

Chapter Ind 45

PURPOSE, SCOPE, DEFINITIONS

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Ind 45.001 Purpose. The application of this code is intended to insure the safe design, construction, installation, inspection and operation of every refrigerating system employing a fluid which is vaporized and liquefied in its refrigerating cycle, which may be used for the extraction of heat, including the preparation and preservation of food, the cooling and dehumidification of air for industrial purposes and for comfort, and as an aid to or a part in a chemical process.

Ind 45.01 Scope. This code shall apply to all refrigerating machines installed in public buildings and places of employment, except refrigerating systems using air or water as the refrigerant.

Ind 45.02 Definitions. (1) **CHECK VALVE.** A valve which permits a fluid to flow in only one direction.

(2) **COMPRESSOR.** A mechanical device used in a refrigerating system for the purpose of increasing the pressure upon the refrigerant.

(3) **CONDENSER.** A vessel or arrangement of pipe or tubing in which vaporized refrigerant is liquefied by the removal of heat.

(a) Double pipe or atmospheric condensers shall be considered as pipe coils.

(b) The gross volume of a shell and tube condenser shall be the entire volume of the vessel including the tubes.

(c) The net volume of a shell and tube condenser shall be the gross volume less the space occupied by the tubes.

Note: For the purpose of this code the net volume of a shell and tube type condenser may be considered as one-half of the gross volume. See section Ind 45.10.

(4) **CONDENSING UNIT.** A specific refrigerating machine combination for a given refrigerant, consisting of one or more power-driven compressors, condensers, liquid receivers (when required), and the regularly furnished accessories.

(5) **DIFFUSER.** A device for use outdoors on the discharge end of a safety or blow-off line, for avoiding straight line discharge, reducing

local concentration, and preventing the entrance of foreign matter and water.

(6) **EVAPORATOR.** That part of the system in which liquid refrigerant is vaporized to procure refrigeration.

(7) **LIQUID RECEIVER.** A vessel permanently connected to a system by inlet and outlet pipes for storage of a liquid refrigerant.

(8) **PRESSURE GAUGE.** A dial instrument for registering the pressure of a fluid confined within a pipe or chamber.

(9) **PRESSURE LIMITING DEVICE.** A pressure responsive mechanism designed to automatically stop the operation of the compressor at a predetermined pressure.

(10) **PRESSURE RELIEF VALVE.** A valve held closed by a spring and designed to automatically relieve pressure in excess of its setting.

(11) **PRESSURE VESSEL.** Any refrigerant containing receptacle of a refrigerating system other than expansion coils, headers and pipe connections.

(12) **REFRIGERANT.** A substance used to produce refrigeration by its expansion or vaporization.

(13) **REFRIGERATING SYSTEM.** A combination of interconnected refrigerant containing parts in which a refrigerant is circulated for the purpose of extracting heat.

(14) **STOP VALVE.** A shut-off for controlling the flow of a refrigerant.

(15) **TONNAGE.** For the purpose of this code, the capacity of a refrigerating machine in tons (200 B.t.u. per minute) shall be the manufacturers' rating at plus 5 degrees Fahrenheit evaporating temperature and plus 86 degrees Fahrenheit condensing temperature or may be approximated from Table 3.

Ind 45.03 Refrigerating systems, classification by type. (1) Refrigerating systems shall be divided into classes, descriptive of the method employed for extracting heat as follows:

(a) *Direct system.* Direct system is one in which the evaporator is in direct contact with the material or space refrigerated or is located in air-circulating passages communicating with such spaces.

(b) *Indirect system.* Indirect system is one in which a liquid, such as brine or water cooled by the refrigerant, is circulated to the material or space refrigerated or is used to cool air so circulated.

(c) *Unit system.* Unit or self-contained system is one which has been assembled and tested prior to its installation and which can be moved about without disconnecting any refrigerant-containing parts.

(d) *Remote system.* Remote system is one in which it is necessary for the installer to connect lines to carry the refrigerant between the various parts of the system.

(e) *Double refrigerant system.* Double refrigerant system is one in which a refrigerant is used in the secondary circuit instead of brine or water.

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(2) For the purpose of this code, each circuit shall be considered as a separate direct refrigerating system.

Note: General information on refrigerants. Every fire department should be acquainted with the location of refrigerating systems and with the refrigerants contained therein so that they may prepare themselves against the hazards presented. As indicated in this code, there may be fire and explosion hazards as well as danger from breathing gas. Escape of gas may be caused by a fire to which a fire department has been called, or it may be the result of a mechanical failure. In either case the fire department may need gas masks, and if so, needs to be trained in their use. A heavy concentration of gas will require the use of an oxygen helmet.

It is recommended that an approved mask or helmet be worn by employees or service men, when practical, when major repairs or adjustments are being made to refrigerating equipment.

GENERAL REQUIREMENTS

Ind 45.04 When effective. (1) NEW AND OLD SYSTEMS. (a) These orders shall apply to all refrigerating systems installed on or after the effective date of this code and to parts replaced or added to systems already in service on or after the same date.

(b) Systems installed prior to the effective date of this code and which do not comply with the requirements of the refrigerating plant code effective June 26, 1918 shall be made to comply with the orders of this code with the exception of section Ind 45.10 (1).

(2) KIND OF REFRIGERANT. (a) Each refrigerating system shall be provided with a legible metal sign indicating thereon the kind of refrigerant in use. The sign shall be permanently attached to the compressor, or at the liquid receiver or charging valve. If either of the above are not within sight of each other then another sign shall be attached to the system in each of the above locations.

(3) MACHINE IDENTIFYING NUMBER. Each refrigerating machine shall be permanently marked with an identifying number.

(4) REGISTRATION AND DECLARATION. New and used remote systems exceeding one and one-half tons capacity or unit systems exceeding three tons capacity shall not be installed until a registration form, indicating that the system will be installed to meet the requirements of this code, has been filed with the industrial commission by the owner or by the installing contractor in behalf of the owner, and a declaration to that effect has been conspicuously posted on the premises.

Note: Table 3 in the appendix may be used to determine the approximate capacity in tons for displacement, and forms for registration and declaration may be obtained from the industrial commission.

Ind 45.05 Materials. No materials shall be used in the construction and installation of refrigerating systems that will deteriorate due to the chemical action of the refrigerant or the oil, or the combination of these. Renewals or replacements of materials or appliances shall be in accordance with the requirements set forth in this code.

Ind 45.06 Supports. All refrigerant-containing parts and piping shall be securely supported by means of metal hangers, brackets, straps, clamps, or pedestals, in such manner as to relieve joints or piping of harmful strains and vibration.

Ind 45.07 Maintenance. All refrigerating systems shall be maintained in safe condition. If any part of a refrigerating system, or any

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piping in connection with such system, becomes dangerous through corrosion or any other cause, it shall be replaced or satisfactorily repaired.

Ind 45.08 Test medium. No oxygen or any flammable gases or liquids or flammable mixtures of them shall be used within a refrigerating system for testing purposes.

Ind 45.09 Gauges. Liquid level gauge glasses, except those of the bulls' eye type or indirect level indicator, shall have automatic closing shut-off devices and all glasses shall be protected against injury by sturdy metal guards.

Ind 45.10 Pressure vessels. (1) **CONSTRUCTION, INSPECTION AND STAMPING.** Refrigerant-containing vessels shall be constructed, inspected and stamped in accordance with the requirements contained in the current Wisconsin boiler and unfired pressure vessel code.

(2) **VOLUME OF SHELL AND TUBE VESSEL.** The net volume of a shell and tube vessel shall be considered as one-half of the gross volume of the vessel. If no liquid receiver is used, the condenser safety valve size shall be based on the gross volume of the vessel.

(3) **PRESSURE RELIEF VALVE.** Each pressure vessel exceeding 5 cubic feet net capacity shall be protected at all times by a pressure relief valve, the diameter of which shall be in accordance with table 4 in the appendix of this code.

(4) **ADDITIONAL RELIEF VALVE AREA.** When the required pressure relief valve area exceeds that provided by a 2 inch diameter valve, then an additional pressure relief valve or valves shall be installed to secure the required area.

(5) **PRESSURE ACTUATED RELIEF DEVICES.** All pressure relief devices for refrigerant-containing vessels shall be directly pressure actuated.

(6) **RELIEF VALVE SETTING.** All pressure relief valves for refrigerant-containing vessels shall be set to function at a pressure not to exceed the maximum allowable working pressure of the vessel.

(7) **RELIEF VALVE MARKING.** Each pressure relief valve shall be legibly marked to designate its setting in pounds per square inch and with the name of the manufacturer.

(8) **DUAL RELIEF VALVES.** No stop valve shall be located between a pressure relief device or pressure limiting device and the part of the system protected thereby, unless two devices of the required size are used and so arranged that only one can be shut off at any one time.

(9) **RELIEF VALVE DISCHARGE.** The discharge from such pressure relief valves shall be by unobstructed continuous piping to the outside atmosphere not less than 12 feet above the ground and not closer than 20 feet to any fire escape, doorway, ventilator or other opening. The pipe shall be provided with a diffuser and so positioned that water cannot enter the line.

(10) **ACCUMULATOR SAFETY VALVES.** The discharge from safety valves attached to low pressure accumulators may be connected into the suction line on the machine side of the stop valve or outdoors as provided in paragraph 9 of this order.

(11) **COMMON DISCHARGE PIPE.** A common discharge pipe may be used for more than one pressure relief valve. It shall have an area at least equal to the combined net areas of the three largest relief valves discharging into it. A drain shall be provided to remove moisture. The diameter of the outlet pipe shall not be less than that of the inlet pipe. If the length of the relief line exceeds 50 feet, the size of the entire line shall be increased one pipe size for each additional 100 feet of length or fraction thereof.

Ind 45.11 Compressors and compressing units. (1) **PRESSURE CONTROL.** Each compressor or water-cooled condensing unit not exceeding 3 tons capacity and each air-cooled condensing unit exceeding one-half ton capacity but not exceeding 3 tons capacity shall be equipped with a pressure relief valve or a pressure limiting device. Each compressor and condensing unit exceeding 3 tons capacity shall be equipped with adequate pressure relief valve capacity. The location of an internal relief valve shall be permanently indicated by stamping or casting the words "Relief Valve" at the location of the relief valve.

(2) **COMPRESSOR RELIEF VALVE.** No stop valve or obstruction of any description shall be placed in the pipe line between the compressor and its pressure relief valve, nor in the discharge pipe between the pressure relief valve and the suction pipe.

(3) **RELIEF VALVE DISCHARGE.** The discharge from the compressor relief devices shall be conducted to a point in the suction line or to the atmosphere as described in section Ind 45.10.

(4) **PRESSURE CONTROL SETTING.** The pressure relief valve or the pressure limiting device shall relieve the pressure on the discharge side of the compressor or halt the operation of the refrigerating machine at a pressure not exceeding the maximum allowable working pressure.

Ind 45.12 Check valves. (1) **WHERE REQUIRED.** A check valve shall be placed in the discharge pipe from each refrigerating machine as close to the machine as is practical when the machine exceeds 3 tons capacity and uses a refrigerant classified under groups 2 or 3 of table 1 in the appendix.

(2) **DEFROSTING LINE.** When a hot gas defrosting line is used, there shall be a check valve in the discharge line between the condenser and the point where the hot gas line connects into the discharge line.

(3) **ABSORPTION SYSTEM.** Check valves shall be installed in an absorption system exceeding 3 tons capacity and shall be located between the rectifier and the condenser and in the discharge line close to the aqua pump.

Ind 45.13 Refrigerant substitutes. No refrigerant shall be put into any refrigerating equipment not specifically designed for that refrigerant until the installation has been made to comply with the requirements applicable to the new refrigerant as set forth in these orders.

Ind 45.14 Purging. Purge lines from any part of an ammonia refrigerating machine shall be of steel pipe, or steel or aluminum tubing.

Ind 45.15 Pressure gauge. Each refrigerating system of 5 tons capacity and over, using group 2 or 3 refrigerant* or 25 tons or over using group 1 refrigerant, shall be equipped with a pressure gauge attached to the high pressure side. The dial of the pressure gauge shall be graduated to at least $1\frac{1}{2}$ times the normal operating pressure.

Ind 45.16 Safety mask or helmet. (1) **WHERE REQUIRED.** Establishments containing refrigerating systems using refrigerants listed under group 2, table 1, shall be equipped with not less than one safety mask or helmet if the amount of refrigerant in the system is more than 100 pounds, but does not exceed 1000 pounds. Not less than two safety masks or helmets shall be provided if the system contains more than 1000 pounds of refrigerant listed under group 2, table 1.

(2) **TYPE AND LOCATION.** Safety masks or helmets shall be as approved by the industrial commission for the refrigerant employed, and they shall be kept in a suitable cabinet immediately outside the machinery room or other approved accessible location. They shall be kept in a usable condition.

(3) **CANISTER RENEWAL.** Each safety mask shall have an additional canister or cartridge. Canisters and cartridges shall be renewed immediately after having been used and if unused, must be renewed at least every 2 years. The date of filling shall be marked on each canister or cartridge.

Ind 45.17 Ventilation. Refrigeration compressor, condenser and receiving room or rooms containing refrigeration machinery exceeding $\frac{1}{2}$ tons capacity shall, for the safety and health of employees and others, be provided with means of ventilation to the outer air. The ventilation shall consist of window or door openings to the outer air, or shall be by mechanical means as set forth in the heating, ventilation and air conditioning code or the general orders on dusts, fumes, vapors and gases issued by the industrial commission.

Ind 45.18 Location. (1) **HOSPITALS AND INSTITUTIONS.** No refrigerating system using a refrigerant listed under groups 2 or 3 of table 1 shall be located in a hospital or in any other institution or place where persons are helpless or confined.

(2) **SEPARATE ROOMS IN OTHER PLACES.** In all other places, refrigerating compressors exceeding 5 tons total capacity and using a refrigerant listed under group 2 or 3 of table 1 shall not be placed in a room where more than 5 persons (not including operating or maintenance personnel) assembly or are employed.

(3) **PROHIBITED USE.** Refrigeration compressor, condenser or receiver room or rooms shall not be used as dressing, lunch or recreation rooms.

* See Appendix Table I.

APPENDIX

Table 1

REFRIGERANT CLASSIFICATION

Refrigerants shall, for Safety Code purposes, be divided into groups as follows:

<i>Group 1</i>	<i>Chemical Formula</i>
Carbon Dioxide -----	CO ₂
Dichlorodifluoromethane (Freon 12) -----	CCl ₂ F ₂
Dichloromethane (Carrene No. 1) Methylene Chloride) -----	CH ₂ Cl ₂
Dichloromonofluoromethane (Freon 21) -----	CHCl ₂ F
Difluoromonochloromethane (Freon 22) -----	CHF ₂ Cl
Dichlorotetrafluoroethane (Freon 114) -----	C ₂ Cl ₂ F ₄
Trichloromonofluoromethane (Carrene No. 2) (Freon 11) -----	CCl ₃ F
Trifluorotrchloroethane (Freon 113) -----	C ₂ Cl ₃ F
<i>Group 2</i>	
Ammonia -----	NH ₃
Dichloroethylene -----	C ₂ H ₂ Cl ₂
Ethyl Chloride -----	C ₂ H ₅ Cl
Methyl Chloride -----	CH ₃ Cl
Methyl Formate -----	HCOOCH ₃
Sulphur Dioxide -----	SO ₂
<i>Group 3</i>	
Butane -----	C ₄ H ₁₀
Ethane -----	C ₂ H ₆
Ethylene -----	CH ₂ CH ₂
Isobutane -----	(CH ₃) ₂ CH
Propane -----	C ₃ H ₈

Refrigerants not included in table 1 shall be classified as set forth in the American Standards Association's "Safety Code" for Mechanical Refrigeration, latest edition.

Table 2
MINIMUM TEST PRESSURES

Every part of a refrigerating system, except pressure gauges and control mechanisms, shall be designed, constructed and assembled to withstand minimum test pressures as specified in this table.

Refrigerant	Minimum Test Pressure Pounds Per Sq. In.	
	High Pressure Side	Low Pressure Side
1. Ammonia.....	300	150
2. Butane.....	90	50
3. Carbon Dioxide.....	1500	1000
4. Dichloroethylene.....	30	30
5. Ethane*.....	1500	1000
6. Ethylene*.....	1500	1000
7. Ethyl Chloride.....	60	50
8. Freon-11.....	30	30
9. Freon-12.....	235	145
10. Freon-21.....	70	50
11. Freon-22.....	300	245
12. Freon-113.....	30	30
13. Freon-114.....	50	50
14. Isobutane.....	130	75
15. Methyl Chloride.....	215	125
16. Methyl Formate.....	50	50
17. Methylene Chloride.....	30	30
18. Propane.....	325	210
19. Sulphur Dioxide.....	170	95

* The test pressures given here shall apply to parts of the system not protected by safety valves.

Refrigerants not listed.

For refrigerants not listed in table 2, the test pressure for the high pressure side shall not be less than the saturated vapor pressure of the refrigerant at 150° F. The test pressure for the low pressure side shall not be less than the saturated vapor pressure of the refrigerant at 115° F. In no case shall the test pressure be less than 30 pounds per square inch by gauge.

Table 3
DISPLACEMENT

Refrigerant	Displacement Per Ton Cubic Feet Per Minute at Plus 5°F. to Plus 86°F.	Chemical Symbol
1. Ammonia.....	3.44	NH ₃
2. Butane.....	16.16	C ₄ H ₁₀
3. Carbon Dioxide.....	.943	CO ₂
4. Dichloroethylene.....	111.2	C ₂ H ₂ Cl ₂
5. Ethane*.....	18.8	C ₂ H ₆
6. Ethyl Chloride.....	20.46	C ₂ H ₅ Cl
7. Ethylene*.....	9.8 (8.8)	C ₂ H ₄
8. Freon-11.....	36.33	CCL ₃ F
9. Freon-12.....	5.82	CCl ₂ F ₂
10. Freon-21.....	20.43	CHCl ₂ F
11. Freon-22.....	3.6	CHClF ₂
12. Freon-113.....	100.9	C ₂ F ₃ Cl ₃
13. Freon-114.....	19.59	C ₂ Cl ₂ F ₄
14. Isobutane.....	11.50	(CH ₃) ₃ CH
15. Methyl Chloride.....	5.95 (6.09)	CH ₃ Cl
16. Methyl Formate.....	49.50	HCOOCH ₃
17. Methylene Chloride.....	74.45	CH ₂ Cl ₂
18. Propane.....	4.09	C ₃ H ₈
19. Sulphur Dioxide.....	9.08	SO ₂

* Based on Evaporation at -160° F. Condensation at -50° F.

Table 4
PRESSURE RELIEF VALVES—DIAMETER

Net Capacity	Diameter of Valve
Over 5 to 25 cubic feet.....	1/2 inch
Over 25 to 45 cubic feet.....	3/4 inch
Over 45 to 60 cubic feet.....	1 inch
Over 60 to 100 cubic feet.....	1 1/4 inch
Over 100 to 200 cubic feet.....	1 1/2 inch
Over 200 to 300 cubic feet.....	2 inch