerant vapor.

(9) "Compressor unit" means a compressor with its prime mover and accessories.

(10) "Condenser" means that part of the refrigerating system where refrigerant is liquefied by removal of heat.

(11) "Condenser coil" means a condenser constructed of pipe or tubing, not enclosed in a pressure vessel.

(12) "Condensing unit" means a combination of one or more power–driven compressors, condensers, liquid receivers, and the regularly furnished accessories.

(13) "Container" means a cylinder for the transportation of refrigerant.

Note: The department will accept containers meeting U.S. department of transportation regulations.

(14) "Corridor" means an enclosed passageway which limits travel to a single path.

(15) "Department" means the department of commerce.

(16) "Design pressure" means the maximum pressure for which a specific part of a refrigerating system is designed.

(17) "Dual pressure–relief device" means 2 pressure–relief devices, mounted on a three–way valve which allows one device to remain active while the other is isolated.

(18) "Duct" means a tube or conduit used to convey or encase as follows:

(a) "Air duct" means a tube or conduit used to convey air. Air passages in self–contained systems are not air ducts.

(b) "Pipe duct" means a tube or conduit used to encase pipe or tubing.

(19) "Evaporator" means that part of the refrigerating system designed to vaporize liquid refrigerant to produce refrigeration.

(20) "Evaporator coil" means an evaporator constructed of pipe or tubing, not enclosed in a pressure vessel.

(21) "Fusible plug" means a plug containing an alloy that will melt, at a specified temperature, and relieve pressure.

(22) "Header" means a chamber to which other pipes or tubes are connected so that fluids may pass freely between the pipes or tubes.

(23) "Heat pump" means a refrigerating system used to transfer heat into a space or substance.

(24) "Highside" means those portions of the refrigerating system that are subject to approximate condensing pressure.

(25) "IDLH" or "Immediately Dangerous to Life or Health" means the maximum concentration from which a person with no mechanical breathing assistance is able to escape within 30 minutes without escape–impairing symptoms or irreversible health effects.

(26) "Inside dimension" means inside diameter, width, height, or cross–sectional diagonal.

(27) "Internal gross volume" means the volume as determined from internal dimensions of the container with no allowance for the volume of internal parts.

(28) "LFL" or "Lower flammable limit" means the minimum concentration of the refrigerant that propagates a flame through a homogeneous mixture of refrigerant and air.

(29) "Limited–charge cascade system" means a system in which, with the compressor idle, the design pressure will not be exceeded when the refrigerant charge has completely evaporated.

(30) "Liquid receiver" means a vessel, permanently connected to a refrigerating system by inlet and outlet pipes, for storage of liquid refrigerant.

(31) "Listed" means included in a list published by an approved nationally recognized testing laboratory, inspection agency, or other organization concerned with product evaluation that periodically inspects listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.

(32) "Lobby" means a waiting room or large hallway serving as a waiting room.

(33) "Lowside" means the portion of a refrigerating system that is subjected to approximate evaporator pressure.

(34) "Machinery" means the refrigerating equipment forming a part of the refrigerating system, including the compressor, condenser, liquid receiver, evaporator, and connecting piping.

(35) "Machinery room" means a space, meeting the requirements of s. Comm 45.19 (12) or (13), that is designed to house refrigerating machinery and other related equipment.

(36) "Manufacturer" means the company or organization that evidences its responsibility by affixing its name, trademark or trade name to refrigerating equipment.

(37) "Means of egress" means a continuous and unobstructed path of travel from any point in a building or structure to a public way.

(38) "Mechanical joint" means a gas–tight joint obtained by joining metal parts with a positive–holding mechanical construction such as flanged, screwed or flared joints, or compression fittings.

(39) "Nonpositive displacement compressor" means a compressor in which the increase in vapor pressure is attained without changing the internal volume of the compression chamber.

(40) "Occupied space" means that portion of the premises normally frequented or occupied by people, excluding machinery rooms.

(41) "Ozone–depleting refrigerant" has the meaning given in s. 100.45 (1) (d), Stats.

Note: Section 100.45 (1) (d), Stats., defines "ozone–depleting refrigerant" to mean a substance used in refrigeration that is or contains a class I substance, as defined in 42 USC 7671 (3) or a Class II substance, as defined in 42 USC 7671 (4).

(42) "Piping" means the pipe or tube used to interconnect various parts of a refrigerating system. Piping includes pipe, flanges, bolting, gaskets, valves, fittings, the pressure–containing parts of other components such as expansion joints or strainers, and devices that serve such purposes as mixing, separating, muffling, snubbing, distributing, metering or controlling flow, pipe support, and structural attachment.

(43) "Positive displacement compressor" means a compressor in which the increase in pressure is attained by changing the internal volume of the compression chamber.

(44) "Premises" means a tract of land and the buildings thereon.

(45) "Pressure–imposing element" means any device or portion of the equipment used to increase refrigerant pressure.

(46) "Pressure–limiting device" means a pressure–responsive electronic or mechanical control designed to automatically stop the operation of the pressure–imposing element at a predetermined pressure.

(47) "Pressure–relief device" means a pressure–actuated valve or rupture member designed to automatically relieve excessive pressure.

(48) "Pressure–relief valve" means a pressure–actuated valve held closed by a spring or other means and designed to automatically relieve pressure in excess of its setting.

(49) "Pressure vessel" means any refrigerant–containing receptacle in a refrigerating system. "Pressure vessel" does not include evaporators where each separate section does not exceed 1/2 cubic foot of refrigerant–containing volume regardless of the maximum inside dimension, evaporator coils, compressors, condenser coils, controls, headers, pumps and piping.

(50) "Psia" means pounds per square inch absolute.

(51) "Psig" means pounds per square inch gauge.

(52) "Pumpdown charge" means the quantity of refrigerant stored at some point in the refrigerating system for operational, service or standby purposes.

(53) "Readily accessible" means capable of being reached safely and quickly for operation, repair and inspection without requiring those to whom ready access is required to climb over or remove obstacles or to resort to the use of portable access equipment.

(54) "Reclaim" means to reprocess refrigerant to new product specifications, by means which may include distillation, and requiring chemical analysis to determine appropriate product specifications and compliance with the Air–Conditioning and Refrigeration Institute (ARI) standard ARI 700.

(55) "Recover" means to remove refrigerant in any condition from a system and store it in an external container without necessarily testing or processing it in any way.

(56) "Recycle" means to reduce contaminants in used refrigerant by oil separation and single or multiple passes through devices which reduce moisture, acidity and particulate matter, such as replaceable core filter–driers.

(57) "Refrigerant" means the fluid used for heat transfer in a refrigerating system.

Note: The refrigerant absorbs heat and transfers it at a higher temperature and a higher pressure, usually with a change of state.

(58) "Refrigerating system" means a combination of interconnected parts forming a closed circuit in which refrigerant is circulated for the purpose of extracting, then rejecting, heat.

(59) "Refrigeration equipment" has the meaning given in s. 101.177 (1) (c), Stats.

Note: Section 101.177 (1) (c), Stats., defines "refrigeration equipment" to mean mechanical vapor compression refrigeration equipment except for a mobile air conditioner, as defined in s. 100.45 (1) (b), Stats., or trailer refrigeration equipment, as defined in s. 100.45 (1) (c), Stats.

(60) "Rupture member" means a device that will rupture at a predetermined pressure.

(61) "Saturation pressure" means the pressure at which vapor and liquid exist in equilibrium at a given temperature.

(62) "Sealed absorption system" means an absorption system in which all refrigerant–containing parts are made permanently tight by welding or brazing.

(63) "Secondary coolant" means any liquid used for the transmission of heat, without a change of state, and having no flash point or a flash point above 150ºF.

(64) "Self–contained system" means a complete, factory–assembled and tested system that is shipped in one or more sections and has no refrigerant–containing parts that are joined in the field by other than companion or block valves.

(65) "Set pressure" means the pressure at which a pressure–relief device or pressure control is set to operate.

(66) "Soldered joint" means a gas–tight joint formed by joining metal parts with alloys that melt at temperatures not exceeding 800ºF and above 400ºF.

(67) "Stop valve" means a device used to shut off the flow of refrigerant.

(68) "Three–way valve" means a service valve for dual pressure–relief devices that allows using one device while isolating the other from the system.

(69) "TLV–TWA" or "Threshold Limit Value–Time Weighted Average" means the refrigerant concentration in air to which nearly all persons may be repeatedly exposed during a normal 8–hour workday and a 40–hour workweek without adverse effect.

(70) "Transfer" means to exchange refrigerant between containers.

(71) "Ultimate strength" means the stress at which rupture occurs.

(72) "Welded joint" means a gas–tight joint, obtained by the joining of metal parts in the plastic or molten state.

(73) "Worst case composition of fractionation" means the composition, either as formulated or at a composition that occurs during fractionation, that for flammability results in the highest concentration of the flammable component in either the vapor or liquid phase and for toxicity results in the highest concentration of the toxic component in either the vapor or liquid phase.

(74) "Zeotropic" means blends comprising multiple components of different volatility that, when used in refrigeration cycles, change volumetric composition and saturation temperatures as they evaporate or condense at constant pressure.

Note: The word "zeotropic" is derived from the Greek words zein (to boil) and tropos (to change).

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.06 Incorporation of standards by reference. (1) CONSENT TO INCORPORATE. Pursuant to s. 227.21, Stats., the attorney general and the revisor of statutes have consented to the incorporation by reference of the following standards:

(a) American Society of Mechanical Engineers (ASME), 345 East 47th Street, New York, New York 10017; Refrigeration Piping, ASME B31.5–1992.

(b) American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, Pennsylvania 19103; Specification for Seamless Copper Water Tube, ASTM B88–93; and Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service, ASTM B280–93.

(c) Air–Conditioning and Refrigeration Institute (ARI), 4301 North Fairfax Drive, Arlington, Virginia 22203; Specifications for Fluorocarbon and Other Refrigerants, ARI Standard 700–93.

(2) ADOPTION OF STANDARDS. The standards specified in sub. (1) are hereby incorporated by reference into this chapter.

(3) INTERIM AMENDMENTS. Interim amendments of the adopted standards shall have no effect in the state until this section is correspondingly revised to reflect those changes.

Note: The standards may be obtained at a nominal cost by writing to the respective addresses.

Note: Copies of the adopted standards are on file in the offices of the department, the secretary of state and the revisor of statutes.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.07 Installation registration. (1) CLASSIFICATIONS. The installer shall register with the department the installation of new, used or additional mechanical refrigerating systems of the following classifications:

(a) Any system using a Group A1 or B1 refrigerant and having a capacity rated at or greater than 50 horsepower, 50 tons or 50,000 volt–amperes.

(b) Any system using a Group A2, B2, A3 or B3 refrigerant and having a capacity rated at or greater than 10 horsepower, 10 tons or 10,000 volt–amperes.

(2) FORMS. Registration information shall be submitted on form DILHR SB–34 obtainable from the department.

Note: Copies of form SB–34 may be obtained from the department at the Division of Safety and Buildings, Boiler Safety Section, P.O. Box 7969, Madison, Wisconsin 53707, telephone 608/266–1904.

(3) SUBMITTAL. The registration form shall be submitted to the department before the system is placed in operation.

Note: The purpose of the registration is so that inspections can be made as specified in s. Comm 45.08 (2).

(4) CERTIFICATE OF OPERATION. (a) The owner or user of a mechanical refrigerating system which requires periodic inspections under s. Comm 45.08 (3) shall be responsible for obtaining and maintaining a valid certificate of operation.

(b) After each periodic inspection, a certificate of operation shall be issued by the department upon determination that the system meets the applicable requirements of this chapter. The department shall make that determination and issue a certificate of operation within 15 business days of the periodic inspection.

(c) The certificate of operation shall indicate the maximum allowable working pressure permitted under the requirements of this chapter.

(d) The certificate of operation shall be valid until the next required periodic inspection as specified in s. Comm 45.08 (3).

(5) REACTIVATION. The owner or user shall notify the department before reactivating a mechanical refrigerating system at any time after the certificate of operation has expired. The system shall be reinspected by the department and a new certificate of operation shall be obtained before the system may be reactivated.

Note: The department can be notified by writing to the Division of Safety and Buildings, Boiler Safety Section, P.O. Box 7969, Madison, WI 53707, or by telephone at (608) 266–1904.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.08 Inspections. (1) GENERAL REQUIREMENTS. The authorized inspectors of the department, upon presenting appropriate credentials to the owner, operator or agent in charge, may:

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

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

Note: The department policy is not to give advance notice, but in the scheduling and in the act of inspecting it may not always be possible to avoid advance notice.

(2) INSTALLATION INSPECTION. (a) A mechanical refrigerating system which requires registration under s. Comm 45.07 (1) shall be inspected by the department before the system is placed in operation.

(b) Refrigerant steel piping using welded joints to be erected on the premises shall be inspected by the department after the piping material is delivered to the job site and prior to the start of con-

struction. The installer shall give the department a minimum of 2 business days notice to arrange for the inspection.

(c) The installer shall complete form SBD–5204 and retain it at the job site prior to the refrigerant piping inspection. The authorized inspector shall indicate acceptance of the refrigerant piping system design by signing form SBD–5204.

Note: Copies of form SBD–5204 may be obtained from, and the inspection notice may be forwarded to, the department at the Division of Safety and Buildings, Boiler Safety Section, P.O. Box 7969, Madison, Wisconsin 53707, telephone 608/266–1904.

(d) The owner of the refrigerant piping system may request piping inspections in addition to the minimum inspections required under this section.

(3) PERIODIC INSPECTIONS. (a) Any mechanical refrigerating system using a Group A1 or B1 refrigerant and having a capacity rated at or greater than 50 horsepower, 50 tons or 50,000 volt–amperes shall be subject to inspection by the department at least once every 36 months.

(b) Any mechanical refrigerating system using a Group A2, B2, A3 or B3 refrigerant and having a capacity rated at or greater than 10 horsepower, 10 tons or 10,000 volt–amperes shall be subject to inspection by the department at least once every 12 months.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.09 Implementation of rules. Failure on the part of a superintendent, foreman, supervisor, or other person having control of any place of employment, employee or operation, to carry out any rule prescribed in this chapter is a violation of the rule by the employer.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.10 Fees. Fees for the registrations, certificates, reviews, inspections and petitions for variance shall be submitted as specified in ch. Comm 2.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.11 Enforcement. The requirements of this chapter shall be enforced by the department.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.12 Appeals. (1) APPEAL OF LOCAL ORDER. Pursuant to s. 101.02 (7) (b), Stats., any person affected by a local order which is in conflict with a rule of the department may petition the department for a hearing on the grounds that the local order is unreasonable and in conflict with the rule of the department.

Note: Section 101.01 (8), Stats., defines "local order" as any ordinance, order, rule or determination of any common council, board of aldermen, board of trustees or the village board, of any village or city, or the board of health of any municipality, or an order or direction of any official of such municipality, upon any matter over which the department has jurisdiction.

(2) PETITION OF ADMINISTRATIVE RULE. Pursuant to s. 227.12, Stats., any municipality, corporation or any 5 or more persons having an interest in an administrative rule may petition the department requesting the adoption, amendment or repeal of that rule.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.13 Petition for variance. (1) PROCEDURE. The department shall consider and may grant a variance to a requirement of this chapter upon receipt of a fee and a completed petition for variance form from the owner, provided an equivalency is established in the petition for variance which meets the intent of the provision. The department may impose specific conditions in a petition for variance to promote the protection of the health, safety or welfare of the employees or the public. Violation of any condition under which the petition is granted constitutes a violation of this chapter.

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

Note: Copies of the petition for variance form (SBD–8) are available from the Division of Safety and Buildings, Boiler Safety Section, P.O. Box 7969, Madison, Wisconsin 53707, telephone 608/266–1904.

Note: Section 101.02 (6), Stats., and ch. Comm 3 outline the procedures for submitting petitions to the department and the department's procedures for hearing petitions.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.14 Penalties. Penalties for violations of this chapter shall be assessed in accordance with s. 101.02 (12) and (13) (a) or 101.177 (5), Stats.

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

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

Note: Section 101.177 (5), Stats., indicates that any person who violates the installation, servicing or sale requirements relating to ozone–depleting refrigerants will be required to forfeit not less than $50 nor more than $1,000. Each act of installation, servicing or sale in violation of the rule constitutes a separate violation.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.15 Occupancy classification. (1) GOVERNED LOCATIONS. Locations of refrigerating systems are described by occupancy classifications that consider the ability of people to respond to potential exposure to refrigerant as follows:

(a) Institutional occupancy, as used in this chapter, is that portion of the premises from which, because they are disabled, debilitated or confined, occupants cannot readily leave without the assistance of others. Institutional occupancies include hospitals, nursing homes, asylums, sanitariums, and spaces containing locked cells.

(b) Public assembly occupancy, as used in this chapter, is that portion of the premises where large numbers of people congregate and from which occupants cannot quickly vacate the space. Public assembly occupancies include auditoriums, ballrooms, classrooms, passenger depots, theaters, armories, assembly rooms, bath houses, bus terminals, broadcasting studios, churches, colleges, courthouses without cells, dance halls, exhibition halls, fraternity halls, libraries, lodge rooms, mortuary chapels, museums, schools, skating rinks, subway stations, enclosed portions of arenas, race tracks and stadiums.

(c) Residential occupancy, as used in this chapter, is that portion of the premises in which occupants, because they are sleeping, may be unaware of a hazard. Residential occupancies include dormitories, hotels, multi–unit apartments, residences, club houses, convents, lodging houses, studios and tenements.

(d) Commercial occupancy, as used in this chapter, is that portion of the premises where people transact business, receive personal service, or purchase food and other goods. Commercial occupancies include office and professional buildings, restaurants, markets, but not large mercantile occupancies, bake shops, fur storage, laboratories, loft buildings, and work or storage areas that do not qualify as industrial occupancies.

(e) Large mercantile occupancy, as used in this chapter, is that portion of the premises where more than 100 persons congregate on levels above or below street level to purchase personal merchandise.

(f) Industrial occupancy, as used in this chapter, is that portion of the premises that is not open to the public, where access by authorized persons is controlled and which is used to manufacture, process or store goods such as chemicals, food, ice, meat or petroleum.

(g) Mixed occupancy, as used in this chapter, occurs when 2 or more occupancies are located within the same building. When

each occupancy is isolated from the rest of the building by tight walls, floors and ceilings and by self–closing doors, the requirements for each occupancy shall apply to that portion of the building. When the various occupancies are not so isolated, the occupancy having the most stringent requirements shall be the governing occupancy.

Note: For example, the cold storage spaces in a hotel are classified as an industrial occupancy while the rest of the building is classified as a residential occupancy.

(2) ADJACENT LOCATIONS. Equipment located outside a building, other than piping, and within 20 feet from any building opening, other than to the compressor room, shall be governed by the occupancy classification of the building.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.16 Refrigerating system classification. **(1)** DIRECT AND INDIRECT. Refrigerating systems are defined by the method employed for extracting or delivering heat as follows:

(a) A direct system is one in which the evaporator or condenser of the refrigerating system is in direct contact with the air or other substances to be cooled or heated.

(b) An indirect system is one in which a secondary coolant cooled or heated by the refrigerating system is circulated to the air or other substance to be cooled or heated. Indirect systems are distinguished by the method of application as follows:

1. An indirect open spray system is one in which a secondary coolant is in direct contact with the air or other substance to be cooled or heated.

2. A double indirect open spray system is one in which the secondary substance for an indirect open spray system is cooled or heated by the secondary coolant circulated from a second enclosure.

3. An indirect closed system is one in which a secondary coolant passes through a closed circuit in the air or other substance to be cooled or heated.

4. An indirect vented closed system is one in which a secondary coolant passes through a closed circuit in the air or other substance to be cooled or heated, except that the evaporator or condenser is placed in an open or appropriately vented tank.

(2) PROBABILITY. For the purpose of applying Tables 45.17–1 and 45.17–2, a refrigerating system shall be classified according to the degree of probability that a leakage of refrigerant will enter an occupancy–classified area as follows:

(a) A high–probability system is any system in which the basic design, or the location of components, is such that a leakage of refrigerant from a failed connection, seal or component will enter the occupied space. Typical high–probability systems are direct systems or indirect open spray systems in which the refrigerant can at any time have a pressure greater than the secondary coolant.

(b) A low–probability system is any system in which the basic design, or location of the components, is such that leakage of refrigerant from a failed connection, seal or component cannot enter the occupied space. Typical low–probability systems are indirect closed systems, double indirect systems, and indirect open spray systems if the secondary coolant pressure remains greater than refrigerant pressure in all conditions of operation and standby.

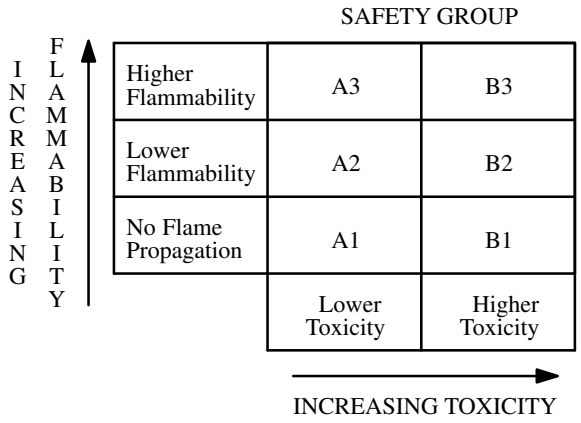
(3) CHANGING REFRIGERANT. A change in the type of refrigerant in a system shall not be made without the approval of the department, permission of the user, consultation with the manufacturers of the original equipment, and due observance of the requirements of this chapter.

Note: The department can be contacted at the Safety and Buildings Division, Boiler Safety Section, P.O. Box 7969, Madison, WI 53707, telephone (608) 266–1904.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.17 Refrigerant classification. **(1)** SAFETY GROUPS. Refrigerants shall be classified into safety groups illustrated in Figure 45.17.

Figure 45.17
REFRIGERANT SAFETY GROUPS



Note: Single–component refrigerants and azeotropic blends are classified by the American Society of Heating, Refrigerating and Air–Conditioning Engineers (ASHRAE) and specified in ASHRAE Standard 34 along with the criteria for classification. The safety group classifications shown in Table 45.17–1 originate in ASHRAE Standard 34. Additional refrigerants are included in ASHRAE Standard 34. As new data becomes available, refrigerant classifications are subject to change in ASHRAE Standard 34.

(2) ZEOTROPIC BLENDS. Zeotropic blends shall be classified by worst case composition of fractionation as follows:

(a) For refrigerants that may change in flammability or toxicity, such as by fractionation of zeotropes, a dual rating, separated by a slant line (/), shall be provided. The first rating shall be the classification of the refrigerants as formulated. The second rating shall be the classification of the worst case composition of fractionation.

(b) Since fractionation can occur as the result of a system leak, both the fractionation of the blend remaining in the system and the composition of the blend leaking into the machinery room or equipment space shall be considered when determining worst case composition.

Note: The worst case composition for toxicity might not be the same as the worst case composition for flammability. Each parameter must be considered independently. The toxicity of blends is defined according to Appendix C of the American Conference of Governmental Industrial Hygienists manual of Threshold Limit Values. The basic formula is as follows:

$$\text{TLV} = \frac{1}{\frac{\text{mol frac A}}{\text{TLV A}} + \frac{\text{mol frac B}}{\text{TLV B}} + \frac{\text{mol frac C}}{\text{TLV C}} \text{ etc.}}$$

TABLE 45.17–1

REFRIGERANT[a] AND AMOUNTS[b,e,]

Refrigerant Number	Chemical Name	Chemical Formula	Quantity of Refrigerant per Occupied Space: Lb per 1000 ft^3[3a]	Parts per Million	Grams per Meter^3[3c]
Group A1					
R–11	Trichlorofluoromethane	CCl_3F	1.6	4,000	25
R–12	Dichlorodifluoromethane	CCl_2F_2	12	40,000	200
R–13	Chlorotrifluoromethane	$CClF_3$	18	67,000	290
R–13B1	Bromotrifluoromethane	$CBrF_3$	22	57,000	350
R–14	Tetrafluoromethane (Carbon tetrafluoride)	CF_4	15	67,000	240
R–22	Chlorodifluoromethane	$CHClF_2$	9.4	42,000	150
R–113	Trichlorotrifluoroethane	CCl_2FCClF_2	1.9	4,000	31
R–114	Dichlorotetrafluoroethane	$CClF_2CClF_2$	9.4	21,000	150
R–115	Chloropentafluoroethane	$CClF_2CF_3$	27	67,000	430
R–134a	1,1,1,2–Tetrafluoroethane	CH_2FCF_3	16	60,000	250
R–C318	Octafluorocyclobutane	C_4F_8	35	67,000	550
R–400	R–12 and R–114	$CCl_2F_2/C_2Cl_2F_4$	d	d	d
R–500	R–12/152a(73.8/26.2)	CCl_2F_2/CH_3CHF_2	12	47,000	200
R–502	R–22/115(48.8/51.2)	$CHClF_2/CClF_2CF_3$	19	65,000	300
R–503	R–23/13(40.1/59.9)	$CHF_3/CClF_3$	15	67,000	240
R–744	Carbon Dioxide	CO_2	5.7	50,000	91
Group A2					
R–142b	1–Chloro–1, 1,–Difluoroethane	CH_3CC1F_2	3.7	14,000	60
R–152a	1,1–Difluoroethane	CH_3CHF_2	1.2	7,000	20
Group A3					
R–170	Ethane	C_2H_6	0.50	6,400	8.0
R–290	Propane	C_3H_8	0.50	4,400	8.0
R–600	Butane	C_4H_{10}	0.51	3,400	8.2
R–600a	2–Methyl propane(Isobutane)	$CH(CH_3)_3$	0.51	3,400	8.2
R–1150	Ethene (Ethylene)	C_2H_4	0.38	5,200	6.0
R–1270	Propene (Propylene)	C_3H_6	0.37	3,400	5.9
Group B1					
R–123	2,2–Dichloro–1,1,1–Trifluoroethane	$CHCl_2CF_3$	0.40	1,000	6.3
R–764	Sulfur Dioxide	SO_2	0.016	100	0.26
Group B2					
R–40	Chloromethane (Methyl chloride)	CH_3Cl	1.3	10,000	21
R–611	Methyl formate	$HCOOCH_3$	0.78	5,000	12
R–717	Ammonia	NH_3	0.022	500	0.35

[a]The refrigerant safety groups in this table are not part of ASHRAE Standard 15. The classifications shown are from ASHRAE Standard 34, which governs in the event of a difference.
[b]To be used only in conjunction with s. Comm 45.18.
[c]To correct for height, H (feet), above sea level, multiply these values by $(1 - 2.42 \times 10^{-6}H)$. To correct for height, h(km), above sea level,multiply these values by $(1 - 7.94 \times 10^{-2}h)$.
[d]The quantity of each component shall comply with the limits set in this table for the pure compound, and the total volume percent of all components shall not exceed 67,000 parts per million by volume.
[e]The basis of the table quantities is a single event where a complete discharge of any refrigerant system into the occupied space occurs. The quantity of refrigerant is the most restrictive of a minimum oxygen concentration of 19.5% or as follows:
Group A1– 80% of the cardiac sensitization level for R–11, R–12, R–13B1, R–22, R–113, R–114, R–134a, R–500 and R–502. 100% of the IDLH for R–744. Others are limited by levels where oxygen deprivation begins to occur.
Group A2, A3– Approximately 20% of LFL.
Group B1– 100% of IDLH for R–764, and 100% of the measure consistent with the IDLH for R–123.
Group B2, B3– 100% of IDLH or 20% of LFL, whichever is lower.

TABLE 45.17–2
SYSTEM APPLICATION REQUIREMENTS[a]

Refrigerant Group	System Probability[b]	Occupancy: Institutional	Occupancy: Public Assm., Residential, Commercial and Large Mercantile	Occupancy: Industrial
A1	High	2	1	3
	Low	4	4	4
A2	High	5	5	3
	Low	7	7	7
A3	High	9	9	3
	Low	9	9	7
B1	High	2,6	1,6	3
	Low	4	4	4
B2	High	5,6	5,6	3
	Low	7	7	7
B3	High	9	9	3
	Low	9	9	7

[a] Numbers in the table under "Occupancy" refer to subds. 1. to 9. in s. Comm 45.18 (4) (b).
[b] See Comm 45.16 for determining the system probability.

(3) OTHER REFRIGERANTS. Refrigerants not specified in Table 45.17–1 shall not be used until approved by the department and assigned a safety group classification. Testing of nonapproved refrigerants shall be limited to manufacturer's research and development only. If the testing is conducted in other than a manufacturer–owned facility, a permanent tag shall be attached identifying the equipment as a test site. The tag shall be removed at the conclusion of the test.

Note: The department will approve the use of refrigerants assigned group classifications by the American Society of Heating, Refrigerating and Air–Conditioning Engineers (ASHRAE) under ASHRAE standard 34, Number Designation and Safety Classification of Refrigerants. In granting the approval, the department may require compliance with additional limitations.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.18 Restrictions on refrigerant use. **(1)** Refrigerating systems shall be installed and operated in accordance with Table 45.17–2 and the requirements of subs. (2), (3) and (4).

Note: To use Table 45.17–2, determine the occupancy class in accordance with s. Comm 45.15, refrigerant group in accordance with Table 45.17–1 and system probability in accordance with s. Comm 45.16, then locate the number of the rule that applies for the corresponding occupancy. The numbers refer to subds. 1. to 9. in s. Comm 45.18 (4) (b). When more than one rule applies, each is a limitation on the other.

(2) GENERAL RESTRICTIONS—SAFEGUARDS. Means shall be taken to adequately safeguard piping, controls and other parts of the refrigerating system to minimize possible accidental damage or rupture by external sources.

(3) GENERAL RESTRICTIONS—NONINDUSTRIAL OCCUPANCY. (a) *Application.* The requirements of this subsection apply to nonindustrial occupancies.

(b) *Stairways and exitways*. Portions of a refrigerating system shall not be installed in or on a public stairway, stair landing, or means of egress.

(c) *Corridors and lobbies*. Portions of a refrigerating system shall not interfere with free passage through public corridors. Refrigerating systems installed in a public corridor or lobby shall be limited to self–contained systems containing not more than the quantities of Group A1 refrigerants specified in Table 45.17–1 or sealed absorption systems as specified in Table 45.18.TABLE

TABLE 45.18
MAXIMUM PERMISSIBLE QUANTITIES OF REFRIGERANTS FOR NONINDUSTRIAL OCCUPANCIES

Type of Refrigerating System	Maximum Pounds for Various Occupancies: Institutional	Public Assembly	Residential	Commercial/Mercantile
Sealed Absorption System				
In public corridors or lobbies	0	0	3.3	3.3
In adjacent outdoor locations	0	0	22	22
In other than public corridors or lobbies	0	6.6	6.6	22
Self–contained Systems				
In other than public corridors or lobbies	0	0	6.6	22

(d) *Unventilated spaces.* When the refrigerant–containing parts of a system are located in one or more unventilated spaces, the volume of the smallest occupied space shall be used to determine the permissible quantity of refrigerant in the system. When a building consists of several stories of unpartitioned space, the permissible quantity of refrigerant in the system shall be based on the volume of the smallest occupied story.

Note: This paragraph does not apply to machinery rooms since they are always ventilated and are not considered occupied space.

(e) *Ventilated spaces*. 1. Except as provided in subd. 2., when an evaporator or condenser is located in an air duct system, the volume of the smallest occupied space, or in the case of an unpartitioned multi–story building the volume of the smallest occupied story, served by the duct shall determine the permissible quantity of refrigerant in the system.

2. When the air duct system serves several enclosed spaces, the permissible quantity of refrigerant in the system shall not

exceed the amount determined by using the total volume of those spaces in which the airflow cannot be reduced to less than one–quarter of its maximum when the fan is operating.

(f) *Plenums.* When the space above a suspended ceiling is continuous and part of the air return system, this space may be included in calculating the permissible quantity of refrigerant in the system.

(4) SYSTEM APPLICATION REQUIREMENTS. (a) *Equipment applied in a high–probability system.* In addition to the provisions of s. Comm 45.03 (3), listed equipment applied in a high–probability system with refrigerant charge not exceeding 6.6 pounds shall be deemed to meet the system application requirements when the equipment is installed in accordance with its listing and manufacturer's installation instructions.

(b) *General system application requirements*. Except as permitted in par. (a), the following rules of subds. 1. to 9. for system application requirements shall be applied as specified in Table 45.17–2, based on refrigerant group, system probability and occupancy:

Note: Blends that may fractionate to change flammability or toxicity are treated according to their worst case classification. For example, an A1/A2 blend follows the rules for A2 refrigerants. The amount of blend allowed corresponds to the limit on the quantity of A2 refrigerant in the blend. The total amount of the blend is limited as in footnote d, of Table 45.17–1.

1. The quantity of refrigerant in each system shall be limited as specified in Table 45.17–1. The quantity of refrigerant per occupied space shall be the amount of refrigerant that could leak into the occupied space at any one time, based on a leak from any single independent refrigeration circuit.

2. The quantity of refrigerant in each system shall be limited to 50% of the amount specified in Table 45.17–1, except that subd. 1. applies in kitchens, laboratories and mortuaries. If any portion of a refrigerating system containing more than one pound of refrigerant, except R–744, is in a room with a flame–sustaining device, this device shall be provided with a hood to exhaust combustion products to the open air. If these conditions are not met, subds. 5. and 6. shall be followed.

3. For refrigerating systems of greater than 100 horsepower, the refrigerated work area shall comply with subd. 3. a. to f. and the separate room housing compressors and related equipment shall comply with subd. 8. For refrigerating systems of 100 horsepower or less and when the quantity of refrigerant in each system exceeds Table 45.17–1 amounts, the amount of refrigerant shall correspond to that for a commercial occupancy unless all of the following conditions are met:

a. The area containing machinery, including a separate room housing compressors and related equipment as well as refrigerated work areas containing lowside components, is separated from the areas of the building not containing machinery by tight construction with tight–fitting doors;

b. Access is restricted to authorized personnel;

c. Personnel density and means of egress are in compliance with chs. Comm 61 to 65;

d. Detectors are located in areas where refrigerant vapor from a leak will be concentrated so as to provide warning at a concentration not exceeding the refrigerant's TLV–TWA. Detectors are not required for ammonia due to its self–alarming character;

e. When the quantity of refrigerant, except refrigerants of Groups A1 and B1, exceeds Table 45.17–1 amounts, no flame producing device or hot surface above 800° F shall be permitted; and

f. When the quantity of refrigerant, except refrigerants of Groups A1 and B1 and ammonia, exceeds Table 45.17–1 amounts, the area shall be classified as a hazardous location and all electrical equipment shall conform to the requirements of Class 1, Division 2 of the National Electrical Code as adopted by reference in ch. Comm 16.

4. When the quantity of refrigerant in the largest system exceeds Table 45.17–1 amounts, all refrigerant–containing parts, except piping and those parts outside the building, shall be installed in a machinery room constructed in accordance with the provisions of s. Comm 45.19 (12).

5. Refrigerant amounts and types of systems shall be limited as shown in Table 45.18.

6. Applications involving air conditioning for human comfort shall not be used.

7. When the quantity of refrigerant in the largest system exceeds Table 45.17–1 amounts, all refrigerant–containing parts, except piping and those parts outside the building, shall be installed in a special machinery room constructed in accordance with the provisions of s. Comm 45.19 (13) with limitations on refrigerant quantities as follows:

a. 550 pounds for institutional occupancies.

b. No limit except subd. 8. for occupancies other than institutional occupancies.

c. If subpar. a. or b. is not met, subd. 5. limits the amount of Group A2, A3, B2 or B3 refrigerant in the system.

8. When the quantity of refrigerant in any system exceeds Table 45.17–1 amounts, all refrigerant–containing parts, except piping, lowside components, condensers and parts outside the building, shall be installed in a machinery room constructed in accordance with the provisions of s. Comm 45.19 (12). In addition, refrigerants of Groups A2, A3, B2, and B3 shall meet the following requirements:

a. The special machinery room requirements of s. Comm 45.19 (13) shall apply; and

b. Except for ammonia systems, amounts of refrigerant exceeding 1100 pounds shall be approved by the department.

9. No refrigerant may be used except in laboratories in commercial occupancies. Only self–contained systems containing not more than 6.6 pounds of Group A3 or B3 refrigerant shall be used unless the laboratory is occupied by less than one person per 100 square feet of floor area, in which case the requirements of industrial occupancies shall apply.

Note: Par. (a) permits a refrigerant charge of 6.6 pounds or less of any refrigerant for any system meeting the requirements of subd. 9.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94; **CR 01–139: am. (4) (b) 3. c. Register June 2002 No. 558, eff. 7–1–02.**

Comm 45.19 Installation restrictions. (1) FOUNDATIONS. Foundations and supports for condensing units or compressor units shall be of substantial construction and of noncombustible construction when more than 12 inches high. Isolation materials such as rubber may be used between the foundation and condensing or compressor units.

(2) GUARDS. Machinery with moving parts shall be guarded in accordance with approved safety standards.

Note: The department will accept guarding meeting federal occupational safety and health administration standards or ASME B15.1, Safety Code for Mechanical Power Transmission Apparatus.

(3) SAFE ACCESS. Access, including ladders, platforms, and clear space for inspection and servicing of condensing units, compressors, condensers and other machinery, shall be provided.

(4) ENCLOSURES. Condensing units or compressor units with enclosures shall be readily accessible for servicing and inspection.

(5) WATER CONNECTIONS. Water supply and discharge connections shall be made in accordance with chs. Comm 81 to 87.

(6) ILLUMINATION. Illumination adequate for inspection and servicing of condensing units or compressor units shall be provided.

(7) ELECTRICAL SAFETY. Electrical equipment and wiring shall be installed in accordance with ch. Comm 16.

(8) GAS FUEL EQUIPMENT. Gas fuel devices and equipment used with refrigerating systems shall be installed in accordance with chs. Comm 61 to 65.

(9) AIR DUCT INSTALLATION. Air duct systems of air–conditioning equipment for human comfort using refrigerating systems shall be installed in accordance with chs. Comm 61 to 65. Air ducts passing through a machinery room shall be of tight construction and shall have no openings in such rooms.

(10) REFRIGERANT PARTS IN AIR DUCT. Joints and all refrigerant–containing parts of a refrigerating system located in an air duct carrying conditioned air to and from an occupied space shall be constructed to withstand a temperature of 700°F without leakage into the airstream.

(11) LOCATION OF REFRIGERANT PIPING. (a) Refrigerant piping crossing an open space that affords passageway in any building shall be not less than 7.25 feet above the floor unless against the ceiling of such space as permitted by the department.

(b) Passageways shall not be obstructed by refrigerant piping. Refrigerant piping shall not be placed in any elevator, dumbwaiter, or other shaft containing a moving object or in any shaft that has openings to living quarters or to means of egress. Refrigerant piping shall not be installed in an enclosed public stairway, stair landing or means of egress.

(c) Refrigerant piping shall not penetrate floors, ceilings or roofs, except as follows:

1. Penetrations connecting the basement and the first floor.

2. Penetrations connecting the top floor and a machinery penthouse or roof installation.

3. Penetrations connecting adjacent floors served by the refrigerating system.

4. In other than industrial occupancies, penetrations which connect separate pieces of equipment that are:

a. Enclosed by an approved gas–tight, fire–resistive duct or shaft with openings to those floors served by the refrigerating system; or

b. Located on the exterior wall of a building when vented to the outside or to the space served by the system and not used as an air shaft, closed court or similar space.

5. Piping of a direct system where the refrigerant quantity limited by s. Comm 45.18 is not required to be enclosed when it connects stories served by that system.

(d) Refrigerant piping may be installed horizontally in closed floors or in open joist spaces. Refrigerant piping installed in concrete floors shall be encased in pipe duct. Refrigerant piping shall be properly isolated and supported to prevent damaging vibration, stress or corrosion.

(12) MACHINERY ROOM GENERAL REQUIREMENTS. When a refrigerating system is located indoors, a machinery room shall be provided when the limitations of Table 45.17–1 are exceeded and when required by s. Comm 45.18 (4). The machinery room shall meet the following requirements:

(a) Machinery rooms are not prohibited from housing other mechanical equipment unless specifically prohibited elsewhere in this chapter. A machinery room shall be so dimensioned that parts have space for service, maintenance and operations. There shall be clear head room of not less than 7.25 feet below equipment situated over passageways.

(b) 1. Each machinery room shall have a tight–fitting door opening outward. The machinery room doors shall be self–closing if they open into the building and shall be adequate in number to ensure freedom for persons to escape in an emergency. Except for access doors and panels in air ducts and air handler units conforming to par. (g), there shall be no openings that will permit passage of escaping refrigerant to other parts of the building.

Note: See the Commercial Building Code, chs. Comm 61 to 65, for means of egress requirements.

2. Except for ammonia systems, each machinery room shall contain a detector located in an area where refrigerant from a leak is likely to concentrate, and an alarm shall be employed. The alarm shall be actuated and the mechanical ventilation started in accordance with par. (d), at a value not greater than the corresponding refrigerant TLV–TWA or consistent toxicity measure. The detector shall have a name plate indicating the type of refrigerant and the parts per million setting.

Note: For ammonia, refer to sub. (13) (h).

(c) Machinery rooms shall be vented to the outdoors utilizing mechanical ventilation in accordance with pars. (d) and (e).

(d) Mechanical ventilation referred to in par. (c) shall be by one or more power–driven fans capable of exhausting air from the machinery room at least in the amount given in the formula in par. (e). To obtain a reduced airflow for normal ventilation, multiple fans or multispeed fans shall be used. Provision shall be made for inlet air to replace that being exhausted. Openings for inlet air shall be positioned to avoid recirculation. Air supply and exhaust ducts to the machinery room shall serve no other area. The discharge of the air shall be to the outdoors in such a manner as not to cause a nuisance or danger.

(e) 1. The mechanical ventilation required to exhaust an accumulation of refrigerant due to leaks or a rupture of the system shall be capable of removing air from the machinery room in not less than the following quantity:

$$Q = 100 \times G^{0.5}$$

where Q = the airflow in cubic feet per minute, and

G = the mass of refrigerant in pounds in the largest system, any part of which is located in the machinery room.

2. A part of the machinery room mechanical ventilation shall be:

a. Operated, when occupied, to supply at least 0.5 cubic feet per minute per square foot of machinery room area or 20 cubic feet per minute per person; and

b. Operable, if necessary for operator comfort, at a volume required to maintain a maximum temperature rise of 18ºF based on all of the heat–producing machinery in the room.

3. When a refrigerating system is located outdoors more than 20 feet from building openings and is enclosed by a penthouse, lean–to or other open structure, natural ventilation may be employed as an alternative to the requirement for mechanical ventilation. The requirements for such natural ventilation are as follows:

a. The free–aperture cross section for the ventilation of a machinery room shall be at least:

$$F = G^{0.5}$$

where F = the free opening area in square feet, and

G = the mass of refrigerant in pounds in the largest system, any part of which is located in the machinery room.

b. Locations of the gravity ventilating openings shall be based on the relative density of the refrigerant to the air.

(f) No open flames that use combustion air from the machinery room shall be installed where any refrigerant other than ammonia or carbon dioxide is used. Machinery rooms where only ammonia is the refrigerant may use internal combustion engines as the prime mover for the compressors. The use of matches, lighters, halide leak detectors and similar devices shall not be considered a violation of this paragraph. Combustion equipment may be installed in the same machinery room with refrigerant–containing equipment under any of the following conditions:

1. Combustion air is ducted from outside the machinery room and sealed in such a manner as to prevent any refrigerant leakage from entering the combustion chamber; or

2. A refrigerant vapor detector is employed to automatically shut down the combustion process in the event of refrigerant leakage.

(g) The passage of air flow to or from an occupied space through a machinery room shall be permitted only when the air is ducted and sealed in such a manner as to prevent refrigerant leakage from entering the air stream. Access doors and panels in ductwork and air handler units shall be gasketed and tight–fitting. A refrigerant vapor detector shall be employed to automatically shut down the air handler system in the event of refrigerant leakage.

(13) MACHINERY ROOM SPECIAL REQUIREMENTS. In cases specified in the rules of s. Comm 45.18 (4) (b) 1. to 9., a machinery room shall meet the following special requirements in addition to those in sub. (12):

(a) There shall be no flame–producing device or continuously operating hot surface over 800ºF permanently installed in the room.

(b) Doors communicating with the building shall be approved, self–closing, tight–fitting fire doors.

(c) Walls, floor and ceiling shall be tight and of noncombustible construction. Walls, floor and ceiling separating the machinery room from other occupied spaces shall be of at least one–hour fire–resistive construction.

(d) The machinery room shall have a door that opens directly to the outside air or through a vestibule equipped with self–closing, tight–fitting doors.

(e) Exterior openings shall not be under any fire escape or any open stairway.

(f) All pipes piercing the interior walls, ceiling or floor of such rooms shall be tightly sealed to the walls, ceiling or floor through which they pass.

(g) When refrigerants of Groups A2, A3, B2 other than ammonia, and B3 are used, the machinery room shall conform to Class 1, Division 2, of the National Electrical Code as adopted in ch. Comm 16.

(h) When ammonia is used, the machinery room is not required to meet Class 1, Division 2 of the National Electrical Code providing:

1. The mechanical ventilation system in the machinery room is run continuously and failure of the mechanical ventilation system actuates an alarm; or

2. The machinery room is equipped with a vapor detector that will automatically start the mechanical ventilation system and actuate an alarm at a detection level not to exceed 1000 parts per million.

(i) Remote control of the mechanical equipment in the machinery room shall be provided immediately outside the machinery room door solely for the purpose of shutting down the equipment in an emergency. Ventilation fans shall be on a separate electrical circuit and have a control switch located immediately outside the machinery room door.

(14) PURGE DISCHARGE. The discharge of purge systems shall be governed by the requirements in s. Comm 45.20 (7) for pressure–relief devices and fusible plugs and shall be piped in conjunction with these devices.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94; **CR 01–139: am. (8) and (9) Register June 2002 No. 558, eff. 7–1–02; correction in (5) made under s. 13.93 (2m) (b) 7., Stats., Register June 2002 No. 558.**

Comm 45.20 Design and construction of equipment and systems. (1) MATERIALS. (a) Materials used in the construction and installation of refrigerating systems shall be suitable for conveying the refrigerant used. Materials shall not be used that will deteriorate because of the refrigerant, the lubricant or their combination in the presence of air or moisture to a degree that poses a safety hazard.

(b) Aluminum, zinc, magnesium or their alloys shall not be used in contact with methyl chloride. Magnesium alloys shall not be used in contact with any halogenated refrigerants.

(c) Copper and its alloys shall not be used in contact with ammonia, except as a component of bronze alloys for bearings or other non–refrigerant– containing uses.

(d) Aluminum and its alloys may be used in ammonia systems.

(2) DESIGN PRESSURE. (a) Design pressures shall not be less than pressure arising under maximum operating, standby or shipping conditions. When selecting the design pressure, suitable allowance shall be provided for setting pressure–limiting devices and pressure–relief devices to avoid unnecessary shutdowns and loss of refrigerant. Standby conditions are intended to include normal conditions that may be attained in the system when not operating, such as maintenance, shutdown and power failure.

Note: Refer to ASME Boiler and Pressure Vessel Code Section VIII, Division I, Appendix M for recommended guidelines.

(b) 1. Design pressure shall not be less than 15 psig and, except as noted in pars. (c), (d) and (e), shall not be less than the saturation gauge pressure corresponding to the following temperatures:

a. Lowsides of all systems: + 80°F

b. Highsides of all water–cooled or evaporatively cooled systems: 30°F higher than the summer one percent wet–bulb for the location as applicable, or 15°F higher than the highest leaving condensing water temperature for which the equipment is designed or 104°F, whichever is greatest.

c. Highsides of all air–cooled systems: 30°F higher than the highest summer one percent design dry–bulb for the location but not lower than 122°F.

2. The design pressure selected shall exceed maximum pressures attained under any anticipated normal operating conditions, including conditions created by expected fouling of heat exchange surfaces.

3. Selection of the design pressure for lowside components shall also consider pressure developed in the lowside of the system from equalization, or heating due to changes in ambient temperature, after the system has stopped.

4. The design pressure for both lowside and highside components that are shipped as part of a gas– or refrigerant–charged system shall be selected with consideration of internal pressures arising from exposure to maximum temperatures anticipated during the course of shipment.

(c) The design pressure for either the highside or lowside need not exceed the critical pressure of the refrigerant unless such pressures are anticipated during operating, standby or shipping conditions.

(d) When a compressor is used as a booster and discharges into the suction side of another compressor, the booster compressor shall be considered a part of the lowside.

(e) Components connected to pressure vessels and subject to the same pressure as the pressure vessel shall have a design pressure no less than the pressure vessel.

(3) REFRIGERANT–CONTAINING PRESSURE VESSELS. (a) *Inside dimensions 6 inches or less.* 1. Pressure vessels having inside dimensions of 6 inches or less shall be listed either individually or as part of an assembly by an approved nationally recognized testing laboratory, or shall be marked directly on the vessel, or on a nameplate attached to the vessel, with a "U" or "UM" symbol signifying compliance with Section VIII of the ASME Boiler and Pressure Vessel Code as adopted in ch. Comm 41, except that such vessels having an internal or external design pressure of 15 psig or less are exempted from this requirement. Pressure vessels having inside dimensions of 6 inches or less shall be protected by either a pressure–relief device or a fusible plug.

2. If a pressure–relief device is used to protect a pressure vessel having an inside dimension of 6 inches or less, the ultimate strength of the pressure vessel so protected shall be sufficient to withstand a pressure at least 3.0 times the design pressure.

3. If a fusible plug is used to protect a pressure vessel having an inside diameter of 6 inches or less, the ultimate strength of the pressure vessel so protected shall be sufficient to withstand a pressure 2.5 times the saturation pressure of the refrigerant used, at the temperature stamped on the fusible plug, or 2.5 times the critical pressure of the refrigerant used, whichever is less.

(b) *Inside dimensions greater than 6 inches.* Pressure vessels having an inside diameter exceeding 6 inches and having an internal or external design pressure greater than 15 psig shall be marked directly, or on a nameplate, with a "U" or "UM" symbol signifying compliance with the rules of Section VIII of the ASME Boiler and Pressure Vessel Code as adopted in ch. Comm 41.

(c) *Pressure vessels for 15 psig or less.* Pressure vessels having an internal or external design pressure of 15 psig or less shall have an ultimate strength to withstand at least 3.0 times the design pressure and shall be tested with a pneumatic test pressure no less than 1.25 times the design pressure or a hydrostatic test pressure no less than 1.50 times the design pressure.

(4) PRESSURE RELIEF PROTECTION. (a) Refrigerating systems shall be protected by a pressure–relief device or other approved means to safely relieve pressure due to fire or other abnormal conditions.

(b) Pressure vessels shall be protected in accordance with sub. (7). Pressure relief valves bearing either a nameplate or directly marked with "UV" or "VR" symbol signifying compliance with Section VIII, of the ASME Boiler and Pressure Vessel Code shall be accepted by the department as evidence of compliance with this paragraph.

(c) A pressure–relief device to relieve hydrostatic pressure to another part of the system shall be used on the portion of liquid–containing parts of the system that can be isolated from the system during operation or service and that will be subjected to over pressure from hydrostatic expansion of the contained liquid due to temperature rise.

(d) 1. Except as provided in subds. 2. and 3., evaporators located downstream, or upstream within 18 inches, of a heating coil shall be fitted with a pressure–relief device discharging outside the building in accordance with the requirements of sub. (7) (h) 1.

2. Relief valves shall not be required on heating coils that are designed to produce a temperature which will result in the saturation pressure of the refrigerant being less than the design pressure.

3. Relief valves shall not be required on self–contained systems if the volume of the lowside of the system, which is shut off by valves, is greater than the specific volume of the refrigerant at critical conditions of temperature and pressure, as determined by the following formula:

$$V1/\left[W_1-(V_2-V_1)V_{gt}\right] \text{ shall be greater than } V_{gc}$$

where V_1 = lowside volume in cubic feet,

V_2 = total volume of system in cubic feet,

W_1 = total weight of refrigerant in system in pounds,

V_{gt} = specific volume of refrigerant vapor at 110°F in cubic feet per pound, and

V_{gc} = specific volume at critical temperature and pressure in cubic feet per pound.

(e) Pressure–relief devices shall be direct–pressure actuated or pilot–operated. Pilot–operated pressure–relief valves shall be self–actuated and the main valve shall open automatically at the set pressure and, if some essential part of the pilot fails, shall discharge its full rated capacity.

(f) Stop valves shall not be located between a pressure–relief device and parts of the system protected by the device. A three–way valve, used in conjunction with the dual relief valve requirements of sub. (7) (b) 4., is not considered a stop valve.

(g) When relief valves are connected to discharge to a common discharge header as described in sub. (7) (h) 5., a full area stop valve may be installed in the discharge pipe between the relief valve and the common header. When such a stop valve is installed, a locking device shall be installed to ensure the stop valve is locked in the open position. This discharge stop valve may be shut only if one of the following conditions exists:

1. Parallel relief valves are installed and the second relief valve is protecting the system or vessels; or

2. The system or vessels have been depressurized and are vented to atmosphere.

(h) Pressure–relief devices shall be connected directly to the pressure vessel or other parts of the system protected by the devices. These devices shall be connected above the liquid refrigerant level and installed so that they are readily accessible, and so that they cannot be readily rendered inoperative, except that fusible plugs used on the high side may be located above or below the liquid refrigerant level.

(i) The seats and discs of pressure–relief devices shall be constructed of suitable material to resist refrigerant corrosion or other chemical action caused by the refrigerant. Seats or discs of cast iron shall not be used. Seats and discs shall be limited in distortion, by pressure or other cause, to a set pressure change of not more than 5% in a span of 5 years.

(5) SETTING OF PRESSURE–RELIEF DEVICES. (a) *Pressure–relief valve setting.* Pressure–relief valves shall start to function at a pressure not to exceed the design pressure of the parts of the system protected.

(b) *Rupture member setting.* Rupture members used in lieu of, or in series with, a relief valve shall have a nominal rated rupture pressure not to exceed the design pressure of the parts of the system protected. The conditions of application shall conform to the requirements of paragraph UG–127 of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code as adopted in ch. Comm 41. The size of rupture members installed ahead of relief valves shall not be less than the relief valve inlet.

(6) MARKING OF RELIEF DEVICES AND FUSIBLE PLUGS. (a) Pressure–relief valves for refrigerant–containing components shall be set and sealed by the manufacturer or an assembler as defined in Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code as adopted in ch. Comm 41. Each pressure–relief valve shall be marked by the manufacturer or assembler with the data required in Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code, except that relief valves for systems with design pressures of 15 psig or less shall be marked by the manufacturer with the pressure setting and capacity.

(b) Each rupture member for refrigerant pressure vessels shall be marked with the data required in paragraph UG–129 (e) of Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code as adopted in ch. Comm 41.

(c) Fusible plugs shall be marked with the melting temperatures in°F.

(7) PRESSURE VESSEL PROTECTION. (a) Pressure vessels shall be provided with over–pressure protection in accordance with rules in Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code as adopted in ch. Comm 41.

(b) 1. Pressure vessels containing liquid refrigerant, and which may be isolated by stop valves from other parts of a refrigerating system, shall be provided with over–pressure protection. Pressure–relief devices or fusible plugs shall be sized in accordance with par. (e).

2. Pressure vessels with an internal gross volume of 3 cubic feet or less may use a single pressure–relief device or a fusible plug.

3. Pressure vessels of more than 3 cubic feet but less than 10 cubic feet internal gross volume may use a single pressure–relief device. Fusible plugs shall not be used.

4. Pressure vessels of 10 cubic feet or more internal gross volume shall use a single rupture member or dual pressure–relief devices when discharging to the atmosphere. Dual pressure–relief devices shall be installed with a three–way valve to allow testing or repair.

5. One or more relief valves shall be used on pressure vessels of 10 cubic feet or more internal gross volume which are located on the lowside of the system, have shut–off valves to isolate the vessels from the rest of the refrigerating system, and when the system is designed to allow pumpdown of the refrigerant charge of the pressure vessel.

(c) For pressure relief valves discharging into the lowside of the system, a single relief valve, not rupture member, of the required relieving capacity shall not be used on vessels of 10 cubic feet or more internal gross volume except under the conditions permitted in par. (h) 2.

(d) Vessels containing liquid refrigerant may use 2 or more pressure–relief devices or dual pressure–relief devices in parallel to obtain the required capacity.

(e) 1. The minimum required discharge capacity of the pressure–relief device or fusible plug for each pressure vessel shall be determined by the following:

$$C = fDL$$

where C = minimum required discharge capacity of the relief device in pounds of air per minute,

D = outside diameter of vessel in feet,

L = length of vessel in feet, and

f = factor dependent upon type of refrigerant from Table 45.20–1.

2. When combustible materials are used within 20 feet of a pressure vessel, the value of f shall be multiplied by 2.5. The formula is based on fire conditions; other heat sources shall be calculated separately.

TABLE 45.20–1
Values of F

Refrigerant	Value of f
When used on the lowside of a limited–charge cascade system:	
R–170, R–744, R–1150	1.0
R–13, R–13B1, R–503	2.0
R–14	2.5
Other applications:	
R–717	0.5
R–11, R–40, R–113, R–123, R–142b, R–152a, R–290, R–600, R–600a, R–611, R–764	1.0
R–12, R–22, R–114, R–134a, R–C318, R–500, R–1270	1.6
R–115, R–502	2.5

3. When one pressure–relief device or fusible plug is used to protect more than one pressure vessel, the required capacity shall be the sum of the capacities required for each pressure vessel.

(f) The rated discharge capacity of a pressure–relief device expressed in pounds of air per minute shall be determined in accordance with paragraph UG–131, Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code as adopted in ch. Comm 41. All pipe and fittings between the pressure–relief valve and the parts of the system it protects shall have at least the area of the pressure–relief valve inlet.

(g) The rated discharge capacity of a rupture member or fusible plug discharging to the atmosphere under critical flow conditions in pounds of air per minute shall be determined by the following formulas:

$$C = 0.64\, P_1 d^2$$
$$d = 1.12\, (C/P_1)^{0.5}$$

where C = rated discharge capacity in pounds of air per minute, and

d = smallest of the internal diameter of the inlet pipe, retaining flanges, fusible plug and rupture member in inches outside diameter of vessel in feet,

For rupture members, P_1 = (rated pressure psig x 1.10) + 14.7, psia;

For fusible plugs, P_1 = absolute saturation pressure corresponding to the stamped temperature melting point of the fusible plug or the critical pressure of the refrigerant used, whichever is smaller, psia.

(h) 1. Pressure–relief devices and fusible plugs on any system containing a Group A3 or B3 refrigerant, on any system containing more than 6.6 pounds of a Group A2, B1 or B2 refrigerant, and on any system containing more than 110 pounds of a Group A1 refrigerant shall discharge to the atmosphere at a location not less than 15 feet above the adjoining ground level and not less than 20 feet from any openable window, ventilation opening, or exit in any building. The discharge shall be terminated in such a manner to prevent direct spray of discharged refrigerant on personnel in the vicinity and foreign material or debris from entering the discharge piping. Discharge piping connected to the discharge side of a fusible plug or rupture member shall have provisions to prevent plugging the pipe in the event the fusible plug or rupture member functions.

2. Except for hydrostatic relief valves, pressure–relief devices shall not discharge into the lowside of the system unless the pressure relief device is a type not affected by back pressure, and the lowside is equipped with pressure–relief devices capable of relieving any increased refrigerant quantity. Such a lowside pressure–relief device shall be set in accordance with sub. (5) (a) and vented to the outside of the building in accordance with subd. 1.

3. Ammonia discharge from automatic or manual pressure–relief valves shall be into one or more of the following:

a. The atmosphere, in accordance subd. 1.

b. A tank containing one gallon of water for each pound of ammonia that can be released in one hour from the largest relief device connected to the discharge pipe. The water shall be prevented from freezing. The discharge pipe from the pressure–relief device shall distribute ammonia in the bottom of the tank but no lower than 33 feet below the maximum liquid level. The tank shall be sized to contain the combined volume of ammonia and water.

4. When sulfur dioxide is used, the discharge may be into a tank of absorptive solution that shall be used for no other purpose except sulfur dioxide absorption. The absorptive solution shall be one gallon of standard dichromate solution which consists of 2.5 pounds of sodium dichromate per gallon of water for each pound of sulfur dioxide in the system. Solutions made with caustic soda or soda ash may be used in place of sodium dichromate provided the quantity and strength have the equivalent sulfur dioxide absorbing power. The tank shall be constructed of not less than 1/8

inch or No. 11 U.S. gauge iron or steel. The tank shall have a hinged cover or, if of the enclosed type, shall have a vent hole at the top. All pipe connections shall be through the top of the tank only. The discharge pipe from the pressure–relief valve shall discharge the sulfur dioxide in the center of the tank near the bottom.

5. The size of the discharge pipe from a pressure–relief device or fusible plug shall not be less than the outlet size of the pressure–relief device or fusible plug. Where outlets of 2 or more relief devices or fusible plugs are connected to a common line or header, the effect of back pressure that will be developed when more than one relief device or fusible plug operates shall be considered. The sizing of the common discharge header downstream from each of the 2 or more relief devices or fusible plugs that are expected to operate simultaneously shall be based on the sum of their outlet areas with due allowance for the pressure drop in all downstream sections. Provision shall be provided at the lowest point in the relief device discharge piping to drain moisture and check for leakage. The material used for the safety relief device discharge piping shall be noncombustible and compatible with the refrigerant used.

6. The maximum length of the discharge piping installed on the outlet of a pressure–relief device or fusible plug shall be determined as follows:

$$L = 09P^2d^5/16C_r^2$$

where C_r = rated discharge capacity as stamped on the device by the manufacturer in pounds of air per minute,

d = internal diameter of pipe in inches, and

L= length of discharge pipe in feet.

For relief valves and rupture members:

P = (Rated pressure, psig x 1.10) + 14.7

For fusible plugs,

P=pressure P_1 as defined in par. (g).

Note: See Table 45.20–2 for the results of computations using the above formula.

TABLE 45.20–2—LENGTH IN FEET OF DISCHARGE PIPING FOR PRESSURE–RELIEF DEVICES OF VARIOUS DISCHARGE CAPACITIES

Required Discharge Capacity C, # Air/Min.	Standard Wall Pipe, Pipe Size in Inches						Standard Wall Pipe, Pipe Size in Inches					
	1/2	3/4	1	1 1/4	1 1/2	2	1/2	3/4	1	1 1/4	1 1/2	2
	Relief Valve Setting 150 psig						Relief Valve Setting 200 psig					
5	68	276					115	470				
10	17	69	231				29	118	394			
15	7	31	102				13	52	175			
20	4	17	58	226			7	29	98			
25	3	11	37	145			5	19	63	248		
30	2	8	26	100	218		3	13	44	172		
40		4	14	57	122		2	7	25	97	210	
50		3	9	36	78	274		5	16	62	134	
60		2	6	25	54	190		3	11	43	93	
70			5	18	40	140		2	8	32	68	238
80			4	14	31	105		2	6	24	52	182
90			3	11	24	84			5	19	41	144
100			2	9	20	68			4	15	33	117
125				6	12	44			2	10	21	75
150				4	9	30				7	15	52
175				3	6	22				5	11	38
200				2	5	17				4	8	29
	Relief Valve Setting 250 psig						Relief Valve Setting 300 psig					
5	176						248					
10	44	179					62	254				
15	20	80	267				28	114				
20	11	45	150				15	54	212			
25	7	29	96				10	41	136			
30	5	20	67	263			7	28	94			
40	3	11	37	147			4	16	53	208		
50	2	7	24	94	204		3	10	34	134		
60		5	17	66	142		2	7	24	93	200	
70		4	12	48	104			5	17	68	147	
80		3	9	37	80			4	13	52	113	
90		2	7	29	63	220		3	10	41	89	
100		2	6	24	51	178		2	8	33	72	252
125			4	15	33	114		2	5	21	46	162
150			3	11	23	79			4	15	32	112
175			2	8	17	58			3	11	24	82
200			2	6	13	44			2	8	18	63
	Relief Valve Setting 350 psig						Relief Valve Setting 400 psig					
5	335						433					
10	84	380					108	492				
15	37	169					48	219				
20	21	95	285				27	123	369			
25	13	61	183				17	79	236			
30	9	42	127				12	55	164			
40	5	24	71	281			7	31	92	364		
50	3	15	46	180			4	20	59	233		
60	2	11	32	125	270		3	14	41	162	349	
70	2	8	23	92	198		2	10	30	119	257	
80		6	18	70	152		2	8	23	91	197	
90		5	14	56	120			6	18	72	155	
100		4	11	45	97	339		5	15	58	126	439
125		2	7	29	62	217		3	9	37	81	281
150		2	5	20	43	151		2	7	26	56	195
175			4	15	32	111		2	5	19	41	143
200			3	11	24	85			4	15	31	110

(8) POSITIVE DISPLACEMENT COMPRESSOR PROTECTION. When required to be equipped with a stop valve in the discharge connection, every positive displacement compressor shall be equipped with a pressure–relief device of adequate size and pressure setting, as specified by the compressor manufacturer, to prevent rupture of the compressor or any other component located between the compressor and the stop valve on the discharge side. The pressure–relief device shall discharge into the low–pressure side of the system or in accordance with sub. (7) (h).

(9) PRESSURE–LIMITING DEVICES. (a) When required. Pressure–limiting devices shall be provided on all systems operating above atmospheric pressure, except that a pressure–limiting device is not mandatory on any factory–sealed system containing less than 22 pounds of Group A1 refrigerant that has been listed by an approved nationally recognized testing laboratory and is so identified.

(b) *Setting.* 1. When required by par. (a), the maximum setting to which a pressure–limiting device may readily be set by use of the adjusting means provided shall not exceed the design pressure of the highside of a system that is not protected by a pressure–relief device or 90% of the setting of the pressure–relief device installed on the highside of a system, except as provided in subd. 2. The pressure–limiting device shall stop the action of the pressure–imposing element at a pressure no higher than this maximum setting.

2. On systems using nonpositive displacement compressors, the maximum setting of the pressure–limiting device is not required to be below the design pressure of the highside of the system provided the pressure–relief device is:

a. Located in the lowside;

b. Subject to lowside pressure; and

c. There is a permanent unvalved relief path between the highside and the lowside of the system.

(c) Connection. Pressure–limiting devices shall be connected between the pressure–imposing element and any stop valve on the discharge side. There shall be no intervening stop valves in the line leading to the pressure– limiting device.

(10) REFRIGERANT PIPING, VALVES, FITTINGS AND RELATED PARTS. Refrigerating piping, valves, fittings and related parts having a maximum internal or external design pressure greater than 15 psig shall be listed either individually or as part of an assembly or a system by an approved nationally recognized testing laboratory or shall comply with ASME B31.5, where applicable.

(11) COMPONENTS OTHER THAN PRESSURE VESSELS AND PIPING. (a) 1. Except as provided in subd. 2., every pressure–containing component of a refrigerating system, other than pressure vessels, piping, pressure gauges, and control mechanisms, shall be listed either individually or as part of a complete refrigerating system or a subassembly by an approved nationally recognized testing laboratory or shall be designed, constructed and assembled to have an ultimate strength sufficient to withstand 3 times the design pressure for which it is rated.

2. Waterside components exempted from the rules of Section VIII of the ASME Boiler and Pressure Vessel Code as adopted in ch. Comm 41 shall be designed, constructed and assembled to have an ultimate strength sufficient to withstand 150 psig or 2 times the design pressure for which it is rated, whichever is greater.

(b) Liquid level gauge glass columns, except those of the bull's eye type, shall have automatic closing shut–off valves, and such glass columns shall be protected against external damage and properly supported.

(c) When a pressure gauge is permanently installed on the highside of a refrigerating system, its dial shall be graduated to at least 1.2 times the design pressure.

(d) Liquid receivers, if used, or parts of a system designed to receive the refrigerant charge during pumpdown shall have sufficient capacity to receive the pumpdown charge. The liquid shall not occupy more than 90% of the volume when the temperature of the refrigerant is 90ºF. The receiver volume is not required to contain the total system charge, but is required to contain the amount being transferred. If the environmental temperature is expected to rise above 122ºF, the designer shall account for the specific expansion characteristics of the refrigerant.

(12) SERVICE PROVISIONS. (a) All refrigerating systems shall have provisions to handle the refrigerant charge for service purposes. There shall be liquid and vapor transfer valves, transfer compressor or pump, and refrigerant storage tanks or appropriate valved connections for removal by a reclaim, recycle or recovery device.

(b) 1. Except as provided in subd. 2., refrigerating systems containing more than 6.6 pounds of refrigerant shall have stop valves installed at the following locations:

a. The suction inlet of each compressor, compressor unit or condensing unit;

b. The discharge outlet of each compressor, compressor unit or condensing unit; and

c. The outlet of each liquid receiver.

2. Stop valves are not required on systems which have a refrigerant pumpout function capable of storing the entire refrigerant charge, systems equipped with the provisions for pumpout of the refrigerant, or self–contained systems.

(c) Except as provided in par. (b) 2., refrigerating systems containing more than 110 pounds of refrigerant shall have stop valves installed at the following locations:

1. The suction inlet of each compressor, compressor unit or condensing unit;

2. The discharge outlet of each compressor, compressor unit or condensing unit;

3. The inlet of each liquid receiver, except for self–contained systems or where the receiver is an integral part of the condenser or condensing unit;

4. The outlet of each liquid receiver; and

5. The inlet and outlet of condensers when more than one condenser is used in parallel in the system.

(d) Stop valves shall be suitably labeled if the components to and from which the valve regulates flow are not in view at the valve location. Labeling of the piping adjacent to the valves is sufficient to satisfy this requirement. When numbers are used to label the valves, there shall be a key to the numbers located within sight of the valves with letters at least 0.5 inch high.

Note: For information on labeling of valves, see ANSI standard A13.1, Scheme for the Identification of Piping Systems.

(13) FABRICATION. (a) The following are minimum requirements for refrigerant–containing copper pipe or tubing:

1. Copper tubing used for refrigerant piping shall conform to the American Society for Testing and Materials (ASTM) specification B88 types K or L, or ASTM specification B280.

2. For Group A1 refrigerants, copper tube shall be connected by brazed joints, soldered joints or mechanical joints.

(b) For Groups A2, A3, B1, B2 and B3 refrigerants, protective metal enclosures shall be provided for annealed copper tube erected on the premises, except that no enclosures shall be required for connections between a condensing unit and the nearest protected riser, if such connections are not more than 6.6 feet in length apart.

(c) Except for Group A1 refrigerants, joints on refrigerant–containing copper tube that are made by the addition of filler metal shall be brazed.

(14) FACTORY TESTS. (a) All refrigerant–containing parts or self–contained systems shall be tested and proved tight by the manufacturer at not less than the design pressure for which they are rated. Pressure vessels shall be tested in accordance with sub. (3).

(b) 1. The test pressure applied to the highside of each factory–assembled refrigerating system shall be at least equal to the design pressure of the highside. The test pressure applied to the lowside of each factory–assembled refrigerating system shall be at least equal to the design pressure of the lowside.

2. The test on the complete system may be conducted at the minimum lowside design pressure in accordance with sub. (2) if final assembly connections are made in accordance with ASME B31.5. In this case, parts shall be individually tested by either the self–contained system manufacturer or the manufacturer of the part at not less than the highside design pressure.

(c) Self–contained systems with a design pressure of 15 psig or less shall be tested at a pressure not less than 1.33 times the design pressure and shall be proved tight at not less than the lowside design pressure.

(15) NAMEPLATE. Each self–contained system and each separate condensing unit, compressor or compressor unit sold for field assembly in a refrigerating system shall carry a nameplate marked with the manufacturer's name, nationally registered trademark or trade name, identification number, the design pressures and the refrigerant for which it is designed. The refrigerant shall be designated by the refrigerant number as shown in Table 45.17–1 or as determined by the American Society of Heating, Refrigerating and Air–Conditioning Engineers.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94; **corrections in (3) (a) 1., (b), (5) (b), (6) (a), (b), (7) (a), (f) and (11) (a) 2. made under s. 13.93 (2m) (b) 7., Stats., Register June 2002 No. 558.**

Comm 45.21 Operation and testing. (1) GENERAL. (a) Every refrigerant–containing part of every system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gauges, control mechanisms and systems that are factory–tested, shall be tested and proved tight after complete installation and before operation.

(b) Except as provided in par. (c), the highside and lowside of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure–relief device protecting the highside or lowside of the system, respectively.

(c) Systems erected on the premises using Group A1 refrigerants and with copper tubing not exceeding 0.62 inch outside diameter may be tested with refrigerant.

(2) TEST MEDIUM. A suitable dry gas such as nitrogen or air shall be used for pressure testing. The means used to build up the test pressure shall have either a pressure–limiting device or a pressure–reducing device with a pressure–relief device and a gauge on the outlet side. The pressure–relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

(3) DECLARATION. A dated declaration of test shall be provided for all systems containing 55 pounds or more of refrigerant. The declaration shall give the name of the refrigerant and the field test pressure applied to the highside and the lowside of the system. The declaration of test shall be signed by the installer and, if an inspector is present at the tests, the inspector shall also sign the declaration. When requested, copies of this declaration shall be furnished to the department.

Note: The declaration of test can be developed on site by the installer; it is not a department form.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.22 General requirements. (1) MACHINERY ROOMS. Access to the machinery room shall be restricted to authorized personnel.

(2) SIGNS AND IDENTIFICATION. (a) *Installation identification.* Each refrigerating system erected on the premises shall be provided with a legible permanent sign, securely attached and readily accessible, indicating the name and address of the installer, the refrigerant number and amount of refrigerant, the lubricant identity and amount, and the field test pressure applied.

(b) *Controls and piping identification.* Systems containing more than 110 pounds of refrigerant shall be provided with durable signs having letters not less than 0.5 inch in height, designating:

1. Valves or switches for controlling the refrigerant flow, the ventilation and the refrigeration compressor; and

2. The name of the refrigerant or secondary coolant contained in exposed piping outside the machinery room.

Note: For information on labeling of piping, see ANSI standard A13.1, Scheme for the Identification of Piping Systems.

(c) *Changes in refrigerant or lubricant.* When the kind of refrigerant or lubricant is changed as provided in s. Comm 45.16 (3), new signs shall be installed to identify the changes.

(3) CHARGING, WITHDRAWAL AND DISPOSITION OF REFRIGERANTS. No service containers may be left connected to a system except while charging or withdrawing refrigerant. Refrigerants withdrawn from refrigerating systems shall be transferred to approved containers only. Except for discharge of pressure–relief devices and fusible plugs, incidental releases due to leaks, purging of noncondensibles, draining oil and other routine operating or maintenance procedures, no refrigerant may be discharged to the atmosphere or to locations such as a sewer, river, stream or lake.

(4) CONTAINERS. Containers used for refrigerants withdrawn from a refrigerating system shall be as prescribed in the pertinent regulations of the U.S. department of transportation and shall be carefully weighed each time they are used for this purpose, and containers shall not be filled in excess of the permissible filling weight.

Note: The pertinent regulations of the U.S. department of transportation are contained in 49 CFR Parts 100 to 199.

(5) STORING REFRIGERANT. Refrigerant stored in a machinery room shall not be more than the amount to normally operate the largest refrigerating system in the room, in addition to the charge in the system and the refrigerant stored in a permanently attached receiver. The refrigerant shall be stored in approved storage containers.

(6) SELF–CONTAINED BREATHING APPARATUS. When a machinery room is required under s. Comm 45.18 (4) and ammonia is used as the refrigerant, at least one approved self–contained breathing apparatus (SCBA) shall be located outside of, but close to, the machinery room.

Note: Requirements for the use and maintenance of SCBA can be found in section 29 CFR 1910.134 of the federal occupational safety and health administration.

(7) MAINTENANCE. (a) General. Refrigerating systems shall be maintained by the user in a clean condition, free from accumulations of oily dirt, waste and other debris.

(b) Stop valves. Stop valves connecting refrigerant–containing parts to atmosphere during shipping, testing, operating, servicing or standby conditions shall be capped, plugged, blanked or locked closed when not in use.

(c) Calibration of pressure measuring equipment. Pressure measuring equipment shall be checked for accuracy and calibrated prior to test and immediately after every occasion of full scale pressure, either by comparison with master gauges or by a dead–weight pressure gauge tester, over the operating range of the equipment.

(d) Periodic tests. Detectors, alarms and mechanical ventilating systems shall be tested in accordance with manufacturers' specifications.

(8) RESPONSIBILITY FOR OPERATION AND EMERGENCY SHUTDOWN. (a) The person in charge of the premises on which a refrigerating system containing more than 55 pounds of refrigerant is installed shall provide a schematic drawing or panel giving directions to the operation of the system at a location that is convenient to the operators of the equipment.

(b) Emergency shutdown procedures, including precautions to be observed in case of a breakdown or leak, shall be displayed on

a conspicuous card located as near as possible to the refrigerant compressor. These precautions shall address:

1. Instructions for shutting down the system in case of emergency;

2. The name, address, and day and night telephone numbers for obtaining service; and

3. The name, address and telephone number of the fire department having jurisdiction and instructions to notify that fire department immediately in case of emergency.

(c) When a machinery room is used, the emergency procedures shall be posted outside the room, immediately adjacent to each door.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.32 Approved equipment. transfer, recovery and recycling equipment. The department shall approve any transfer, recovery or recycling equipment if an approved nationally recognized testing laboratory has certified the equipment.

Note: The department will accept equipment that has been tested and certified in accordance with ARI standard 740.

(2) RECLAIMING EQUIPMENT. The department shall approve any refrigerant reclaiming equipment if the equipment reprocesses the used refrigerant to the purity standards specified in ARI Standard 700.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.

Comm 45.33 Refrigerant purity. Ozone–depleting refrigerant that has been removed from refrigeration equipment and that will be transferred to a different owner's refrigeration equipment shall comply with ARI Standard 700. Documentation certifying product specifications in accordance with ARI Standard 700 shall accompany the reclaimed refrigerant.

History: Cr. Register, August, 1994, No. 464, eff. 9–1–94.