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# Refrigerating systems and heat pumps — Safety and environmental requirements —

## Part 3: Installation site

*Systèmes frigorifiques et pompes à chaleur — Exigences de sécurité et d'environnement —*

*Partie 3: Site d'installation*

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# Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 1, *Safety and environmental requirements for refrigerating systems*.

ISO 5149-3, together with ISO 5149-1, ISO 5149-2, and ISO 5149-4, cancels and replaces ISO 5149:1993, which has been technically revised.

ISO 5149 consists of the following parts, under the general title *Refrigerating systems and heat pumps — Safety and environmental requirements*:

— *Part 1: Definitions, classification and selection criteria*

— *Part 2: Design, construction, testing, marking and documentation*

— *Part 3: Installation site*

— *Part 4: Operation, maintenance, repair and recovery*

# Refrigerating systems and heat pumps — Safety and environmental requirements —

# Part 3: Installation site

## 1 Scope

This part of ISO 5149 is applicable to the installation site (plant space and services). It specifies requirements for the site for safety, which could be needed because of, but not directly connected with, the refrigerating system and its ancillary components.

This part of ISO 5149 is applicable to new refrigerating systems, extensions or modifications of existing systems, and for used systems being transferred to and operated on another site. This part of ISO 5149 also applies in the case of the conversion of a system for another refrigerant.

## 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5149-1:2014, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 1: Definitions, classification and selection criteria*

ISO 5149-2:2014, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 2: Design, construction, testing, marking and documentation*

ISO 13850, *Safety of machinery — Emergency stop — Principles for design*

IEC 60204-1, *Safety of machinery — Electrical equipment of machines — General requirements*

IEC 60364-1, *Low-voltage electrical installations — Part 1: Fundamental principles, assessment of general characteristics, definitions*

IEC 60364-5, *Electrical installations of buildings — Part 5: Selection and erection of electrical equipment*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5149-1 apply.

## 4 Location of refrigerating equipment

### 4.1 General

Refrigerating equipment can be sited outside the building in the open air, in a designated machinery room, in occupied areas, or in unoccupied areas not designated as a machinery room.

The refrigerating equipment can be contained in a ventilated enclosure provided by the manufacturer. Requirements for this enclosure are given in ISO 5149-2:2014, 5.2.17.

### 4.2 Refrigerating equipment located in the open air

Refrigerating systems sited in the open air shall be positioned to avoid refrigerant leaking into the building or endangering people. If sited on the roof, the refrigerant shall not be able to flow across the roof into any ventilation fresh air opening, doorway, trap door, or similar opening in the event of a leak. Where a shelter is provided for refrigerating equipment sited in the open air, it shall have natural or forced ventilation.

A room where at least one of the longer walls is open to the outside air by means of louvres with 75 % free area and covering at least 80 % of the wall area (or the equivalent if more than one wall is to outside) is considered as being in the open air.

### 4.3 Refrigerating equipment located in a machinery room

When a machinery room is chosen as the location of the refrigerating equipment, it shall meet the requirements specified in 5.1 to 5.14. Where the charge of a refrigerant is above the practical limits specified in ISO 5149-1, the refrigerating system shall be located in a special machinery room unless the ignition sources in the machinery room meet the requirements of 5.3, 5.4, and 5.14.4.

NOTE 1 Additional requirements could be needed for refrigerating systems containing R-717 or other B2L, B2, B3, A2L, A2, and A3 refrigerants as specified in 5.12.

NOTE 2 Where housing around refrigerating equipment is sufficiently large for people to enter, the housing is considered as a machinery room and requirements for such rooms apply.

### 4.4 Refrigerating equipment located in the occupied space

The requirements shall be as specified in ISO 5149-1:2014, Annex A.

### 4.5 Refrigerating equipment located in unoccupied areas not designated a machinery room

If this area is sealed from any occupied area, the requirements shall be as those for a machinery room. If the area cannot be sealed from any occupied space, then the refrigerating machinery shall be considered as located in a human-occupied space and requirements for such spaces shall apply.

### 4.6 Refrigerating equipment located in a ventilated enclosure within an occupied space

The ventilated enclosure containing the refrigerating system shall have a ventilation duct as specified by the manufacturer. The duct shall be no greater in length and have no more bends than the maximum number specified by the manufacturer. The room into which the ventilated enclosure is installed shall be at least 10 times the volume of the enclosure and shall have sufficient make up air to replace any exhausted air. The ventilation from the enclosure shall be to outside air or to a room having a minimum volume specified in ISO 5149-1:2014, 5.2.17 for an occupied space.

### 4.7 Piping duct or shaft

Where hand-operated shut-off devices are mounted in a piping duct or shaft designed for human entry, the duct or shaft shall have more than one escape exit. The duct shall have at least 1,2 m of ceiling height.

## 5 Machinery rooms

### 5.1 Occupancy of machinery rooms and special machinery rooms

Machinery rooms should not be used as occupied spaces. The building owner or user shall ensure that access is permitted only by instructed personnel doing the necessary maintenance to the machinery room or general plant. If machinery rooms are occupied for significant periods, e.g. used as a building

maintenance workspace, they shall be considered as occupied spaces under occupancy category c, "Authorized Occupancy" given in ISO 5149-1.

A special machinery room shall not be used as an occupied space.

In accordance with ISO 5149-4, when occupied for maintenance or repair, a duly authorized person, familiar with the use of the emergency protective equipment and emergency procedures, should be available near to the machinery room during such occupation in case of an emergency.

## 5.2 Venting from or through the machinery room

Refrigerant shall be prevented from entering neighbouring rooms, staircases, courts, gangways, or building draining systems. The escaping gas shall be vented outdoors.

There shall be no airflow to an occupied space through a machinery room unless the air is ducted and sealed to prevent any refrigerant leakage from entering the air stream.

## 5.3 Combustion equipment and air compressors

Where a piece of combustion equipment is located in a machinery room containing refrigerating equipment, the combustion air supply for combustion engines, boilers, or the supply air for air compressors shall be drawn from a place where there is no refrigerant gas. If such a piece of equipment is installed in a machinery room, the combustion air for combustion engines or the supply air for air compressors shall be ducted from outside in such a manner as to prevent any refrigerant leakage from entering the combustion chamber.

## 5.4 Open flame

Open (naked) flames shall not be permitted in machinery rooms or special machinery rooms, except for welding, brazing, or similar activity and then provided that the refrigerant concentration is monitored and adequate ventilation is ensured. Such open flames shall not be left unattended.

NOTE When the refrigerant in the refrigerating machinery is R-744, the use of an open flame can be permitted.

The ventilation rate for welding and brazing shall be adequate, considering the combustion (products of combustion) of any refrigerant contained in the room.

## 5.5 Storage

Machinery rooms shall not be used for storage with the exception of tools, spare parts, and compressor oil for the installed equipment. Any refrigerants and flammable or toxic materials shall be stored as required by national regulations.

## 5.6 Remote emergency switch

A remote switch for stopping the refrigerating system shall be provided outside the room, near the machinery room. A similar-acting switch shall be located at a suitable location inside the room. The switches shall meet the requirements for emergency switches in accordance with ISO 13850 and IEC 60204-1.

## 5.7 Exterior openings of the machinery room

Exterior openings shall not be situated within 2 m of building emergency exit staircases or other building openings, e.g. windows, doors, ventilation inlets, etc.

## 5.8 Piping and ducting

All piping and ventilation ducting that passes through walls, ceiling, and floors of machinery rooms shall be sealed where it passes through the walls, ceiling, or floors. The sealing shall have at least equivalent fire-resisting properties to the walls, ceiling, or floor.

NOTE 1 Discharge pipes from relief devices, safety valves, and fusible plugs can diffuse the charge into the air by adequate means but away from any air intake to the building or discharge into an adequate quantity of a suitable absorbing material.

Relief devices for refrigerants in group A1 can discharge into the machinery room provided the system charge is less than the limits set in Annex A of ISO 5149-1:2014. Such discharges of refrigerant should take place so that persons and property are not endangered.

## 5.9 Normal lighting

Fixed lighting shall be selected and positioned in spaces containing refrigerating equipment to provide adequate illumination for safe operation. The illumination level and location shall be as required by national regulations. Filament light bulbs shall be protected by "splash-safe" covers (IP X4) in machinery rooms containing R-717 refrigerating systems.

## 5.10 Emergency lighting

A fixed or portable emergency lighting system shall be provided, adequate to allow operation of controls and evacuation of personnel, when normal lighting fails.

## 5.11 Dimensions and accessibility

The dimensions of the machinery room shall allow easy installation and sufficient room for service, maintenance, operation, repair, and disassembly of the refrigerating equipment, including sufficient space for persons wearing personal protection equipment.

If necessary, catwalks and fixed ladders shall be provided in order to avoid standing or walking on piping, fittings, their supports and supporting structures, and components during the operation, maintenance, inspection, and repair of the refrigerating system.

There shall be clear headroom of at least 2 m below equipment situated over gangways and permanent workplaces.

NOTE Headroom is defined as 2 m above the walking surface.

## 5.12 Doors, walls, and ducts

### 5.12.1 Doors and openings

Machinery rooms shall have doors opening outward and sufficient in number to ensure persons can escape in an emergency.

The doors shall be tight-fitting, self-closing, and so designed that they can be opened from inside (anti-panic system).

The doors shall have at least 1 h fire-resistive construction, using materials and construction tested in accordance with national regulations. There shall be no openings that permit unintended passage of escaping refrigerant, vapours, odours, and all other gases to other parts of the building.

### 5.12.2 Emergency

Provision shall be made to facilitate immediate exit from the machinery room in the event of an emergency.

 

At least one emergency exit shall open directly to the open air or it shall lead to an emergency exit passageway.

#### 5.12.3 Walls, floor, and ceiling

Walls, floor, and ceiling between the inside of the building and of the machinery room shall have at least a 1 h fire-resistive construction and be tightly sealed. They shall be of materials and construction that are in accordance with national regulations.

#### 5.12.4 Service ducts

Service ducts shall conform to the requirements of national regulations and they shall be sealed to minimize escaped refrigerant leakage into the service duct and have the same fire resistance as walls and doors. Service ducts, including walkways and crawl spaces containing piping for flammable or toxic refrigerants, shall be vented to a safe place to prevent a dangerous accumulation (i.e. exceeds the limits of ISO 5149-1:2014, A.1) of vapour in the event of a leak.

Service ducts shall not be used for ventilation or conditioned air.

#### 5.12.5 Emergency ventilation ducts

Sheet metal for normal and emergency ventilation ducts shall be in accordance with national standards and supported as required. After erection, all duct seams and joints shall be sealed to minimize gas leakage from the duct. The ventilation duct shall have the same fire resistance as the doors and walls of the machinery room.

### 5.13 Ventilation

#### 5.13.1 General

The ventilation of machinery rooms shall be sufficient both for normal operating conditions and emergencies.

Air from machinery rooms shall be vented outdoors using mechanical ventilation in case of a release of refrigerant due to leaks or rupture of components. This ventilation system shall be independent of any other ventilation system on the site.

Provision shall be made for a sufficient supply of outside replacement air and a good distribution of that air over the machinery room avoiding dead zones.

Openings for outside air shall be positioned to avoid re-circulation into the room.

#### 5.13.2 Ventilation for normal operating conditions or when machinery room is occupied

Ventilation shall be in accordance with national regulations with a minimum of four air changes per hour when the machinery room is occupied.

#### 5.13.3 Emergency mechanical ventilation

If gas detection is required in the machinery room, the emergency mechanical ventilation system shall be activated by a detector(s) located in the machinery room. The detector(s) shall be as specified in Clause 9.

Emergency mechanical ventilation shall also be provided with two independent emergency controls, one located outside the machinery room and the other inside.

In case the necessary ventilation rate cannot be achieved, an audible and/or visual alarm shall be initiated and, where relevant, electrical supplies shall also be terminated.

#### 5.13.4 Required airflow for emergency mechanical ventilation

Airflow of the mechanical ventilation shall be at least the quantity obtained by Formula (1):

$$V = 0{,}014 m^{2/3} \quad (1)$$

where

$V$ is the airflow rate, in cubic metres per second ($m^3/s$);

$m$ is the mass of refrigerant charge, in kilograms (kg), in the refrigerating system with the largest charge, any part of which is located in the machinery room.

NOTE 0,014 is a conversion factor with units of $(m^3/s)(kg)^{-2/3}$.

#### 5.13.5 Mechanical ventilation openings

Mechanical ventilation openings shall be made in the position and of sizes to permit sufficient airflow considering the characteristics of the refrigerant, the choice of intake or exhaust, and the performance of the ventilator. The intake and exhaust openings shall be arranged to evacuate the refrigerant under all conditions of leaking refrigerant.

### 5.14 Machinery rooms for flammable refrigerants (groups A2L, A2, B2L, B2, B3, and A3)

#### 5.14.1 General

##### 5.14.1.1 Location

The machinery room shall be located in accordance with local and national regulations, and depending on the amount of charge in the refrigerating system.

Machinery rooms with group A2L, A2, B2L, B2, A3, and B3 refrigerants, where the risk of explosion can occur because it is possible for the concentration of refrigerant to reach the lower flammability limit, shall comply with the requirements of hazardous areas. Some explosion relief (e.g. frangible wall or roof) shall be provided in accordance with national regulations.

##### 5.14.1.2 Emergency exhaust ventilation

The emergency exhaust ventilation shall be either

a) in the airflow with the motor outside the airflow, or

b) rated for hazardous areas as required in ISO 5149-2:2014, 5.2.16.

The fan shall be located to avoid pressurization of the exhaust ductwork in the machinery room.

The fan shall not cause sparks to occur if it contacts the duct material.

The outlet from the exhaust ventilation shall be in accordance with national regulations. The outlet shall not be restricted but have means of keeping rubbish, leaves, and birds from entering. The bottom of any rising ductwork open to the outside shall have a drain with a trap for rainwater and with access for inspection.

#### 5.14.2 Additional requirements for R-717

##### 5.14.2.1 Drainage

To prevent R-717 spill reaching surface waters, a catchment system shall be designed and installed in accordance with national regulations. The machinery room floor shall be designed in order to prevent liquid R-717 from spilling out from the room. The drain from the catchment system shall be normally closed.

##### 5.14.2.2 Specific equipment for emergency washing

For R-717 or other caustic or skin or eye irritant refrigerant, easily accessible eyewash and body shower facilities shall be provided outside the emergency exit from the machinery room. An automatic drench shower, providing at least 1,5 l/s flow at between 25 °C and 30 °C, shall be provided.

##### 5.14.2.3 Fire sprinkler systems

Fire sprinkler (water) systems shall not be permitted in machinery rooms with R-717 refrigerating systems of more than 200 kg of R-717 charge.

#### 5.14.3 Combustion equipment

Combustion equipment shall not be installed in a machinery room containing an A2L, A2/A3 refrigerating system.

#### 5.14.4 Maximum surface temperature

Hot surfaces shall not exceed a temperature of 100 K less than the auto-ignition temperature of the refrigerant.

## 6 Requirements for alternative provisions

### 6.1 General

Where an indoor unit is in, or the piping passes through, an occupied space having a volume of such size so that the total charge exceeds the allowable charge specified in ISO 5149-1:2014, A.5, special provisions can be made to ensure safety.

### 6.2 Occupied space

If the indoor unit is installed at a height less than 1,8 m, an indoor unit fan, circulator, or mechanical ventilation shall be provided to avoid the risk and shall operate continuously or be turned on by a detector. If a transfer opening at the floor level is provided such as a gap below the door, low-level installation without air mixing is acceptable.

The space where the indoor unit is installed shall be of general occupancy. Indoor units shall not be used in a sealed room without ventilation to the outside of the room. The indoor system shall be used to provide for human comfort.

The indoor equipment and pipes shall be securely mounted and guarded such that accidental rupture of equipment cannot occur from such events as moving furniture or reconstruction activities.

### 6.3 Ventilation

#### 6.3.1 General

ISO 5149-1:2014, A.5.2.2 or A.5.2.3 can require employing ventilation as a safety measure.

Ventilation shall be made to a place where sufficient air is available to dilute the leaked refrigerant such as outdoors or a large space. The indoor place used to provide ventilation air shall have sufficient volume, including the volume of the room in which the indoor unit is installed, to ensure that the quantity limit with minimum ventilation (QLMV) value is not exceeded. Indoor ventilation shall be made to a room that has enough volume to satisfy the QLMV value in total with the occupied space volume. Natural ventilation to outdoors shall not be taken into account.

NOTE QLMV values can be found in ISO 5149-1:2014, Annex A.

### 6.3.2 Dilution transfer openings for natural convection

Dilution transfer opening shall be provided in both high and low level locations. Each high and low opening area of transfer opening shall be at least the value obtained by Formula (2). This area can be divided into two or more openings in each high and low location. These shall be located near the floor and near the ceiling respectively. If the ceiling is suspended and the wall is not provided between the next rooms above the ceiling, upper opening is not necessary.

$$A = 0{,}0032 \times \frac{M}{\mathrm{QLMV} \times V} \tag{2}$$

where

$A$ is the required opening area, expressed in square metres ($m^2$);

$M$ is the refrigerant charge, expressed in kilograms (kg);

$V$ is the room volume, expressed in cubic metres ($m^3$);

QLMV is the quantity limit with minimum ventilation as given in ISO 5149-1:2014, A.5.2, expressed in kilograms per cubic metre ($kg/m^3$).

The lower edge of the lower opening shall be a height of 0,2 m or less from the floor. The upper edge of the upper opening shall be equal to or higher than the upper edge of the door opening.

### 6.3.3 Mechanical ventilation

#### 6.3.3.1 Required airflow

The actual, not nominal, airflow of the mechanical ventilation shall be at least the quantity that satisfies Formula (3).

$$M = -\frac{10 \times V}{Q} \ln\left(1 - \frac{Q \times \mathrm{RCL}}{10}\right) \tag{3}$$

where

$M$ is the refrigerant charge, expressed in kilograms (kg);

$V$ is the room volume, expressed in cubic metres ($m^3$);

10 is the expected maximum leak rate, expressed in kilograms per hour (kg/h);

$Q$ is the ventilation airflow, expressed in cubic metres per hour ($m^3/h$);

RCL is the Refrigerant Concentration Limit, in kilograms per cubic metre ($kg/m^3$), as given in ISO 817;

A simplified calculation is given in Formula (4). The airflow that satisfies this formula can be employed instead of the value obtained above. However as a consequence of the simplification, it provides a higher airflow value.

$$Q = \frac{10}{\mathrm{RCL}} \tag{4}$$

#### 6.3.3.2 Mechanical ventilation openings

The lower edge of the mechanical ventilation opening shall be as low as practicable. Exhaust ventilation openings shall be located a sufficient distance from intake openings to prevent re-circulation to the occupied space.

#### 6.3.3.3 Operation of mechanical ventilation

Mechanical ventilation shall be operated continuously or shall be switched on by the detector in accordance with Clause 9.

### 6.4 Safety shut-off valves

#### 6.4.1 General

If safety shut-off valves are employed as a safety measure according to A.5.2 of ISO 5149-1:2014, then they shall be provided at appropriate position in a refrigerating circuit. In the event of refrigerant leak, the valves shall shut off the refrigerant so that the amount of refrigerant leaked into the occupied space is less than the QLMV value in the occupied space.

RCL value, as given in ISO 817, shall be used instead of QLMV for the lowest underground floor of the building. Valves shall isolate the refrigeration circuit from the occupied space under the control of a detector in accordance with Clause 9. The manufacturer of the equipment shall provide the data necessary to calculate the amount of refrigerant that could leak into the occupied space.

#### 6.4.2 Location

Shut-off valves shall be located outside of the occupied space and shall be positioned to enable access for maintenance by an authorized person.

#### 6.4.3 Design

Valves shall be designed to close in the event of an electric power failure, e.g. spring return solenoid valves.

Valves in the refrigeration circuit shall be able to shut-off the refrigerant flow in the event of a leak of refrigerant without unduly affecting the normal operation flow.

## 7 Electrical installations

### 7.1 General requirements

The general electrical installation of the refrigerating and other equipment including lighting, power, etc., shall conform to national regulations and the provisions in IEC 60364-1 and IEC 60364-5 as appropriate.

NOTE Additional guidance can be found in IEC/TR 61200-52.

### 7.2 Main power supply

The electrical power supply to a refrigerating system shall be electrically arranged so that it can be switched off independently of the electricity supply to other electrical equipment in general and, in particular, to any lighting system, ventilation unit, alarm, and other safety equipment. The connection of the main power supply to the refrigerating machinery shall be in accordance with IEC 60204-1.

### 7.3 Electrical equipment in machinery rooms in which a refrigerating system contains class 2L flammability refrigerants

Electrical equipment in rooms in which a refrigerating system containing only 2L refrigerant is located need not conform to the requirements for hazardous areas.

## 8 Safety alarms

### 8.1 General

If an alarm is employed to warn of a leak in the machinery room (see Clause 9) or in the occupied space, the alarm shall warn of a refrigerant leak in accordance with 8.3. The alarm shall be turned on by the signal from the detector in accordance with Clause 9. The alarm shall also alert an authorized person to take appropriate action.

If the system charge exceeds the practical limit multiplied by the room volume or 20 % of the Lower Flammability Limit (LFL) multiplied by the room volume, an alarm system according to the requirements of 8.3 shall be installed.

### 8.2 Alarm system power

In cases where an alarm system is installed, the power source of the alarm system shall not supply any other refrigerating system which the alarm system is protecting or equipment that can generate a refrigerant leak hazard. The alarm system shall comply with the requirements for fire alarms.

NOTE Backup power using batteries can be used for the alarm system.

### 8.3 Alarm system warning

#### 8.3.1 General

The alarm system shall warn both audibly and visibly, such as both a loud (15 dBA above the background level) buzzer and a flashing lamp.

#### 8.3.2 Alarm for machinery room

The alarm system shall warn both inside and outside the machinery room or at least inside where used in an occupied space. The outside alarm can be installed in a security or supervised location.

#### 8.3.3 Alarm for occupancy

At least one alarm inside the occupancy shall be installed. For occupancy A (see ISO 5149-1), the alarm system shall also warn at a supervised location, such as the night porter's location, as well as the occupied space. The outside alarm can be installed in a watch room or other supervised location, such as the night porter's location.

### 8.4 Additional alarm system requirements for R-717 systems with charges above 4 500 kg

The refrigerating system user/owner shall ensure that a continuously attended station is provided as a central alarm station. Specialized personnel shall be present on site within 60 min of an alarm. The personnel can also be informed of the alarm by technical equipment, e.g. mobile telephone, pager, etc.

## 9 Detectors

### 9.1 General

When the concentration of the refrigerant can exceed the practical limit in accordance with ISO 5149-1, detectors shall at least actuate an alarm, and in the case of the machinery room the emergency mechanical ventilation. They shall conform to the requirements given in 9.2 to 9.5 as appropriate.

### 9.2 Location of detectors

The location of detectors shall be chosen in relation to the refrigerant and they shall be located where the refrigerant from the leak will concentrate.

At least one detector shall be installed in each machinery room or the occupied space being considered and/or at the lowest underground room for refrigerants heavier than air and at the highest point for refrigerants lighter than air.

### 9.3 Function of the detector

The sensor shall detect the leaked refrigerant or the oxygen deprivation and shall conform to the requirements of 9.4 and 9.5. Oxygen sensors shall not be used with systems containing R-717 or carbon dioxide.

### 9.4 Type and performance of a detector

#### 9.4.1 General

Any suitable detector can be used and shall give an electrical signal at the pre-set value of the refrigerant or oxygen concentration (the pre-set value hereafter) that activates the shut-off valves, the alarm system, or the mechanical ventilation and/or other emergency controls.

The pre-set value for the refrigerant detector at 30 °C or 0 °C, whichever is more critical, shall be half or less of the RCL concentration, as given in ISO 817. The pre-set value for the oxygen deprivation detector shall be 19,5 %.

The sensitivity tolerance of the detector shall be considered to ensure that the output signal is triggered at or below the pre-set value. The tolerance of the detector shall take into account the ±10 % of power line voltage tolerance. If an oxygen detector is used, it shall be reliable and accurate at the Acute Toxicity Exposure Limit (ATEL) value when calculated for oxygen depletion.

The delay of the detector shall be 30 s or less at a concentration of 1,6 times the pre-set value.

An appropriate maintenance period shall be established for each type of detector used.

#### 9.4.2 Refrigerant detectors for A2L, A2, B2L, B2 (except for R-717), A3, and B3 refrigerants

A refrigerant detector for a group A2L, A2, B2L, B2 (except for R-717), A3, and B3 refrigerant shall activate the alarm signal at a level not exceeding 25 % of the LFL of the refrigerant. The detector shall continue to activate at higher concentrations. The detector shall be set lower for the toxicity, if applicable. It shall automatically activate an alarm, start mechanical ventilation, and stop the system when it triggers.

#### 9.4.3 Refrigerant detectors for R-717

In order to warn against the danger of explosion or fire in equipment in machinery rooms and special machinery rooms, and for control purposes where the charge size is more than 50 kg, an R-717 detector is required in accordance with 5.14, which shall function at a concentration not exceeding

a) 152 mg/m$^3$ **[**200 × 10$^{-6}$ (*V*/*V*)] in machinery rooms (pre-alarm), and

b) 22,8 g/m$^3$ **[**30 000 × 10$^{-6}$ (*V*/*V*)] for main alarm.

At the pre-alarm level, an alarm and the mechanical ventilation shall be activated. At the main alarm level, the refrigerating system shall automatically be stopped. At the main alarm level, the power supply to the machinery rooms or special machinery rooms shall also be stopped, as well as the ventilation if special provisions are not made (see 5.14.1). Where the machinery rooms or special machinery rooms only house the compressors or compressor units, at least one detector shall be placed over the compressors or units.

The site of the refrigerant pumps shall also be monitored by a detector, mounted above and near the pumps.

Detectors shall be suitable for their use and tested by an appropriate authority dealing with R-717 use. A competent person shall carry out the commissioning of these detectors. A test and, if necessary, a calibration of the sensors shall be repeated after the first calibration.

Ammonia detectors shall be incorporated in the heat-transfer circuit of indirect systems, for example water or glycol circuits, if the R-717 charge is greater than 500 kg. These detectors shall initiate an alarm in the machinery room, and where practicable in the control system operator interface, but they shall not trigger beacons or klaxons, and they shall not initiate an evacuation.

### 9.5 Installation

**9.5.1** The installation of the detector shall allow access for checking, repair, or replacement by an authorized person.

**9.5.2** The detector shall be protected to prevent tampering or unauthorized resetting of the pre-set value.

## 10 Instruction manuals, notices, and inspections

### 10.1 Instruction manual

The instructions given with the installation shall clearly state the required emergency procedures for the building in the event of the alarm system operating. An authorized person(s) shall be designated for the machinery room, special machinery rooms, and each occupied space who shall know these procedures and have the authority to act on them.

NOTE Requirements for instructions for the refrigerating system are given in ISO 5149-2.

### 10.2 Warning notice

Machinery rooms shall be clearly marked as such on the entries together with warning notices that unauthorized persons shall not enter and that smoking, naked lights, or flames are prohibited. Additionally, warning notices shall be displayed prohibiting unauthorized operation of the system. A notice indicating the procedures to be adopted in the event of an alarm shall be clearly visible within the occupied space.

### 10.3 Visual inspection of site

The installation site shall be checked to ensure that services and equipment related to the refrigerating system are correctly installed and functioning prior to delivering the site to the owner. In particular, the following shall be checked for correct installation and function:

a) escape and access routes for passage are free from obstruction;

b) openings for ventilation are free from obstruction;

c) mechanical ventilation of the machinery room;

d) refrigerant detectors;

e) alarms and back-up power, where required;

f) emergency lighting;

g) availability and access to personal protective equipment.

### 10.4 Maintenance of the site

The user/owner or their authorized representative shall regularly check the alarms, mechanical ventilation, and detectors, where required by this part of ISO 5149, at least once a year to ensure their correct functioning. A logbook shall be maintained.

The results of these checks shall be recorded in the logbook. Transfer openings in occupied spaces shall be checked to confirm no obstruction.

NOTE For maintenance of the refrigerating system, see ISO 5149-4.

## 11 Heat sources and temporary high temperatures located at the site

If evaporators or air coolers are installed in the proximity of heat sources, effective measures shall be taken to prevent the evaporators or coolers being exposed to excessive heat, which will give rise to high pressure.

Condensers and liquid receivers shall not be located in the proximity of heat sources.

Heat sources, accessories, and parts shall not be added to the refrigerating system unless compliance with ISO 5149-2 is determined.

If any part of the refrigeration circuit can reach a temperature which is above the temperature corresponding with the maximum allowable pressure (e.g. on account of an electrical defrosting system, a defrosting system using hot water or cleaning by means of hot water or steam), the liquid contained in it shall be able to escape to some other part of the system in which the higher temperature does not prevail. If necessary, the system shall be equipped with a receiver that is permanently connected to the apparatus in question.

# Bibliography

[1] ISO 5149–4, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 4: Operation, maintenance, repair and recovery*

[2] IEC/TR 61200–52, *Electrical installation guide — Part 52: Selection and erection of electrical equipment — Wiring systems*

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