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BSI Standards Publication

Refrigerating systems and heat pumps — Safety and environmental requirements

Part 1: Definitions, classification and selection criteria

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National foreword

This British Standard is the UK implementation of ISO 5149-1:2014+A2:2021. It supersedes BS ISO 5149-1:2014+A1:2015, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to ISO text carry the number of the ISO amendment. For example, text altered by ISO amendment 1 is indicated by A1⟩ ⟨A1.

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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INTERNATIONAL STANDARD

ISO 5149-1

First edition
2014-04-15

Refrigerating systems and heat pumps — Safety and environmental requirements —

Part 1: Definitions, classification and selection criteria

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

Partie 1: Définitions, classification et critères de choix

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 ISOISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 1, *Safety and environmental requirements for refrigerating systems*.

ISO 5149-1, together with ISO 5149-2, ISO 5149-3, 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*

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Introduction

The purpose of this International Standard is to promote the safe design, construction, disposal, installation, and operation of refrigerating systems.

The industry response to the chlorofluorocarbon (CFC) issue has accelerated the introduction of alternative refrigerants. The entry of new refrigerants and blends in the market and the introduction of new safety classifications prompted the revision of this International Standard.

This International Standard is directed to the safety of persons and property on or near the premises where refrigeration facilities are located. It includes specifications for fabricating a tight system.

This International Standard is intended to minimize possible hazards to persons, property, and environment from refrigerating systems and refrigerants. These hazards are essentially associated with the physical and chemical characteristics of refrigerants as well as the pressures and temperatures occurring in the refrigeration cycles (see Annex A).

Attention is drawn to hazards common to all compression systems, such as high temperature at discharge, liquid slugging, erroneous operation, or reduction in mechanical strength caused by corrosion, erosion, thermal stress, fatigue stresses, liquid hammer, or vibration.

Corrosion, however, should have special consideration as specific conditions to refrigerating systems arise due to the alternate frosting and defrosting or the covering of equipment by insulation.

Commonly used refrigerants except R-717 are heavier than air. Care should be taken to avoid stagnant pockets of heavy refrigerant vapours by proper location of ventilation inlet and exhaust openings. All machinery rooms are required to have mechanical ventilation controlled by oxygen deficiency alarms or refrigerant vapour alarms.

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Refrigerating systems and heat pumps — Safety and environmental requirements —

Part 1: Definitions, classification and selection criteria

1 Scope

This International Standard specifies the requirements for the safety of persons and property, provides guidance for the protection of the environment, and establishes procedures for the operation, maintenance, and repair of refrigerating systems and the recovery of refrigerants.

This part of ISO 5149 specifies the classification and selection criteria applicable to the refrigerating systems and heat pumps. These classification and selection criteria are used in ISO 5149-2, ISO 5149-3, and ISO 5149-4.

This part of ISO 5149 applies to:

a) refrigerating systems, stationary or mobile, of all sizes including heat pumps;

b) secondary cooling or heating systems;

c) the location of the refrigerating systems;

d) replaced parts and added components after adoption of this part of ISO 5149 if they are not identical in function and in the capacity.

This part of ISO 5149 applies to fixed or mobile systems, except to vehicle air conditioning systems covered by a specific product standard, e.g. ISO 13043 and SAE J 639.

This part of ISO 5149 is applicable to new refrigerating systems, extensions or modifications of already 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 to another refrigerant.

Annex A specifies the limits for the quantity of refrigerant charge permitted in systems in various locations and occupancy classes.

Annex B specifies the criteria for safety and environmental considerations of different refrigerants used in refrigeration and air conditioning.

Systems containing refrigerants which are not listed in ISO 817 are not covered in this part of ISO 5149.

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 817:2014, *Refrigerants — Designation and safety classification*

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

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ISO 5149-3:2014, *Refrigerating systems and heat pumps — Safety and environmental requirements — Part 3: Installation site*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 817 and the following apply.

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

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

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

3.1 Refrigerating system

3.1.1
absorption system
refrigerating 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 then liquefied by cooling

3.1.2
cascade system
two or more independent refrigerant circuits where the condenser of one system rejects heat directly to the evaporator of another

3.1.3
direct releasable system
system with one degree of separation from an occupied space

Note 1 to entry: Systems in which the secondary coolant is in contact with the air or the goods to be cooled or heated (e.g. spray systems) are direct releasable systems.

Note 2 to entry: For the purpose of this part of ISO 5149, direct and indirect systems are defined with respect to the potential to leak refrigerant into an occupied space. When the system does not serve an occupied space, it can be classed as direct or indirect depending on the system design.

3.1.4
indirect system
systems with more than one degree of separation from the occupied space

3.1.5
double indirect system
indirect system for which the heat-transfer medium passes through a second heat exchanger located externally to the space, and cools or heats a second heat-transfer medium fluid, which is brought into direct contact with the substance concerned (e.g. by sprays or similar means)

3.1.6
limited charge system
refrigerating system in which the internal volume and total refrigerant charge are such that, with the system idle, the allowable pressure is not exceeded when complete evaporation of the refrigerant occurs

3.1.7
high-pressure side
part of a refrigerating system operating approximately at the condenser pressure

3.1.8
low-pressure side
part of a refrigerating system operating approximately at the evaporator pressure

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3.1.9
refrigerating system (heat pump)
combination of interconnected refrigerant-containing parts constituting one closed circuit in which the refrigerant is circulated for the purpose of extracting and rejecting heat (i.e. cooling and heating)

Note 1 to entry: Refrigerating is used to refer to the on-going process, while refrigeration is used to refer to something that is completed, such as the equipment (refrigeration equipment).

3.1.10
self-contained system
complete factory-made refrigerating system in a suitable frame and/or enclosure, that is fabricated and transported completely, or in two or more sections and in which no refrigerant-containing parts are connected on site other than by isolation valves, such as companion (block) valves

3.1.11
sealed system
refrigerating system in which all refrigerant-containing parts are made tight by welding, brazing, or a similar permanent connection

Note 1 to entry: A connection that is tightness-tested for a leakage rate of less than 3 g refrigerant per year under a pressure of at least 0,25 X PS, and where the mechanical joints are prevented from improper use by the need of a special tool (e.g. glue), is considered as a similar permanent connection. This can include capped valves and capped service ports.

3.1.12
system
set of components working together as a mechanism or interconnected network

Note 1 to entry: Examples of systems are given in 4.2.

3.1.13
unit system
self-contained system that has been assembled, filled, ready for use, and tested prior to its installation and is installed without the need for connecting any refrigerant-containing parts

3.1.14
split system
refrigerating system, air conditioner, or heat pump incorporating one or more refrigerant circuits, comprising one or more factory-built indoor units providing cooling or heating to the space and or more factory-built outdoor units

3.1.15
multisplit system
split system with at least more than one indoor unit

3.2 Location

3.2.1
crawl space
space that is generally accessed for maintenance only and where it is not possible to walk or access by walking

Note 1 to entry: Usually, the height of crawl spaces is less than 1 m.

3.2.2
exit
opening in the outer wall, with or without door or gate

3.2.3
exit passageway
passageway in the immediate vicinity of the door through which people leave the building

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3.2.4
hallway
corridor for the passage of people

3.2.5
machinery room
enclosed room or space, with mechanical ventilation, sealed from public areas and not accessible to the public, which is intended to contain components of the refrigerating system

Note 1 to entry: A machinery room can contain other equipment provided that the design and its installation requirements are compatible with the requirements for the safety of the refrigerating system.

3.2.6
occupied space
space in a building which is bounded by walls, floors, and ceilings and which is occupied for a significant period by persons

Note 1 to entry: Where the spaces around the apparent occupied space are, by construction or design, not airtight with respect to the occupied space, these can be considered as part of the occupied space, e.g. false ceiling voids, crawl ways, ducts, movable partitions, and doors with transfer grilles.

3.2.7
open air
any unenclosed space, possibly but not necessarily roofed

3.2.8
special machinery room
machinery room intended to contain only components of the refrigerating system, having no combustion element, (except where the refrigerating system is direct gas fired absorption) and accessible only to competent personnel for the purposes of inspection, maintenance, and repair

3.2.9
ventilated enclosure
enclosure containing the refrigerating system that does not enable air to flow from the enclosure to the surrounding space, and has a ventilation system that produces airflow from the enclosures to the open air through a ventilation duct

3.3 Pressure

3.3.1
design pressure
pressure chosen for the strength calculation of each component

Note 1 to entry: It is used for determining the necessary materials, thickness, and construction for components with regard to their ability to withstand pressure.

3.3.2
tightness test pressure
pressure that is applied to test a system or any part of it for tightness under pressure

3.3.3
maximum allowable pressure
PS
maximum pressure which system or component is designed, as specified by the manufacturer

3.3.4
strength test pressure
pressure that is applied to test the strength of a refrigerating system or any part of it

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3.4 Components of refrigerating system

3.4.1
coil
part of the refrigerating system constructed from pipes or tubes suitably connected and serving as a heat exchanger (evaporator or condenser)

Note 1 to entry: A header connecting the tubes of the heat exchanger is part of the coil.

3.4.2
compressor
device for mechanically increasing the pressure of a refrigerant vapour

3.4.2.1
compressor unit
combination of one or more compressors and the regularly furnished accessories

3.4.2.2
positive displacement compressor
compressor in which compression is obtained by changing the internal volume of the compression chamber

3.4.2.3
non-positive displacement compressor
compressor in which compression is obtained without changing the internal volume of the compression chamber

3.4.2.4
open compressor
compressor having a drive shaft penetrating the refrigerant-tight housing

3.4.3
heat exchanger
device designed to transfer heat between two physically separated fluids

3.4.4
condenser
heat exchanger in which refrigerant vapour is liquefied by removal of heat

3.4.5
condensing unit
combination of one or more compressors, condensers or liquid receivers (when required), and the regularly furnished accessories

3.4.6
evaporator
heat exchanger in which liquid refrigerant is vaporized by absorbing heat from the substance to be cooled

3.4.7
pressure vessel
any refrigerant-containing part of a refrigerating system other than

— compressors,

— pumps,

— component parts of sealed absorption systems,

— evaporators, each separate section of which does not exceed 15 l of refrigerant-containing volume,

— coils,

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— piping and its valves, joints, and fittings,

— control devices, and

— pressure-containing components (including headers) having an internal diameter or largest cross sectional dimension not greater than 152 mm.

3.4.8
fade-out vessel
vapour receiver connected to the low temperature stage of a limited charge cascade system which is of sufficient size to limit the rise in pressure during system standstill

Note 1 to entry: The receiver provides sufficient volume to accommodate the total refrigerant charge of the circuit as vapour at ambient temperature without exceeding the allowable pressure of the system.

3.4.9
liquid receiver
vessel permanently connected to a system by inlet and outlet pipes for accumulation of liquid refrigerant

3.4.10
internal net volume
volume calculated from the internal dimensions of a vessel, after the subtraction of the volume of the parts within the internal dimensions

3.4.11
refrigerating equipment
components forming a part of the refrigerating system, e.g. compressor, condenser, generator, absorber, adsorber, liquid receiver, evaporator, and surge drum

3.4.12
surge drum
vessel containing refrigerant at low pressure and temperature, and connected by liquid feed and vapour return pipes to an evaporator(s)

3.5 Piping, joint, and fitting

3.5.1
brazed joint
joint obtained by the joining of metal parts with alloys which melt at temperatures that is generally higher than 450 °C, but less than the melting temperatures of the joined parts

3.5.2
companion (block) valve
pair of mating stop valves, isolating sections of systems and arranged so that these sections can be joined before opening these valves or separated after closing them

3.5.3
compression joint
pipe joint in which the tightening of a nut compresses a shaped ring that presses on the outside of the pipe sealing the system

3.5.4
flanged joint
joint made by bolting together a pair of flanged ends

3.5.5
flared joint
metal-metal compression joint in which a conical spread is made on the end of the tube

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3.5.6
header
pipe or tube component of a refrigerating system to which several other pipes or tubes are connected

3.5.7
isolating valve
valve which prevent flow in either direction when closed

3.5.8
joint
connection which assures the gas-tight connection between parts

3.5.9
piping
pipes or tubes (including any hose, bellows, or flexible pipe) for interconnecting the various parts of a refrigerating system

3.5.10
quick-closing valve
shut-off device which closes automatically (e.g. by weight, spring force, quick closing ball) or has a closing angle of 130° or less

3.5.11
service duct
duct containing the electrical supply, refrigerant piping, plumbing, other ducts, or equivalent service required for operation of the product

3.5.12
shut-off device
device to shut off the flow of the fluid

3.5.13
tapered thread joint
threaded pipe joint requiring filler materials in order to block the spiral leakage path

3.5.14
three-way valve
service valve that connects one refrigerant line to one or two other refrigerant lines and generally intended to permit servicing part of a refrigerating system without removing the refrigerant from the complete system

3.5.15
welded joint
assembly of metal parts in the plastic or molten state

3.6 Safety device

3.6.1
bursting disc
disc or foil which bursts at a predetermined differential pressure

Note 1 to entry: Bursting disc is also called rupture disc or rupture member.

3.6.2
changeover device
valve controlling two safety devices and so arranged that only one can be made inoperative at any one time

3.6.3
fusible plug
device containing any material which melts at a predetermined temperature and relieves the pressure

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3.6.4
liquid level cut out
actuated device designed to prevent unsafe liquid levels

3.6.5
overflow valve
pressure relief device discharging to the low pressure side of the refrigerating system

3.6.6
pressure limiter
switching device for limiting the pressure that resets automatically

3.6.7
pressure relief device
pressure relief valve or bursting disc device designed to relieve excessive pressure automatically

3.6.8
pressure relief valve
pressure-actuated valve held shut by a spring or other means and designed to relieve excessive pressure automatically

3.6.9
refrigerant detector
sensing device which responds to a pre-set concentration of refrigerant in the environment

3.6.10
safety switching device for limiting the pressure
type-approved pressure-actuated device that is designed to stop the operation of the pressure generator

3.6.11
self-closing valve
valve that closes automatically, e.g. by weight or spring force

3.6.12
temperature limiting device
temperature-actuated device that is designed to prevent excessive temperatures

Note 1 to entry: A fusible plug is not a temperature limiting device.

3.6.13
type-approved component
component for which the examination is performed on one or more samples of this component by following a recognized standard for type approval

3.6.13.1
type-approved pressure cut out
safety switching device for limiting the pressure that requires to be manually reset

3.6.13.2
type-approved pressure limiter
safety switching device for limiting the pressure that automatically resets

3.6.13.3
type-approved safety pressure cut out
safety switching device for limiting the pressure that requires to be reset manually only with the aid of a tool

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3.7 Fluid

3.7.1
lubricant
fluid present in the internal volume of the refrigerating system, present for the main purpose of lubrication of wearing surfaces

3.7.2
azeotrope
blend composed of two or more refrigerants whose equilibrium vapour and liquid phase compositions are the same at a given pressure, but can be different at other condition

Note 1 to entry: See Table B.3.

[SOURCE: ISO 817:2014, ⟦A2⟧ 3.1.5, modified ⟨A2⟧ — Note 1 to entry has been added.]

3.7.3
zeotrope
blend composed of two or more refrigerants whose equilibrium vapour and liquid phase compositions are not the same at any pressure below the critical pressure

Note 1 to entry: See Table B.2.

[SOURCE: ISO 817:2014, ⟦A2⟧ 3.1.43, modified — Note 1 to entry has been added. ⟨A2⟧]

3.7.4
halocarbon
chemical compound consisting of halogen (fluorine, chlorine, bromine, or iodine), carbon, and in some cases, hydrogen

3.7.5
hydrocarbon
chemical compound consisting of hydrogen and carbon

3.7.6
heat-transfer fluid
HTF
fluid (e.g. brine, water, air) for the transmission of heat

3.7.7
auto-ignition temperature
lowest temperature of a substance at or above which a chemical can spontaneously ignite in a normal atmosphere, without an external source of ignition, such as a flame or spark

3.7.8
outside air
air from outside of the building

3.7.9
refrigerant
fluid used for heat transfer in a refrigerating system, which absorbs heat at a low temperature and a low pressure of the fluid, and rejects it at a higher temperature and a higher pressure of the fluid usually involving changes of the phase of the fluid

Note 1 to entry: Refrigerants are listed in ISO 817.

[SOURCE: ISO 817:2014, ⟦A2⟧ 3.1.5, modified ⟨A2⟧ — Note 1 to entry has been added.]

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3.7.10
refrigerant type
chemical compound or blend of compounds used as a specific nomenclature designation

Note 1 to entry: Designation is given in ISO 817.

3.7.11
toxicity
ability of a refrigerant or a heat-transfer fluid to be harmful or lethal or to impair a person's ability to escape due to acute or chronic exposure by contact, inhalation, or ingestion

Note 1 to entry: Temporary discomfort that does not impair health is not considered to be harmful.

3.7.12
flammability
ability of a refrigerant or heat-transfer fluid to propagate a flame from an ignition source

3.7.13
practical limit
concentration used for simplified calculation to determine the maximum acceptable amount of refrigerant in an occupied space

Note 1 to entry: Refrigerant Concentration Limit (RCL) is determined by toxicity or flammability tests, but practical limit is derived from RCL or historically established charge limit.

3.8 Heat transfer circuit

3.8.1
heat-transfer circuit
circuit which is composed of at least two heat exchangers and interconnecting pipes

3.9 Refrigerant disposal

3.9.1
disposal
to dispose of or to convey a product usually for scrapping or destruction

3.9.2
reclaim
to process used refrigerants to new product specifications

3.9.3
recover
to remove refrigerant in any condition from a system and store it in an external container

3.9.4
recycle
reduction of contaminants in used refrigerants by separating oil, removing non-condensables, and using devices to reduce moisture, acidity, and particulate matter

Note 1 to entry: Devices can include filters and dryers.

3.9.5
reuse
use (charge) of recovered refrigerant without any processing to remove impurities

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3.10 Miscellaneous

3.10.1
factory made
manufactured at a dedicated production location under control of a recognized quality system

3.10.2
dilution transfer opening
opening which allows the leaked refrigerant to flow out from the room to an adjacent room or corridor by density difference, dilution, convection, or ventilation

A1 **3.10.3**
quantity limit with additional ventilation
charge density of refrigerant that when exceeded creates an instantaneous dangerous situation, if the total charge leaked within the occupied space

A2 *Text deleted* A2 A1

A1 **3.10.4**
quantity limit with minimum ventilation
charge density of refrigerant that results in a concentration equal to the RCL in a room of non-airtight construction with a moderately severe refrigerant leak

A2 *Text deleted* A2 A1

4 Abbreviated terms

A/C	Air Conditioning systems
ATEL	Acute Toxicity Exposure Limit
GWP	Global Warning Potential
HTF	Heat-Transfer Fluid
ITH	Integration Time Horizon
LFL	Lower Flammability Limit
MSDS	Material Safety Data Sheet
ODL	Oxygen Deprivation Limit
ODP	Oxygen Deprivation Potential
PS	Maximum Allowable Pressure
QLAV	Quantity Limit with Additional Ventilation
QLMV	Quantity Limit with Minimum Ventilation
RCL	Refrigerant Concentration Limit

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