**Chapter 53 Mechanical Refrigeration**

53.1\* General

53.1.1 Applicability

53.1.1.1\*

Refrigeration unit and system installations having a refrigerant circuit containing more than 220 lb (100 kg) of Group A1 or 30 lb (13.6 kg) of any other group refrigerant shall be in accordance with Chapter 53 and the mechanical code.

53.1.1.2

Temporary and portable installations shall be exempt from the requirements of this chapter when approved.

53.1.1.3 Ammonia Refrigeration

Ammonia refrigeration systems shall be exempt from the requirements of this chapter, other than 53.1.2 and 53.1.3.

53.1.2 Permits and Plans

53.1.2.2

Plans and specifications for devices and systems required by this chapter shall be submitted to the AHJ for review and approval prior to installation.

53.1.3 Reference Codes and Standards

53.1.3.1

Refrigeration systems using a refrigerant other than ammonia shall be in accordance with ANSI/ASHRAE 15, Safety Standard for Refrigeration Systems, and the mechanical code.

53.1.3.2

Refrigeration systems using ammonia as the refrigerant shall comply with ANSI/IIAR 2, Standard for Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems; ANSI/IIAR 6, Standard for Inspection, Testing, and Maintenance of Closed-Circuit Ammonia Refrigeration Systems; ANSI/IIAR 7, Developing Operating Procedures for Closed-Circuit Ammonia Mechanical Refrigerating Systems; and ANSI/IIAR 8, Decommissioning of Closed-Circuit Ammonia Mechanical Refrigerating Systems.

53.2 Safety Features

53.2.1 Emergency Pressure Control System

Refrigeration systems containing more than 6.6 lb (3 kg) of flammable, toxic, or highly toxic refrigerant shall be provided with an emergency pressure control system in accordance with 53.2.1.1 and 53.2.1.2.

53.2.1.1 High- And Intermediate-Pressure Zones

Each highland intermediate-pressure zone in a refrigeration system shall be provided with a single automatic valve providing a crossover connection to a lower pressure zone. Automatic crossover valves shall comply with 53.2.1.1.1 through 53.2.1.1.4.

53.2.1.1.1 Overpressure Limit Set Point for Crossover Valves

Automatic crossover valves shall be provided to automatically relieve excess system pressure to a lower pressure zone if the pressure in a high- or intermediate-pressure zone rises to within 90 percent of the set point for emergency pressure relief devices.

53.2.1.1.2 Manual Operation

Where required by the AHJ, automatic crossover valves shall be capable of manual operation.

53.2.1.1.3 System Design Pressure

Refrigeration system zones that are connected to a higher pressure zone by an automatic crossover valve shall be designed to safely contain the maximum pressure that can be achieved by interconnection of the two zones.

53.2.1.1.4 Automatic Emergency Stop

Operation of an automatic crossover valve shall cause all compressors on the affected system to immediately stop in accordance with the following:

Dedicated pressure-sensing devices located immediately adjacent to crossover valves shall be permitted as a means for determining operation of a valve.

To ensure that the automatic crossover valve system provides a redundant means of stopping compressors in an overpressure condition, high-pressure cutout sensors associated with compressors shall not be used as a basis for determining operation of a crossover valve.

53.2.1.2 Low-Pressure Zone

53.2.1.2.1 Overpressure Limit Set Point for Emergency Stop

The lowest pressure zone in a refrigeration system shall be provided with a dedicated means of determining a rise in system pressure to within 90 percent of the set point for emergency pressure relief devices.

53.2.1.2.2 Automatic Emergency Stop

Activation of the overpressure sensing device shall cause all compressors on the affected system to immediately stop.

53.2.2 Treatment, Flaring, and Diffusion Systems for Refrigerant Discharge

53.2.2.1 Required Systems

Unless the AHJ determines, upon review of an engineering analysis prepared at the expense of the owner, that a significant fire, health, or environmental hazard would not result from an atmospheric release, refrigeration systems that are designed to discharge refrigerant vapor to the atmosphere shall be provided with an approved treatment, flaring, or diffusion system where required by 53.2.2.1.1 and 53.2.2.1.2.

53.2.2.1.1 Toxic and Highly Toxic Refrigerants

Systems containing toxic or highly toxic refrigerants shall discharge vapor to the atmosphere only through an approved treatment system in accordance with Chapter 63 or flaring system in accordance with 53.2.2.2.

53.2.2.1.2 Flammable Refrigerants

Systems containing flammable refrigerants shall discharge vapor to the atmosphere in accordance with the following:

For refrigerants having a density equal to or greater than the density of air, discharge shall be through an approved treatment system in accordance with or flaring system in accordance with 53.2.2.2.

For refrigerants having a density less than the density of air, discharge to the atmosphere shall be permitted, provided that the point of discharge is located outside of the structure at not less than 15 ft (4.6 m) above the adjoining grade level and not less than 20 ft (6.1 m) from any window, ventilation opening, or exit.

53.2.2.2 Design of Flaring Systems

53.2.2.2.1

Flaring systems for incineration of flammable, toxic, or highly toxic refrigerants shall be designed to incinerate the entire discharge.

53.2.2.2.2

The products of refrigerant incineration shall not pose health or environmental hazards.

53.2.2.2.3

Incineration shall be automatic upon initiation of discharge, shall be designed to prevent blowback, and shall not expose structures or materials to threat of fire.

53.2.2.2.4

Standby fuel, such as LP-Gas, and standby power shall have the capacity to operate for one and one half the required time for complete incineration of refrigerant in the system.

53.2.3 Refrigeration Machinery Rooms

Where required by the mechanical code, refrigeration systems shall be provided with a refrigeration machinery room, which shall comply with 53.2.3.1 through 53.2.3.4.

53.2.3.1 Refrigerant Vapor Detection, Monitoring, Alarm, and Electrical Systems

Refrigeration machinery rooms shall have an approved refrigerant vapor detection, monitoring, and alarm system in accordance with 53.2.3.1.1 through 53.2.3.1.7 and the mechanical code.

53.2.3.1.1 Alarm Threshold

The refrigerant vapor detector shall activate approved visual and audible alarm signaling devices at a value not greater than the corresponding TLV-TWA (or toxicity measure consistent therewith), not to exceed 25 percent of the lower flammable limit (LFL).

53.2.3.1.2 Location of Signaling Devices

Audible and visual alarm signaling devices shall be located inside the refrigeration machinery room and outside the room at each entrance into the room.

53.2.3.1.3 Audibility

Audible alarm signaling devices shall provide a sound level of at least 15 dB above the operating ambient noise sound pressure level of the space in which they are installed and shall provide approved, distinctive audible and visual alarms.

53.2.3.1.4\* Emergency Shutoff Interface

Where the quantity of a Group A2, B2, A3, or B3 refrigerant in an independent circuit would exceed 25 percent of the LFL if released to the surrounding room, either of the following shall apply:

Electrical equipment shall comply with the requirements of NFPA 70 for Class I, Division 2.

The refrigerant vapor detection system required by 53.2.3.1 shall automatically de-energize all electrical power within the space at vapor concentrations at or above 25 percent of the LFL.

53.2.3.1.5 Power and Supervision

Refrigerant vapor detection and alarm systems shall be powered and supervised as required for fire alarm systems in accordance with NFPA 72.

53.2.3.1.6 Monitoring and Annunciation

Refrigerant vapor detection and alarm systems shall transmit a signal to an approved location.

53.2.3.1.7 Installation and Maintenance

Detection and alarm systems shall be installed and maintained in accordance with the equipment manufacturers' specifications. (Also see 53.3.2.1.)

53.2.3.2\* Prohibited Sources of Ignition

Open flames or devices having an exposed surface temperature exceeding 800°F (427°C) shall be prohibited in refrigeration machinery rooms except as follows:

Momentary temperature excursions such as electrical contacts in Group A1 and B1 systems shall be permitted.

Open flames or devices having an exposed surface temperature exceeding 800°F (427°C) shall be permitted in refrigeration machinery rooms used exclusively for direct-fired absorption equipment.

Existing nonconforming installations shall be permitted where approved by the AHJ, where the combustion system is interlocked with the refrigerant detection system to shut off at the permissible exposure limit (PEL).

Direct-vented combustion equipment shall be permitted in accordance with the mechanical code.

53.2.3.3 Ventilation Systems

53.2.3.3.1

Fans providing emergency purge ventilation for refrigerant escape from a refrigeration room shall have a clearly identified switch of the break-glass type providing on-only control immediately adjacent to, and outside of, each refrigerant machinery room means of egress.

53.2.3.3.2

An emergency purge control shall be provided with a manual reset only.

53.2.3.3.3

Purge fans shall also respond automatically to the refrigerant concentration detection system set to activate the ventilation system at the threshold levels set forth in 53.2.3.1.1.

53.2.3.3.4

Mechanical ventilation systems serving refrigeration rooms shall have switches to control the power to each fan.

53.2.3.3.5

The switches shall be key-operated or within a locked glass-covered or tamper-resistant enclosure at an approved location adjacent to and outside of the principal entrance to the refrigeration machinery room.

53.2.3.3.6

Keys necessary for operation of ventilation systems shall be located in a single approved location.

53.2.3.3.7

Switches controlling fans providing continuous ventilation shall be of the two-position, on/off type.

53.2.3.3.8

Switches controlling fans providing intermittent or emergency ventilation shall be of the three-position, automatic on/off type.

53.2.3.3.9

Switches shall be labeled identifying both the function and the specific fan being controlled.

53.2.3.3.10

Two colored and labeled indicator lamps responding to the differential pressure created by airflow shall be provided for each switch.

53.2.3.3.11

One lamp shall indicate flow, and the other shall indicate no flow.

53.2.3.3.12

Exhaust from mechanical ventilation systems in refrigeration rooms shall be discharged 20 ft (6.1 m) or more from a property line or openings into buildings.

53.2.3.3.13

Discharges capable of exceeding 25 percent of the LFL or 50 percent of the immediately dangerous to life and health (IDLH) value shall be equipped with approved treatment systems to reduce the discharge concentrations to these values or lower, except as provided in 53.2.3.3.13.1. (Also see 53.2.2.1.)

53.2.3.3.13.1

A treatment system shall not be required when an approved engineering analysis of plume dispersion demonstrates that the limiting value will not be exceeded at the property line.

53.2.3.4 Electrical

53.2.3.4.1

The refrigeration machinery room shall not be required to be classified as a hazardous location for electrical equipment except as provided in the mechanical code or NFPA 70.

53.2.3.4.2

Refrigeration machinery rooms used exclusively for direct-fired absorption equipment shall be permitted not to be classified as a hazardous location for electrical equipment in accordance with NFPA 70.

53.2.3.4.3

Electrical equipment and electrical installations in refrigeration machinery rooms shall comply with Section 11.1.

53.2.3.4.4

Where treatment, detection, or alarm systems are required, such systems shall be connected to a secondary source of power to automatically supply electrical power in the event of loss of power from the primary source.

53.2.3.4.5

A clearly identified switch of the break-glass type or with an approved tamper-resistant cover shall provide off-only control of refrigerant compressors, refrigerant pumps, and normally closed, automatic refrigerant valves located in the machinery room. In addition, this equipment shall be automatically shut off whenever the refrigerant vapor concentration in the machinery room exceeds the vapor detector's upper detection limit or 25 percent of the LFL, whichever is lower.

53.2.3.4.5.1

In machinery rooms where only nonflammable refrigerants are used, only compressors shall be required to be stopped by vapor detection or the cut-off switch. (Also see 53.2.3.1.4.)

53.2.4 Signs and Labels

53.2.4.1 General

Refrigeration units or systems shall be provided with approved hazard identification signs in accordance with NFPA 704, emergency operational signs, charts, and labels in accordance with the mechanical code, and the following:

Name and address of the manufacturer or installer

Type and total number of pounds of refrigerant contained in the system

Field test pressure applied

53.2.4.2 Systems With More Than 110 LB (50 kg) of Refrigerant

Systems containing more than 110 lb (50 kg) of refrigerant shall be provided with signs having letters not less than 1/2 in. (12.7 mm) high, designating the following:

Main shutoff valves to each vessel

Mainstream or electrical controls

Remote control switch

Pressure-limiting device

53.3 Operations, Maintenance, Testing, and Decommissioning

53.3.1 Operations and Maintenance

53.3.1.1 General

Refrigeration systems shall be operated and maintained in a safe and operable condition, free from accumulations of oil, dirt, waste, excessive corrosion, other debris, or leaks, and in accordance with ASHRAE 15, Safety Standard for Refrigeration Systems, and the mechanical code.

53.3.1.2 Access to System

Refrigeration systems shall be maintained accessible to the fire department as required by the AHJ.

53.3.1.3 Storage in Machinery Rooms

53.3.1.3.1

Flammable and combustible materials shall not be stored in refrigeration machinery rooms except for incidental materials necessary for the safe and proper operation and maintenance of the system.

53.3.1.3.2

Storage of materials in a refrigeration machinery room, including reserve supplies of refrigerants or refrigerant oils, shall be in accordance with other applicable chapters of this Code.

53.3.1.4 Changing of Refrigerant Type

Refrigerant types shall not be changed without prior notification and approval of the AHJ.

53.3.1.5 Records of Refrigerant Quantities

The person in charge of the premises on which a refrigeration unit or system subject to these regulations is installed or maintained shall keep a written record of refrigerant quantities brought onto and removed from the premises, which shall be made available to the AHJ upon request.

53.3.1.6 Permissible Refrigerant Discharges

Refrigerant shall be only permitted to be released to atmosphere in the following circumstances:

Refrigeration systems operating at pressures below atmospheric and incorporating automatic purge cycles

Incidental operation of automatic pressure relief valves resulting in minor release of the refrigerant charge

Incidental minor releases associated with service operations after system pumpdown has been accomplished

In an emergency

53.3.1.7 Notification of Fugitive Releases

Where required by the fire department, the fire department shall be notified upon discharges of refrigerant that are not in accordance with 53.3.1.6(1), 53.3.1.6(2), or 53.3.1.6(3).

53.3.2 Testing of Equipment

53.3.2.1 Acceptance Testing

The following emergency devices or systems shall be tested to demonstrate their safety and effectiveness upon completion of the installation or alteration:

Treatment and flaring systems

Fans and associated equipment intended to operate emergency purge ventilation systems

Refrigerant vapor detection and alarm systems

53.3.2.2 Periodic Testing

The following emergency devices or systems shall be tested in accordance with the manufacturers' specifications at intervals not exceeding one year:

Treatment and flaring systems

Fans and associated equipment intended to operate emergency purge ventilation systems

Refrigerant vapor detection and alarm systems

A written record of required testing shall be maintained on the premises.

53.3.2.4 Testing Personnel Qualifications

Tests of emergency devices or systems required by Chapter 53 shall be conducted by persons trained in such testing.