International Standard

ISO 5149-3

Second edition
2026-11

Refrigerating systems and heat pumps — Safety and environmental requirements —

Part 3: Installation site, classification and selection criteria

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

Partie 3: Site d'installation, classification et critères de sélection

Reference number
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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 required for the different types of ISO document 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).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

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This document was prepared by Technical Committee ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 1, *Safety and environmental requirements for refrigerating systems*.

This second edition cancels and replaces the first edition (ISO 5149-3:2014), which has been technically revised. It also incorporates the Amendment ISO 5149-3:2014/Amd 1:2021.

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The main changes are as follows:

— integration of Clause 5 to Clause 8 and Annex A of ISO 5149-1:2014 in this document;

— introduction of Path A and Path B safety concepts and related safety provisions;

— introduction of the releasable charge concept;

— partial alignment of the document with EN 378-3.

A list of all parts in the ISO 5149 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Refrigerating systems and heat pumps — Safety and environmental requirements —

Part 3: Installation site, classification and selection criteria

1 Scope

This document specifies:

— the classification and selection criteria applicable to refrigerating systems;

— safety requirements for the installation site of refrigerating systems and their ancillary components.

These classification and selection criteria are used in ISO 5149-2 and ISO 5149-4.

This document is applicable to:

a) refrigerating systems, stationary or mobile, of all sizes, except vehicle air conditioning systems covered by a specific product standard, e.g. ISO 13043 and SAE J 639;

b) secondary cooling or heating systems;

c) the location of the refrigerating systems;

d) parts replaced and components added after publication of this document if they are not identical in function and in capacity.

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This document is applicable:

— to new refrigerating systems, extensions or modifications of already existing systems;

— for used systems, being transferred to and operated on another site;

— in the case of the conversion of a system for another refrigerant.

This document is only applicable to systems containing refrigerants which have a safety group classification and are listed in ISO 817.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 817:2024, *Refrigerants — Designation and safety classification*

ISO 5149-1, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 1: Vocabulary*

ISO 5149-2:2026, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 2: Design, construction, testing, marking and documentation*

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

ISO 12100, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

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

ISO 22712, *Refrigerating systems and heat pumps — Competence of personnel*

IEC 60079-10-1, *Explosive atmospheres — Part 10-1: Classification of areas — Explosive gas atmospheres*

IEC 60204-1, *Safety of machinery — Electrical equipment of machines — Part 1: 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*

IEC 62990-3, *Workplace atmospheres — Part 3. Gas detectors. Electrical apparatus for the detection and measurement of oxygen — Performance requirements and test methods*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

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For the user's convenience, the list of abbreviated terms used in this document is given in Table 1.

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Table 1 — Additional abbreviated terms

Abbreviated term	Description
ATEL	acute toxicity exposure limit
CL	concentration limit
CLAM	concentration limit with additional measures
GWP	global warming potential
LFL	lower flammability limit
ODL	oxygen deprivation limit
ppm	parts per million by volume
RV	room volume
SDS	safety data sheet
TF	toxicity factor

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 areas not designated as occupied or as a machinery room.

The refrigerating equipment can be contained in a class IV ventilated enclosure provided by the manufacturer.

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4.2 Refrigerating equipment located in the open air

Refrigerating equipment sited in the open air shall be positioned to avoid refrigerant flowing from the equipment into the building or otherwise endangering people and property.

NOTE Possible methods to achieve this include one or more of the following:

— location of the refrigerant-containing part of the refrigeration system (except piping) at least 6 m away from any opening to the building;

— for refrigerants heavier than air, use of barriers of at least 1 m height between the system location and the inlet ventilation opening to block the flow of leaked or vented refrigerant;

— for refrigerants heavier than air, location of the inlet ventilation opening at least 1 m above the level at which the system is installed.

The discharge opening from safety relief devices or associated discharge pipes shall be positioned according to the manufacturer's instructions and oriented to direct vented refrigerant away from inlet ventilation openings. Alternatively, for flammable refrigerants, the distance to the inlet ventilation opening may be determined in accordance with IEC 60079-10-1.

4.3 Refrigerating equipment located in a machinery room

When a machinery room is chosen as the location for refrigerating equipment, it shall meet the requirements specified in Clause 8.

A risk assessment based on the safety concept for the refrigerating system (as determined by the manufacturer and including the charge and safety classification of the refrigerant used) shall be conducted to determine whether it is necessary to place the refrigerating system in a separate refrigeration machinery room.

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NOTE 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.

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4.4 Refrigerating equipment located in the occupied space

The requirements shall be as specified in Clause 5, Clause 6 and Clause 7.

4.5 Refrigerating equipment located in an area not designated as an occupied space or a machinery room

For any equipment located in a space that cannot be sealed from an occupied space, the location shall be treated as an occupied space in accordance with 4.4.

Where compressors or pressure vessels are located in an indoor space that is sealed from any occupied space, the location shall be treated as an occupied space in accordance with 4.4 or a machinery room in accordance with Clause 8.

Where equipment (not including compressors and pressure vessels) containing non-permanent joints is located in an unoccupied space that is sealed from any occupied space, the requirements of Clause 8 shall apply. If mechanical ventilation is required according to 8.13, ventilation shall be from an extractor hood positioned adjacent to the equipment and the ventilation rate shall be more than 0,05 m^3/s per ventilator.

In the case of equipment subject to adverse conditions, for example severe vibration or a corrosive atmosphere, the ventilation rate shall be more than 0,5 m^3/s per extractor hood.

If mechanical ventilation is required, refrigerant gas detectors shall activate the ventilation in accordance with the requirements given in Clause 12.

NOTE 1 Severe vibration can be caused by unbalanced dynamic loads or hydraulic shock during defrost operation.

NOTE 2 The ventilation rate is deemed sufficient to ventilate a volume of 18 m^3.

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

The class IV ventilated enclosure containing the refrigerating equipment shall be installed in accordance with the design specified in ISO 5149-2:2026, 6.2.17. The class IV ventilated enclosure shall have a sufficient make up air source to replace any exhausted air. The ventilation from the enclosure shall be to the open air or to a room having a minimum volume as specified in 7.3 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 an internal height of at least 1,2 m.

5 Classification

5.1 General

For the purpose of this document, refrigerating systems shall be classified according to:

— the location in which the system is installed;

— the type of people who have access to the place in which the system is installed;

— the toxicity and flammability characteristics of the refrigerant.

There are four classes of location and three access categories for refrigerating systems or parts of refrigerating systems. Where a refrigerating system contains parts installed in several spaces, each space shall be considered individually. The charge limits shall be calculated for each of them, according to Clause 7.

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For installations with multiple refrigerating systems, each refrigerating system shall be evaluated independently.

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Examples of classification of system locations, categorisation of access and classification of refrigerants are given in Annex A.

5.2 Classification of system locations

5.2.1 Class I – Mechanical equipment located within the occupied space

If the refrigerating system or any of its refrigerant-containing parts are located indoors in an occupied space or a non-occupied space which is not sealed from the occupied space or which can leak into the occupied space, then the system is considered to be of class I unless the system conforms to the requirements in 5.2.2 or 5.2.4.

EXAMPLE Integral display unit.

5.2.2 Class II – Compressors and pressure vessels outside the occupied space

If all compressors and pressure vessels are outside the occupied space and refrigerant leaks from compressors or pressure vessels cannot flow into the occupied space, then the requirements for a class II location shall apply to any refrigerant-containing part in the occupied space or that can leak refrigerant into the occupied space. Coil-type heat exchangers and pipework, including valves, may be located in an occupied space.

Refrigerant can leak into the occupied space through heat-transfer fluid if, for example:

— the heat-transfer fluid is ventilation air;

— the heat-transfer fluid is an open spray system;

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— leakage of the refrigerant into the occupied space is caused by leakage of the refrigerant into the heat-transfer fluid;

— there is a heat-transfer fluid relief valve or an automatic purge point that vents into the space.

Leakage via the heat-transfer fluid is not considered for systems that conform to ISO 5149-2:2026, 6.2.9.5 on the protection of the secondary cooling and heating system.

EXAMPLE Cold store.

5.2.3 Class III – Machinery room or open air

If all of the refrigerant-containing parts are located in a machinery room or the open air, then the requirements for a class III location shall apply. The machinery room shall conform to the requirements of Clause 8.

EXAMPLE Water-cooled chiller.

5.2.4 Class IV – Ventilated enclosures

If, with the intent of preventing migration of leaked refrigerant to the surrounding area, refrigerant-containing parts are located in a ventilated enclosure that conforms to the requirements of 4.6 and ISO 5149-2:2026, 6.2.17, then the requirements for a class IV location shall apply.

EXAMPLE Heat pump within a ventilated enclosure.

5.3 Classification of access to occupied spaces, machinery rooms and open air

For the purpose of this document, access classification shall be determined according to Table 2.

The access category is defined according to Table 2 by consideration of the group of occupants who are least familiar with the safety precautions. For example, in a supermarket, department store or transport terminus, an unregulated number of customers who are not familiar with the location or its safety precautions can gather. In a general office, the number of people in the building is more easily regulated and occasional visitors are accompanied by a regular occupant who can advise on the safety precautions in the event of an emergency. In a manufacturing facility, all of the occupants are familiar with the safety requirements and access to the workplace is restricted.

NOTE 1 A complex building can contain several access categories. For example, the public areas and the plant rooms in a hospital can be classified as access category a and access category c respectively.

Table 2 — Categories of access

Categories	General characteristics
General access a (least restrictive access to the space)	Parts of buildings: — where sleeping facilities are the main purpose of the building — where people are restricted in their movement — where an uncontrolled number of people are present — where students are present and are under instruction or supervision — to which any person has access
Supervised access b	Parts of buildings where: — only a limited number of people can be assembled, some being necessarily acquainted with the general safety precautions of the establishment — public access is not permitted but specific knowledge of refrigerating systems is not required — personnel access is strictly controlled but specific knowledge of refrigerating systems is not required

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Table 2 *(continued)*

Categories	General characteristics
Authorised access c (most restrictive access to the space)	Parts of 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 — access to the space is restricted to personnel with specific knowledge of refrigerating systems — access to the space is restricted by the layout of the building and securely controlled

Examples of access categories are given in Annex A.

NOTE 2 Open air locations including roofs, car parks and outdoor equipment compounds are considered to be parts of the building.

Machinery rooms shall not be considered as an occupied space except as defined in 8.1.

5.4 Classification of refrigerants

Refrigerant shall be classified according to toxicity and flammability as specified in ISO 817 (see Annex B).

The toxicity class of the refrigerant is designated by A or B. The flammability class of the refrigerant is designated by 1, 2L, 2 or 3.

6 Determining the room volume and room area used in refrigerant quantity limit calculations

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6.1 General

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Where IEC or ISO product standards exist for particular types of systems, and where these product standards provide a method to determine refrigerant quantity limits or room volume limits or floor area limits, those methods shall be used in place of the requirements of this document.

The space considered shall be any occupied space that contains refrigerant-containing parts. The refrigerant quantity limit for any system or part of a system shall be based on the quantity of refrigerant that can leak into the occupied space, the room volume or floor area of that space and the effect that the leak can have on the space or on the occupants of the space.

Any significant volume taken up by equipment or inventory and similar shall be deducted from the space volume calculation. Spaces above false ceilings shall not be included in the volume calculation unless the false ceiling has openings greater than 50 % of the ceiling area (e.g. grille construction) or is used as part of a ventilation system, allowing free air movement with the space below.

NOTE The volume of equipment or inventory is considered significant if it is more than 20 % of the gross room volume.

6.2 Space volume and area calculations

The space for a refrigerant quantity limit calculation shall be a space into which refrigerant can leak. When considering systems located in (or serving) multiple spaces, the refrigerant quantity limit shall be based on the most stringent combination of space volume or area, access category and refrigerant characteristic.

For a system using a heat-transfer fluid where the system is subject to the requirements for a Class III location, the space to be considered for the refrigerant quantity limit calculation shall be the machinery room or open-air location in which the system is located.

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Spaces that are not occupied and are not machinery rooms but that contain components of the refrigerating system shall conform to 4.5.

Multiple spaces that have appropriate openings, that cannot be closed between the individual spaces or are connected with a common ventilation supply, return or exhaust system not containing the evaporator or the condenser shall be treated as a single space. Where the evaporator or condenser is located in an air supply duct system serving multiple spaces, the volume of the smallest single space shall be used. If the airflow to a space cannot be reduced to less than 10 % of the maximum airflow by the use of an airflow reducer, then that space shall be included in the volume of the smallest occupied space.

7 Setting refrigerant quantity limits

7.1 General

This document provides two alternative methods to ensure that the risk of hazards arising from the leakage of refrigerant from refrigeration systems is tolerable. The first method, Path A safety concept, applies a limit to the amount of refrigerant that is contained within the system and can leak. This limit is established in accordance with 7.2 to 7.8. The limitation of refrigerant charge ensures that the quantity of refrigerant in the atmosphere does not present unacceptable risk to building occupants or property. The second method, Path B safety concept, does not necessarily rely on a limitation of charge to ensure safety of the building occupants or property. Both methods, Path A safety concept and Path B safety concept, consider the hazards associated with toxicity and flammability.

The refrigerant charge for a system shall not be higher than the maximum refrigerant charge. The releasable charge for a system shall not be higher than the refrigerant quantity limit as calculated according to Clause 7.

If no maximum refrigerant charge is specified, then the maximum refrigerant charge shall be the maximum amount of refrigerant that can be contained in that part of the system without adversely affecting its capacity, efficiency, reliability, operability or maintainability.

NOTE In some systems, it can be possible to charge the system with more refrigerant than the minimum required for normal operation. The normal operating charge in this case can be lower than the maximum refrigerant charge.

If the releasable charge, m_{rl}, is used, it shall be determined according to Annex C. If a releasable charge is not determined by testing according to Clause C.2 or calculation according to Clause C.3, then the releasable charge for a system shall be the refrigerant charge. If Path A safety concept is applied, the refrigerant charge may be replaced by the releasable charge in the formulae in Clause 7.

7.2 Defining toxicity and flammability classes, toxicity factor, lower flammability limit and cap factors

The toxicity and flammability classes shall be as indicated in Annex B.

The toxicity factor (TF), expressed in kg/m^3, for the refrigerant shall be the acute toxicity exposure limit/oxygen deprivation limit (ATEL/ODL) value or the practical limit (see Annex B), whichever is greater.

The lower flammable limit (LFL), expressed in kg/m^3, shall be as indicated in Annex B.

If Path A safety concept is applied to flammable refrigerants, then the refrigerant charge shall be capped to limits based upon the LFL of the refrigerant. The cap factors apply to the refrigerant charge even where the releasable charge is determined and used instead of the refrigerant charge in Clause 7.

In case of flammability class 2 or 3 refrigerants, the basic cap factors m_1, m_2 and m_3 shall be calculated using Formula (1) to Formula (3).

$$m_1 = 4 \times L_{LF} \quad (1)$$

$$m_2 = 26 \times L_{LF} \quad (2)$$

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$$m_3 = 130 \times L_{LF} \quad (3)$$

where

L_{LF} is equal to the lower flammability limit according to Annex B, expressed in kg/m^3;

Factors 4, 26 and 130 are expressed in m^3;

m_1, m_2 and m_3 are the basic cap factors, expressed in kg.

In case of flammability class 2L refrigerants, the basic cap factors m_1, m_2 and m_3 shall be calculated using Formula (4) to Formula (6).

$$m_1 = 1,5 \times 4 \times L_{LF} \quad (4)$$

$$m_2 = 2 \times 26 \times L_{LF} \quad (5)$$

$$m_3 = 2 \times 130 \times L_{LF} \quad (6)$$

where

L_{LF} is equal to the lower flammable limit according to Annex B, expressed in kg/m^3;

Factors 4, 26 and 130 are expressed in m^3;

m_1, m_2 and m_3 are the basic cap factors, expressed in kg.

There are no room volume restrictions for refrigerant charges below or equal to m_1.

NOTE The factor of 26 is based on a charge of 1 kg of R-290.

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7.3 Establishing the refrigerant quantity limit

If Path A safety concept is used, the following method shall be applied to determine the refrigerant quantity limit:

a) Determine the appropriate access category a, b or c according to 5.3 and location I, II, III or IV according to 5.2 for the refrigerating system.

b) Determine the toxicity class and the TF of the refrigerant used in the refrigerating system according to 7.2.

c) Determine the charge limit for the refrigerating system based on toxicity as the greater of:

   1) charge limit according to 7.4.2, 7.5 or 7.6.1 with 7.8 when required;

   2) 20 m^3 multiplied by the TF for sealed refrigerating systems;

d) Determine the flammability class of the refrigerant used in the refrigerating system, the corresponding LFL and the m_1, m_2 and m_3 according to 7.2.

e) Determine the charge limit for the refrigerating system based on flammability as the greater of:

   1) charge limit according to 7.4.3, 7.5 or 7.6.2 with 7.8 when required;

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2) m_1 for refrigerating systems using flammability class 2L, 2 or 3;

f) The refrigerant quantity limit corresponds to the lowest charge limit obtained according to c) and e). For flammable refrigerants (class 2L, 2 or 3), where the TF exceeds 75 % of LFL, c) is not applicable. For refrigerants of flammability class 1, e) is not applicable.

7.4 Refrigerant charge limit calculation for Path A safety concept

7.4.1 General

Under Path A safety concept, the risk is mitigated by refrigerant charge limitation depending on the room size, and in some cases by integral circulation airflow within the system designs.

7.4.2 Refrigerant charge limit based on toxicity

Where the refrigerant is flammable (class 2L, 2 or 3) and the TF exceeds 75 % of LFL, no further calculation is required: the charge limit based on flammability class shall be used, see 7.4.3.

Table 3 specifies the charge limit requirements for refrigerating systems or parts of systems based on toxicity.

Table 3 — Charge limits based on toxicity

<table>
<tr><th rowspan="2">Toxicity class</th><th rowspan="2">Access category</th><th colspan="4">Location classification</th></tr>
<tr><th>I</th><th>II</th><th>III</th><th>IV</th></tr>
<tr><td rowspan="3">A</td><td>a</td><td>$F_T \times V_R$ or 7.6.1</td><td>$F_T \times V_R$ or 7.5 or 7.6.1</td><td rowspan="5">No charge limit [a]</td><td rowspan="5">The charge requirements shall be assessed according to location classification I, II, or III, depending on the location of the ventilated enclosure.</td></tr>
<tr><td>b</td><td rowspan="2">No charge limit [a]</td><td rowspan="2">No charge limit [a]</td></tr>
<tr><td>c</td></tr>
<tr><td rowspan="3">B</td><td>a</td><td colspan="2">$F_T \times V_R$
or
only for sealed sorption systems: $F_T \times V_R$ and not more than 2,5 kg</td></tr>
<tr><td>b</td><td rowspan="2">Charge not more than 10 kg [a]</td><td rowspan="2">No charge limit [a]</td></tr>
<tr><td>c</td></tr>
<tr><td colspan="6">For below ground, additional requirements in 7.8 apply.
[a] Subclause 11.1 applies.
Key
F_T toxicity factor, expressed in kg/m^3
V_R room volume, expressed in m^3</td></tr>
</table>

7.4.3 Refrigerant charge limit based on flammability

7.4.3.1 General

Where the refrigerant is flammability class 1, no further calculation is required: the charge limit based on toxicity class shall be used. See 7.4.2.

Table 4 specifies the charge limit requirements for refrigerating systems or parts of systems based on flammability.

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