

Australian/New Zealand Standard™

Refrigerating systems

Part 2: Safety requirements for fixed applications



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Association of Fluorocarbons Consumers and Manufacturers, Australia
Australasian Railway Association
Australian Chamber of Commerce and Industry
Australian Institute of Refrigeration Air Conditioning and Heating
Australian Liquefied Petroleum Gas Association
Australian Retailers Association
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Australian/New Zealand Standard™

Refrigerating systems

Part 2: Safety requirements for fixed applications

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PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee ME/6, Refrigeration. This Standard supersedes (in part) AS 1677—1986, Refrigerating systems and NZS 5235, Code of practice for safety in mechanical refrigeration (Refrigeration code), Part 1:1991, Refrigerating systems with a total refrigeration effect in excess of 30 kW and Part 2:1988, Refrigerating systems with a total refrigeration effect less than 30 kW.

This Standard incorporates Amendment No. 1, (June 1999) and Amendment No. 2, (December 2000). The changes required by the Amendments are indicated in the text by a marginal bar and amendment number against the clause, note, table, figure, or part thereof affected.

The objective of this document is to provide standardized minimum requirements to address the fundamental safety aspects of refrigerating systems for use by designers, installers, manufacturers, operators and regulators of these systems.

This Standard forms Part 2 of a three-part series of Standards to address refrigerating systems. Part 1 of the series covers refrigerant classification and Part 3 addresses safety requirements for mobile applications. This Standard is based on BS 4434:1995, Safety and environmental aspects in the design, construction and installation of refrigerating appliances and systems, ANSI/ASHRAE 15:1992, Safety code for mechanical refrigeration and ISO 5149:1993, Mechanical refrigerating systems used for cooling and heating—Safety requirements.

The terms ‘normative’ and ‘informative’ have been used in this Standard to define the application of the appendix to which they apply. A ‘normative’ appendix is an integral part of a Standard, whereas an ‘informative’ appendix is only for information and guidance.

This Standard has undergone a considerable number of changes and revisions. Details of the publishing history can be obtained from Standards Australia or Standards New Zealand Information Centre.

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Australian/New Zealand Standard Refrigerating systems

Part 2: Safety requirements for fixed applications

SECTION 1 SCOPE AND GENERAL

1.1 SCOPE

This Standard specifies requirements for the safety aspects, in terms of the design, construction, installation and inspection, of refrigerating appliances, systems and ancillary equipment intended for use or installation in institutional, public assembly, residential, commercial and industrial occupancies. It includes heat pumps and reverse cycle airconditioning systems.

It applies to new refrigerating systems, to extensions and modifications of existing systems and to used systems on being reinstalled and operated at another site. It also applies in the case of the conversion of a system for use with another refrigerant.

It does not apply to specific requirements detailed in the following:

- (a) Household refrigerators covered by AS/NZS 4474.1.
- (b) Refrigerated room airconditioners covered by AS 1861.
- (c) Electrical approval and test specifications such as AS/NZS 3179, AS 3303, AS 3305 or NZS 6324.

NOTES:

- 1 This Standard is limited to fundamental safety requirements and does not purport to provide detailed design guidance.
- 2 The requirements of this Standard are based on the assumption that refrigerating systems are designed, constructed, installed, inspected and maintained by competent personnel.
- 3 The introduction of new refrigerants and techniques make it critical to ensure that the equipment to be installed or converted is suitable for use with the refrigerant to be used. Failure to observe appropriate precautions could lead to system failure resulting in injury or death.

1.2 PERFORMANCE REQUIREMENTS

The basis of the prescriptive approach to refrigerating system safety specified in this document is that the total charge of refrigerant and the volume of space in which a system is located are chosen so as to ensure that the practical limit requirements of this Standard can not be exceeded.

A performance based approach may be used for system design. Such systems shall be as safe as that specified in the prescriptive approach. The safety of such systems shall be assessed and verified by a competent person. Such systems shall be approved by the relevant regulatory authorities.

1.3 REFERENCED DOCUMENTS

A list of documents referred to in this Standard is provided in Appendix A.

1.4 DEFINITIONS

For the purposes of this Standard, the definitions given in AS/NZS 1677.1, AS 2812 and the following apply.

1.4.1 Absorption refrigerating system (adsorption refrigerating system)

A system in which refrigeration is effected by evaporation of a refrigerant, the vapour then being absorbed or adsorbed by an absorbent or adsorbent medium, respectively, from which it is subsequently expelled at a higher partial vapour pressure by heating and liquefied by cooling.

1.4.2 Breathing apparatus

Self-contained breathing apparatus which has a portable supply of compressed air, independent of the ambient atmosphere, where exhaust air passes without recirculation to the ambient atmosphere.

1.4.3 Bursting disc

A safety device that will rupture at a predetermined pressure.

1.4.4 Changeover device

A valve controlling two protection devices and so arranged that only one can be made inoperative at any one time.

1.4.5 Charge

An amount of refrigerant within a system.

1.4.6 Competent person

A person who has had appropriate training or practical experience (or both) in the subject, sufficient to provide safe and satisfactory performance.

1.4.7 Component

Any fitting or subdivision of the refrigerating system into functional parts (e.g. heat exchangers, vessels, interconnecting piping, gauges and controls) that may be separately ordered from a manufacturer or supplier.

1.4.8 Compressor

A mechanically operated component for compressing a refrigerant vapour.

1.4.9 Condenser

A heat exchanger in the form of a vessel or arrangement of tubing in which vapour is liquefied by the removal of heat.

1.4.10 Condensing unit

A specific refrigerating machine combination for a given refrigerant consisting of one or more power-drive compressors, condensers and liquid receivers (where required).

1.4.11 Cool room

A refrigerated space which is designed to maintain a temperature below 5°C and is used primarily for the storage of product.

1.4.12 Cooling system

The part of the refrigerating system that includes the evaporator and any secondary system for the purpose of cooling air or other substances.

NOTE: For the purposes of this Standard, cooling systems are classified into six types as illustrated and described in Section 2.

1.4.13 Design pressure

The pressure used in determining the necessary materials, thickness and construction requirements for components with regard to their ability to contain pressure.

1.4.14 Detector (leak detector)

A sensing device which responds to the presence of specified gas(es) in the environment at a specified minimum ppm or concentration level.

1.4.15 Evaporator

A heat exchanger in which liquid refrigerant is vapourized by absorbing heat from the substance to be cooled.

1.4.16 Exit

An opening in the outer wall, with or without a door or gate.

NOTE: Emergency exits are required to comply with building regulations.

1.4.17 Exit passageway

A passageway immediately in the vicinity of the door through which people leave the building.

1.4.18 Flanged joint

Joint made by bolting together a pair of flanged ends.

1.4.19 Flared joint

Metal-to-metal compression joint in which a conical spread is made on the end of the tube.

1.4.20 Fusible plug or fusible component

A safety device having a low-temperature melting point element to release pressure at a predetermined temperature.

1.4.21 Hallway

A corridor for the passage of people.

1.4.22 Heat pump system

A refrigerating system designed to make use of the heat rejected by the system, e.g. for space or process heating.

1.4.23 High pressure side

That portion of a refrigerating system which is subject to the highest condensing pressure.

1.4.24 Ignition source

A source of energy sufficient to ignite a flammable atmosphere and includes naked flames, exposed incandescent material, electric welding arcs and electrical or mechanical equipment not approved for use in hazardous location.

1.4.25 Individual system

A discrete refrigerating system having no interconnecting pipework connecting to other refrigerating systems. These include storage vessels, tanks and cylinders.

1.4.26 Internal gross volume

The volume calculated from the internal dimensions of a pressure vessel, no account being taken of the volume of any internal parts.

1.4.27 Isolating valve

A valve used to shut off flow completely.

NOTE: Valves may be arranged to isolate sections of systems for the purposes of assembly or maintenance while other sections remain charged with refrigerant.

1.4.28 Leakage test pressure

The pressure that is applied to test a system or any part of it for pressure tightness.

1.4.29 Limited charge system

A refrigerating system in which the internal volume and total refrigerant charge are such that, with the system idle, the maximum operating pressure will not be exceeded if complete evaporation of the refrigerant charge occurs.

1.4.30 Liquid receiver

A vessel permanently installed in the high-pressure side of a system to provide a reserve liquid refrigerant, or to facilitate storage of system charge during repairs or maintenance.

1.4.31 Lobby

An entrance hall or large hallway serving as a waiting room.

1.4.32 Low pressure side

That portion of a refrigerating system which is subject to the lower or evaporating pressure.

1.4.33 Machinery

The refrigerating equipment forming a part of the refrigerating system, e.g. compressor, condenser, generator, absorber (adsorber), liquid receiver, connecting piping, evaporator and pump.

1.4.34 Machinery room

An enclosure in which equipment such as pumps and compressors are housed.

NOTE: For a refrigerating system this does not include evaporators located in a coolroom, refrigerator box, air-cooled space or any other enclosed space.

1.4.35 Maximum charge

The maximum allowable mass of the refrigerant in the refrigerating system.

1.4.36 Maximum operating pressure (p_s)

The pressure that is not to be exceeded in any part of the system, irrespective of whether the system is or is not operating. It may be differently specified for the high- and low-pressure sides.

1.4.37 Non-positive displacement compressor

A compressor in which increase in vapour pressure is attained without changing the internal volume of the compression chamber.

1.4.38 Occupied space

Space normally frequented or occupied by people with the exception of machinery rooms and of cool rooms used for storage purposes. Where spaces around the space are, by construction or design, not air tight, these are considered as part of the humanly occupied space, e.g. false ceilings voids, crawl ways, ducts, moveable partitions and doors with transfer grilles.

1.4.39 Piping

The pipes or tubes (including any hose, bellows or flexible pipe) for interconnecting the various parts of a refrigerating system.

1.4.40 Positive displacement compressor

A compressor in which increase in vapour pressure is attained by changing the internal volume of the compression chamber.

1.4.41 Pressure limiting device

A pressure actuated adjustable or factory preset non-adjustable instrument (e.g. a high or low pressure switch) that is designed to stop the operation of the pressure imposing element and may also operate an alarm.

1.4.42 Pressure relief device

A valve or bursting disc designed to relieve excessive pressure automatically.

1.4.43 Pressure relieve valve

A pressure actuated valve held shut by a spring or other means and designed to relieve excessive pressure automatically by starting to open at a pressure not exceeding the design pressure and reclosing, to prevent further flow of fluid, after normal conditions of service have been restored.

1.4.44 Pressure vessel

A closed vessel containing fluid at a pressure differing from atmospheric pressure.

1.4.45 Receiver

A vessel that stores refrigerant located in the refrigerating system.

NOTE: Low-pressure suction accumulators and high-pressure liquid receivers are both examples of receivers.

1.4.46 Recovery

To remove refrigerant in any condition from a system and store it in an external container.

1.4.47 Recycle

To reduce contaminants in used refrigerants by separating oil, removing non-condensibles and using devices such as filter/driers to reduce moisture, acidity and particulate matter.

1.4.48 Reclaim

To reprocess used refrigerants to acceptable specifications. Chemical analysis of the refrigerant is required to determine that appropriate specifications are met. The identification of contaminants and required chemical analysis is specified in national and international Standards for new product specifications.

1.4.49 Refrigerated space

A refrigerated room used for operations or service purposes (e.g. cold stores, freezing tunnels and low temperature environmental areas).

1.4.50 Refrigerating system

A combination of interconnected refrigerant-containing parts constituting one closed refrigerant circuit in which a refrigerant is circulated for the purposes of extracting heat.

1.4.51 Secondary refrigerant

A liquid used for the transmission of heat without any change in its liquid state.

NOTE: See Clause 2.8 for requirements regarding temperature limitations.

1.4.52 Self-contained system

A complete factory-made system in a suitable frame or enclosure, that is fabricated and transported in one or more sections and in which no refrigerant containing parts are connected on site other than by companions or block valves.

1.4.53 Special machinery room

An enclosure in which equipment such as pumps and compressors are housed and which complies with the requirements of Clause 4.7.4.

1.4.54 Strength test pressure

The gauge pressure that is applied to test the strength of a refrigerating system or any part of it.

1.4.55 Sudden major release

When the majority of the total refrigerant charge is released into the humanly occupied space in a short time, e.g. under five minutes.

1.4.56 Type test

A test intended to prove the suitability and performance of a processing technique or design.

1.4.57 Unit system

A self-contained system that has been assembled and tested prior to its installation and is installed without connecting any refrigerant containing parts, a unit system may include factory assembled companion or block valves.

1.4.58 Vent

A device permitting fluid flow in order to maintain the balance of pressure between the atmosphere and the system.

1.4.59 Vestibule with doors (air lock)

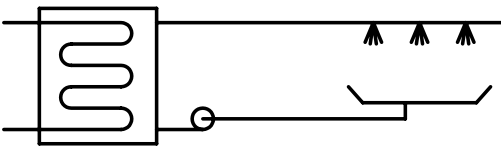
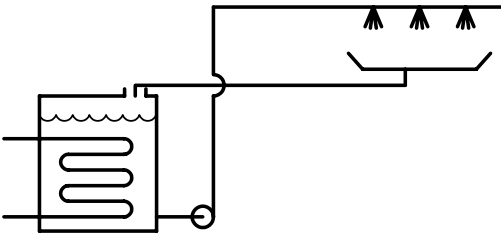
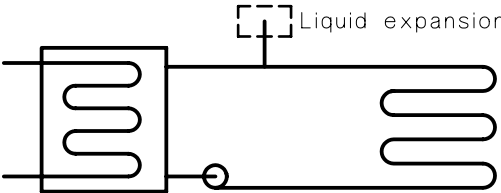
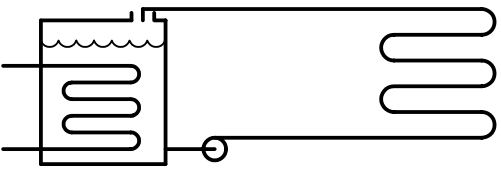
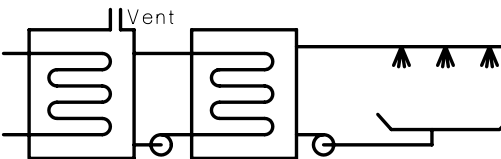
An isolating chamber provided with separate entrance and exit doors allowing passage from one place to another whilst isolating one from the other.

SECTION 2 SYSTEM SELECTION

2.1 SYSTEM DESIGNATION

Refrigerant systems shall be designated in accordance with Table 2.1 based on the system arrangement.

TABLE 2.1
TYPES OF COOLING SYSTEM

Designation	Refrigerating source	Spaces where air or substance is cooled	Description
(a) Direct system			Evaporator in direct communication with substance to be cooled.
(b) Indirect open system			Evaporator cools a heat transferring fluid which is brought into direct communication with a substance.
(c) Indirect vented open system			Similar to (b) but with open or vented secondary refrigerant system.
(d) Indirect closed system			Evaporator cools a heat transferring fluid which passes through a closed circuit in direct communication with a substance.
(e) Indirect vented closed system			Similar to (d) but with open or vented secondary refrigerant system.
(f) Double indirect system			A combination of (b) and (c) where heat transfer fluid passes through second heat exchanger.

NOTES:

- 1 Primary evaporator contains primary refrigerant.
- 2 Descriptions given would change in reverse cycle operation.

2.2 OCCUPANCY CLASSIFICATION

For the purposes of system selection, each occupied area shall be categorized in accordance with the general characteristics given in Table 2.2.

TABLE 2.2
CATEGORIES OF OCCUPANCY

Categories	General characteristics	Examples
I	Rooms, parts of buildings or buildings where— • people sleep; • people are restricted in their movement; • an uncontrolled number of people are present or to which any person has access without being personally acquainted with the necessary safety precautions.	Public areas of buildings, hospitals, courts or prisons, theatres, supermarkets, schools, lecture halls, public transport terminals, hotels, dwellings, restaurants.
II	Rooms, parts of buildings or buildings where only a limited number of people may be assembled, some being necessarily acquainted with the general safety precautions of the establishment.	Business or professional offices, small shops, small restaurants, laboratories, places for general manufacturing and where people work.
III	Rooms, parts of buildings or buildings where only authorized persons have access, who are acquainted with general and special safety precautions of the establishment and where manufacturing, processing, or storage of material or products take place.	Manufacturing and processing facilities, including those for chemicals, food, beverages and drink, ice, milk products and ice cream, dairies, abattoirs and meat products, cool rooms, non-public areas in shopping centres and facilities, and other such typical places where access is restricted to only authorized persons.

NOTE: The examples given in this Table are not intended to be exhaustive and the general characteristics should be considered for any particular occupancy not listed.

2.3 REFRIGERANT GROUP AND COOLING SYSTEM

The refrigerant Group A1, A2, A3, B1 or B2 (see AS/NZS 1677.1) and the type of cooling system (see Table 2.1) shall be selected according to the category of occupancy (see Table 2.2).

The charge limitations of Clauses 2.5, 2.6 and 2.7 apply to the largest individual system being considered. Table 2.3 provides cross-references to the Clauses of this Standard which specify detailed requirements for the refrigerant and the type of cooling system selected in relation to the category of occupancy.

NOTES:

- 1 Where refrigerating systems are to be installed in locations adjacent to property classifiable in any of the categories described in Table 2.2, it is important that due regard should be paid to the safety of the adjacent property and its occupants.
- 2 The selection of the refrigerating/cooling system also depends on detailed considerations in relation to the nature of the intended installation.
- 3 In normal circumstances it is not expected that more than one system will fail at any time.

TABLE 2.3
SELECTION OF REFRIGERANT GROUP AND COOLING SYSTEM IN
RELATION TO CATEGORY OF OCCUPANCY—APPLICABLE CLAUSES

Type of cooling system (Table 2.1)	Refrigerant group in accordance with AS/NZS 1677.1							
	A1 and A2		A3			B1 and B2		
	Category of occupancy (Table 2.2)							
	I and II	III	I	II	III	I	II	III
Direct	2.5.2	2.5.3	2.6.2	2.6.3	2.6.4	2.7.1.1	2.7.1.2	2.7.1.3
Indirect open	2.5.2	2.5.3	2.6.2	2.6.3	2.6.4	2.7.1.1	2.7.1.2	2.7.1.3
Indirect vented open	2.5.4	2.5.4	2.6.2	2.6.3	2.6.4	2.7.1.1	2.7.1.2	2.7.1.3
Indirect closed	2.5.4	2.5.4	2.6.2	2.6.3	2.6.4	2.7.2	2.7.2	2.7.2
Indirect vented closed	2.5.4	2.5.4	2.6.2	2.6.3	2.6.4	2.7.2	2.7.2	2.7.2
Double indirect	2.5.4	2.5.4	2.6.2	2.6.3	2.6.4	2.7.2	2.7.2	2.7.2

2.4 MULTIPLE OCCUPANCIES

Where there is more than one category of occupancy being served by a common refrigerating system, the most stringent requirements shall apply, except that when the occupancies are suitably isolated the requirements of the individual occupancies apply.

2.5 MAXIMUM CHARGE OF REFRIGERANTS OF GROUPS A1 AND A2

2.5.1 General

Group A1 refrigerants shall comply with Clauses 2.5.2 to 2.5.4. Group A2 refrigerants are non-toxic and moderately flammable therefore they shall be treated in the same way as A1 refrigerants provided the practical limits of AS/NZS 1677.1, which are based on the LEL for Group A2 refrigerants, are observed.

2.5.2 Direct and indirect open cooling systems

For systems designed to be used in Categories I and II occupancies, the charge of refrigerant M_R (in kg) shall not exceed the mass given by the following equation:

$$M_R \leq cV \quad \dots 2.1$$

where

c = the maximum allowable concentration in kg/m³ (practical limit) of the refrigerant in the occupied space as given in AS/NZS 1677.1.

V = the lesser of—

- (a) the volume (in m³) of the smallest occupied space into which the whole of the refrigerant charge could leak; or
- (b) the total volume (in m³) of all occupied spaces cooled by one air circulation system, provided the duct work serving those spaces cannot be shut off other than in an emergency.

NOTE: It is not necessary to relate the maximum refrigerant charge to the volume of rooms crossed by piping if the pipelines are carried through rigid, tightly sealed, continuous, fire-resistant channels or ducts vented to atmosphere or to a machinery room concerned with the system or to a space containing parts of the system. (See Clause 4.3.)

Where detectors are fitted, giving local or central alarms, or both, at a value no greater than the Exposure Standard of the refrigerant in use, the refrigerant charge for Group A1 refrigerants may be increased to $2 \times cV$ provided—

- (a) the central alarm point is continuously manned;
- (b) detectors are fitted in each occupied space in which the maximum allowable concentration, $c = \frac{M_R}{V}$, could be reached; and
- (c) the alarm system is appropriately maintained.

2.5.3 Category III occupancies

For systems designed to be used in Category III occupancies, there shall be no restriction of charge. The high pressure side of systems containing Group A2 refrigerant shall be situated in a special machinery room at ground level or above. If the charge of Group A2 refrigerant is such that the practical limit given in AS/NZS 1677.1 could be exceeded in any space outside the special machinery room, continuously operating detectors shall be fitted in that space.

2.5.4 Indirect vented open, indirect closed, indirect vented closed and double indirect cooling systems

The maximum charge of refrigerant shall be restricted as in Clause 2.5.2 unless the entire primary refrigerating system (other than components outside the building) is to be installed in a machinery room, in which case no restriction on charge shall apply.

2.6 MAXIMUM CHARGE OF REFRIGERANT OF GROUP A3

2.6.1 General

Group A3 refrigerants are highly flammable and potentially explosive. Direct expansion systems using A3 refrigerants shall be permitted only in systems with restricted charge or in occupancy categories where only competent staff are present. The refrigerant charge in systems situated below ground level shall be restricted to 1.0 kg. Where the refrigerant charge exceeds 2.5 kg and the area is classified as hazardous in accordance with AS 2430.1 or NZS 6101.1, as applicable, the electrical equipment within the space shall be in accordance with AS 2381.1.

2.6.2 Category I occupancies

Group A3 refrigerants shall be permitted only in systems with a refrigerant charge of up to 1.5 kg for each individual system, provided sudden loss of refrigerant could not raise the concentration of the refrigerant to or above the practical limit in an occupied space and provided there are no sources of ignition, e.g. unsealed electrical contacts associated with the refrigerating system or located in an area where the refrigerant could gather in the event of a leak.

Very small sealed systems with refrigerant charge of 0.25 kg or less may be sited in any location or category of occupancy provided there are no sources of ignition, e.g. unsealed electrical contacts associated with the refrigerating system or located in an area where the refrigerant could gather in the event of a leak.

In addition, indirect closed, indirect vented closed and double indirect refrigerating systems may be used but shall meet either of the following requirements:

- (a) The refrigerant charge shall not exceed 5.0 kg in a special machinery room (see Clause 4.7.4).
- (b) The primary refrigerating system shall be in the open air (see Clause 2.6.4(a)(i)).

2.6.3 Category II occupancies

Group A3 refrigerants shall be permitted, as for Category I occupancy, with the maximum charge restricted to 2.5 kg for refrigerating systems installed in an occupied space.

In addition, indirect closed, indirect vented closed and double indirect cooling systems may be used but shall meet either of the following requirements:

- (a) The refrigerant charge shall not exceed 10 kg in a special machinery room (see Clause 4.7.4).
- (b) The primary refrigerating system shall be in the open air (see Clause 2.6.4(a)(i)).

2.6.4 Category III occupancies

Group A3 refrigerants shall be permitted as for Category II occupancies.

In addition, any type of system may be used but shall meet the following requirements:

- (a) For systems located in an occupied space which is not a special machinery room (see Clause 4.7.4), the following requirements shall be met:
 - (i) The refrigerant charge shall not exceed 10 kg.
 - (ii) The system shall be at ground level or above.
- (b) For refrigerating systems with the high pressure side (except air-cooled condensers) located in a special machinery room (see Clause 4.7.4), or in the open air, the following requirements shall be met:
 - (i) The refrigerant charge shall not exceed 25 kg.
 - (ii) The system shall be at ground level or above.
- (c) For refrigerating systems with all refrigerant-containing parts located in a special machinery room (see Clause 4.7.4) or in the open air, the following requirements shall be met:
 - (i) There shall be no restriction of refrigerant charge, except as required by regulations, i.e. local planning and building regulations.
 - (ii) The system shall be at ground level or above.

2.7 MAXIMUM CHARGE OF REFRIGERANTS OF GROUP B1 AND B2

2.7.1 Direct, indirect open and indirect vented open systems

2.7.1.1 Category I occupancies

Refrigerating systems shall not be located in basements and, where not located in a special machinery room, the charge shall be restricted to 2.5 kg in a sealed system. Sealed systems need not be used in special machinery rooms but these shall be at ground level or above and the refrigerant charge shall not exceed 2.5 kg (see Clause 4.7.4).

2.7.1.2 Category II occupancies

The following applies to Category II occupancies:

- (a) The requirements of Clause 2.7.1.1 shall apply but the charge shall not exceed 10 kg or the practical limit given in AS/NZS 1677.1, whichever is smaller, where the system is located in an occupied space.
- (b) Where the refrigerating system is located in a special machinery room at ground level or above, or in the open air, the refrigerant charge shall not exceed 25 kg.

2.7.1.3 Category III occupancies

The following applies to Category III occupancies:

- (a) Where the system is located in an occupied space and where the number of people is not restricted, apart from restriction imposed by building regulations, the refrigerant charge shall not exceed 10 kg.
- (b) For a system located in an occupied space which is not a special machinery room (see Clause 4.7.4) but where the density of occupancy is lower than one person per 10 m² floor area and provided there are a sufficient number of clearly indicated emergency exits for the number of persons normally present, the refrigerant charge shall not exceed 50 kg.
- (c) For systems with the high-pressure side located in a special machinery room (see Clause 4.7.4) or in the open air there shall be no restriction of refrigerant charge provided the refrigerating system extends only to rooms or areas where the density of occupancy is lower than one person per 10 m² floor area.

All pressure equipment in those rooms or areas shall be designed and rated for the highest operating pressure expected in that part of the refrigerating system, and only authorized persons shall have access to them.

With such systems having a refrigerant charge greater than 50 kg, only duly qualified personnel who have been given instruction about the escapeways and safety devices of the refrigerating plant, shall work in rooms or areas within the above restricted density of occupancy. Also such systems serving refrigerated equipment in production areas, or working areas which are temperature regulated for the needs of a process (as distinct from cool room storage areas), shall be supervised continuously during ordinary working hours by trained refrigeration machine attendants whenever the plant is in operation or on call (unless shut down). Any occurrence of fault or hazard shall be reported.

Continuous supervision may be replaced by once daily supervision (when operating) by competent attendant(s) if that system is equipped with continuously operating monitoring equipment (e.g. computerized monitoring system) capable of alerting a manned alarm centre of any faults or hazards related to refrigerant leaks or abnormal operating pressures occurring in the system.

Any report or alert of fault or hazard shall be addressed immediately and shall follow an established hazard routine familiar to all personnel authorized to work in the area.

NOTE: It is a requirement for Category III occupancies that only authorized persons who are acquainted with general and special safety precautions of the enclosure have access.

- (d) Where a refrigerating system has all refrigerant-containing parts located in a special machinery room (see Clause 4.7.4) or in the open air there shall be no restriction of refrigerant charge, except as required by regulations, e.g. local planning and building regulations.

2.7.2 Indirect closed, indirect vented closed and double indirect cooling systems

The maximum charge of refrigerants shall be as follows:

- (a) For Category I occupancies, 500 kg.
- (b) For Categories II and III occupancies, no restriction on charge.

Machinery shall be installed at ground level, or above, in a special machinery room or in the open air as follows:

- (i) For Categories I and II occupancies, all machinery.
- (ii) For Category III occupancies, where the refrigerant charge exceeds 500 kg, all compressors and high-pressure side machinery.

2.8 SECONDARY REFRIGERANTS

Secondary refrigerants used in any indirect system in any occupancy shall have either—

- (a) no flash point; or
- (b) a flash point higher than 65°C.

Flashpoint shall be determined by the closed cup Pensky-Martens apparatus method in accordance with AS 2106.

Where secondary refrigerants are found to be toxic or flammable in accordance with the classification system of AS/NZS 1677.1 their usage shall comply with the requirements (for primary refrigerants) of this Standard.

2.9 CRITICAL TEMPERATURES

Refrigerants shall be selected so that the critical temperature is never reached in high ambient air-cooled systems.

NOTE: Critical temperatures of common refrigerants are given in AS/NZS 1677.1.

2.10 COMPATIBILITY

All materials used in the manufacture of the refrigerating system shall be compatible with the refrigerant used.

NOTE: Information on the compatibility of materials is given in Appendix B.

2.11 COMBINATION SYSTEMS

Where different types of systems or different categories of occupancies are combined the most severe requirements shall apply to the system.

2.12 ACCUMULATION OF HEAVIER-THAN-AIR REFRIGERANTS

2.12.1 Group A1, A2 and B1

Suitable precautions shall be taken to prevent the undue accumulation of leaked refrigerant in occupied spaces.

2.12.2 Group A3, and B2

Suitable precautions shall be taken to prevent the undue accumulation of leaked refrigerant in any space.

SECTION 3 DESIGN AND CONSTRUCTION

3.1 MAXIMUM OPERATING PRESSURE (p_s)

3.1.1 General

The system shall be designed and constructed such that the maximum operating pressure is not exceeded with the system either in operation or at rest.

The maximum operating pressure shall be determined by taking into account such factors as:

- (a) Ambient temperature.
- (b) Possible build-up of non-condensable gases.
- (c) Setting of any pressure relief device.
- (d) Method of defrosting.
- (e) Application (e.g. cooling or heat pump application).
- (f) Solar radiation.
- (g) Fouling.
- (h) Operation at reduced capacity in extreme ambient conditions.

The minimum p_s shall be at least the saturation pressure at the minimum system design temperature—

- (i) given in Clause 3.1.2 for systems whose geographic location is known and fixed for the system life; and
- (ii) given in Clause 3.1.3 for general systems.

- A2 | Where an existing system is being converted from one A1 refrigerant to another A1 refrigerant of a higher pressure, the lower pressure side of the system shall be protected by a relief device with a setting lower than the theoretical p_s (developed from the temperatures of Table 3.1), providing that the relief device shall not relieve under any foreseeable normal local operating or standstill condition.

3.1.2 Specific systems

Minimum system saturation pressures for systems whose geographical location is known and fixed for the life of the system shall be based on the following system temperatures (refer Figure 3.1):

- (a) Low pressure sides of all systems: the summer critical process (0800–1800) dry bulb temperature.
- A1 | (b) High pressure sides of all water-cooled or evaporatively cooled systems: 16.7°C higher than the summer critical process (0800–1800) wet-bulb temperatures for the location as applicable, or 8.3°C higher than the highest design leaving condensing water temperature for which the equipment is designed, whichever is greatest.
- A1 | (c) High pressure sides of all air-cooled systems: 16.7°C higher than the highest summer critical process (0800–1800) dry-bulb temperature for the location.

NOTE: Summer critical process temperatures for specific locations in Australian and New Zealand are available in AIRAH application manual DA 9.*

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