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Refrigerants — Designation and safety classification

Fluides frigorigènes — Désignation et classification de sécurité

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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 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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This document was prepared by Technical Committee ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 8, *Refrigerants and refrigeration lubricants*.

This fourth edition cancels and replaces the third edition (ISO 817:2014), which has been technically revised. It also incorporates the Amendments ISO 817:2014/Amd 1:2017 and ISO 817:2014/Amd 2:2021.

The main changes are as follows:

— the scope has been expanded to include data necessary for safe applications of the refrigerants;

— the rules of toxicity safety classification to consider acute and chronic toxicity, have been incorporated into 6.1.2;

— requirements to apply for designations, safety classifications, and refrigerant concentration limits for refrigerants, including blends, and requirements to submit new or revised data for refrigerants listed in ISO 817 tables, previously located in Annex F, have been relocated to https://standards.iso.org/iso/817/ma/en/.

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.

Refrigerants — Designation and safety classification

1 Scope

This document provides an unambiguous system for assigning designations to refrigerants. It also establishes a system for assigning a safety classification to refrigerants based on toxicity and flammability data, and provides a means of determining the refrigerant concentration limit. Tables listing the refrigerant designations, safety classifications, refrigerant concentration limits and data necessary for safe use of the refrigerants are included based on data submitted with the application.

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/PAS 24499, *Method of test for burning velocity measurement of A2L flammable gases*

ANSI/ASHRAE Standard 34, *Designation and Safety Classification of Refrigerants*

ASTM D8211, *Standard Test Method for Hot Surface Ignition Temperature of Gases on Flat Surface*

ASTM E681, *Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapours and Gases)*

3 Terms, definitions, abbreviated terms and symbols

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions 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/

3.1.1
acute toxicity
adverse health effect(s) from a single, short-term exposure

3.1.2
acute-toxicity exposure limit
ATEL
maximum recommended *refrigerant* (3.1.37) concentration determined in accordance with the established systems and intended to reduce the risks of *acute toxicity* (3.1.1) hazards to humans in the event of a *refrigerant* release

Note 1 to entry: The systems are specified in this document.

3.1.3
anaesthetic effect
impairment of the ability to perceive pain and other sensory stimulation

3.1.4
approximate lethal concentration
ALC
concentration of a *refrigerant* (3.1.37) that is lethal to even a single test animal but to less than 50 % of the animals in that group when tested by the same conditions as for an LC_{50} test

3.1.5
auto-ignition temperature
AIT
lowest temperature at or above which a substance can spontaneously ignite in air at standard atmospheric pressure without an external source of ignition, such as a flame or spark

3.1.6
azeotrope
blend (3.1.7) composed of two or more *refrigerants* (3.1.37) whose equilibrium vapour and liquid phase compositions are the same at a specific pressure, but can be different at other conditions

3.1.7
blend
mixture composed of two or more *refrigerants* (3.1.37)

3.1.8
burning velocity
S_u
velocity, relative to the unburnt gas, at which a laminar flame propagates in a direction normal to the flame front, at the concentration of *refrigerant* (3.1.37) with air giving the maximum velocity

Note 1 to entry: This value is expressed in centimetres per second.

3.1.9
central nervous system effect
CNS
treatment-related depression, distraction, stimulation, or other behavioural modification to a degree that could represent an impairment of the ability to escape from a hazard

3.1.10
chronic toxicity
adverse health effect(s) from long-term repeated exposures

3.1.11
combustion
exothermal reaction between an oxidant component (combustive) and a reducer (combustible fuel)

3.1.12
compound
substance composed of two or more atoms chemically bonded in definite proportions

3.1.13
critical point
point with conditions above which distinct liquid and gas phases do not exist

3.1.14
cyclic compound
organic compound whose structure is characterized by a closed ring of atoms

3.1.15
effective concentration 50 %
EC_{50}
concentration of a *refrigerant* (3.1.37) which causes a biological effect to 50 % of exposed animals in a test for anaesthetic or other effects

Note 1 to entry: This value is typically a calculated value from experimental data.

3.1.16
elevated temperature flame limit
ETFL
minimum concentration by volumic ratio (volume per cent) of the *refrigerant(3.1.37)*, which is capable of propagating a *flame* (3.1.18) through a homogeneous mixture of the *refrigerant* and air under the specified test conditions at 60,0 °C and 101,3 kPa

Note 1 to entry: The test conditions are specified in 6.1.3.

Note 2 to entry: 101,3 kPa is the standard atmospheric pressure at sea level.

3.1.17
equivalence ratio
fraction of the combustible in the mixture divided by the combustible fraction at the stoichiometric conditions

Note 1 to entry: It can be written as (combustible fraction)/(combustible fraction)$_{st}$.

Note 2 to entry: It is used in the determination of *burning velocity* (3.1.8).

Note 3 to entry: Lean mixtures have an equivalence ratio lower than one and rich mixtures have an equivalence ratio greater than one.

3.1.18
flame
collection of gases of a rapid combustion, generally visible due to the emission of light

3.1.19
flame propagation
combustion, causing a continuous *flame* (3.1.18) which moves upward and outward from the point of ignition without help from the ignition source

Note 1 to entry: Flame propagation as applied in the test method for determining LFL and flammability classification is specified in B.1.8. Flame propagation as applied in the test method for determining *burning velocity* (3.1.8) is described in ISO/PAS 24499.

3.1.20
flame propagation velocity
velocity at which a *flame* (3.1.18) propagates in a space

3.1.21
flammable
property of a mixture in which a *flame* (3.1.18) is capable of self-propagating for a certain distance

3.1.22
fractionation
change in composition of a *blend* (3.1.7) by preferential evaporation of the more volatile component(s) or condensation of the less volatile component(s)

3.1.23
heat of combustion
HOC
heat evolved from a specified exothermic reaction of a substance with oxygen.

Note 1 to entry: The heat of combustion is as determined in accordance with 6.1.3.7.

Note 2 to entry: The heat of combustion for this document is expressed as a positive value for exothermic reactions in energy per unit mass (kJ/kg).

Note 3 to entry: The heat of combustion for Class 2L, 2, and 3 *refrigerants* (3.1.37) is listed in Tables E.2 and E.3 available at https://standards.iso.org/iso/817/ma/en.

3.1.24
hot surface ignition temperature
HSIT
lowest temperature at which a substance ignites in normal atmosphere when impinged upon a heated surface

Note 1 to entry: Refer to ASTM D8211.

3.1.25
immediately dangerous to life or health
IDLH
atmospheric concentration of any toxic, corrosive, or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere

Note 1 to entry: IDLH values are used by the National Institute for Occupational Safety and Health (NIOSH) as respirator selection criteria.

3.1.26
isomer
two or more compounds having the same chemical composition with differing molecular configurations

3.1.27
lethal concentration 50 %
LC_{50}
atmospheric concentration that is lethal to 50 % of the exposed population

Note 1 to entry: LC_{50} is associated with inhalation exposures.

3.1.28
lethal dose 50 %
LD_{50}
oral or dermal dose that is lethal to 50 % of the exposed population

3.1.29
lower flammability limit
LFL

minimum concentration of the *refrigerant* (3.1.37) that is capable of propagating a *flame* (3.1.18) through a homogeneous mixture of the *refrigerant* and air under the specified test conditions at 23,0 °C and 101,3 kPa

Note 1 to entry: The test conditions are specified in 6.1.3.

Note 2 to entry: The LFL is expressed as *refrigerant* percentage by volume.

3.1.30
lowest observed adverse effect level
LOAEL
lowest concentration of a *refrigerant* (3.1.37) that causes any observed adverse effect on one or more test animals

3.1.31
no observed adverse effect level
NOAEL
highest concentration of a *refrigerant* (3.1.37) at which no adverse effect is observed on even one test animal.

3.1.32
nominal composition
nominal formulation
design composition as stated in the *refrigerant blend* (3.1.7) application, excluding any tolerances

Note 1 to entry: Composition of the *refrigerant blends* shall be as listed in Tables C.2 and C.3.

Note 2 to entry: When a container with the nominal composition is 80 % or more liquid filled, the liquid composition can be considered the nominal composition.

3.1.33
occupational exposure limit
OEL
time-weighted average concentration for a normal 8 h workday and a 40 h work week to which nearly all workers can be repeatedly exposed without adverse effect

Note 1 to entry: The OEL is determined by an independent organization that (1) is composed of health science experts, (2) is experienced in generating OELs for *refrigerant* compounds and (3) formally publishes the derived OELs in a way that is publicly accessible.

3.1.34
olefin
unsaturated chemical compound containing at least one carbon-to-carbon double bond

3.1.35
oxygen deprivation limit
ODL
concentration of a *refrigerant* (3.1.37) or other gas that can result in insufficient oxygen for normal breathing

3.1.36
quenching
effect of extinction of a *flame* (3.1.18) as it approaches a surface due to heat conduction losses, absorption of active chemical species and viscous effects on the surface

3.1.37
refrigerant
fluid used for heat transfer in a refrigerating system

Note 1 to entry: A refrigerant 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.

3.1.38
relative molar mass
mass numerically equal to the molecular mass expressed in grams per mole, except that it is dimensionless

3.1.39
saturated organic compound
carbon-containing compound that has only single bonds between carbon atoms

3.1.40
stoichiometric concentration for combustion
C_{st}
concentration of a fuel in a fuel-air mixture that contains exactly the necessary quantity of air (21 % O_2/79 % N_2 by volume) needed for the complete oxidation of all compounds present

3.1.41
threshold limit value-short term exposure limit
TLV-STEL
15 min time weighted average exposure that should not be exceeded at any time during a workday

3.1.42
threshold limit value-time weighted average
TLV-TWA
time weighted average concentration for a normal 8 h workday and a 40 h work week, to which nearly all workers may be repeatedly exposed, day after day, without adverse effect

3.1.43
unsaturated organic compound
carbon-containing compound containing at least one double or triple bond between carbon atoms

3.1.44
workplace environmental exposure limit
WEEL
occupational exposure limit (3.1.33) set by the Toxicology Excellence for Risk Assessment (TERA)

3.1.45
worst-case formulation
WCF
composition that results from application of the tolerances to the *nominal composition* (3.1.32) resulting in the most toxic or the most *flammable* (3.1.21) formulation

3.1.46
worst-case fractionated formulation
WCFF
composition produced during *fractionation* (3.1.22) of the *worst-case formulation* (3.1.45) that results in the most toxic or most *flammable* (3.1.21) formulation

3.1.47
zeotrope
blend (3.1.7) composed of two or more *refrigerants* (3.1.37) whose equilibrium vapour and liquid phase compositions are not the same at any pressure below the critical pressure

3.2 Abbreviated terms

ACGIH	American Conference of Governmental Industrial Hygienists
AIT	auto-ignition temperature
ALC	approximate lethal concentration
ATEL	acute-toxicity exposure limit
CNS	central nervous system effect
C_{st}	stoichiometric concentration for combustion
EC_{50}	effective concentration 50 %
ETFL	elevated temperature flame limit
HOC	heat of combustion
HSIT	hot surface ignition temperature
IDLH	immediately dangerous to life or health
LC_{50}	lethal concentration 50 %
LD_{50}	lethal dose 50 %
LFL	lower flammability limit
LOAEL	lowest observed adverse effect level
NIOSH	National Institute for Occupational Safety and Health (United States)
NOAEL	no observed adverse effect level
ODL	oxygen deprivation limit
PEL	permissible exposure limit