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

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

**AMENDMENT 2: Update of Annex A and  
the refrigerant tables**

[ISO 5149-1:2014/Amd 2:2021](https://standards.iso.org/iso/5149-1:2014-amd-2-2021)

<https://standards.iso.org/iso/5149-1:2014-amd-2-2021>  
**Systemes frigorifiques et pompes à chaleur — Exigences de sécurité et  
d'environnement**

*Partie 1: Définitions, classification et critères de choix*

*AMENDEMENT 2: Mise à jour de l'Annexe A et des tableaux de fluides  
frigorigènes*



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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](http://www.iso.org/directives)).

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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*.

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](http://www.iso.org/members.html).

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

## Part 1: Definitions, classification and selection criteria

### AMENDMENT 2: Update of Annex A and the refrigerant tables

#### Clause 3

Replace the introductory paragraph with the following:

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/>

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#### 3.7.2

ISO 5149-1:2014/Amd 2:2021

In the SOURCE, replace "2.5" with "3.1.5, modified" <https://standards.iteh.ai/catalog/standards/sist/12142180-347f-4dd8-9ca1-20e675571c66/iso-5149-1-2014-amd-2-2021>

#### 3.7.3

Reverse the order of the "Note 1 to entry" and the SOURCE. In the indication of the SOURCE, replace "2.1.44" with "3.1.43, modified — Note 1 to entry has been added".

#### 3.7.9

In the indication of the SOURCE, replace "2.32" with "3.1.35, modified".

#### 3.10.3

Delete Note 1 to entry.

#### 3.10.4

Delete Note 1 to entry.

## ISO 5149-1:2014/Amd.2:2021(E)

### *Annex A, Table A.1*

In row A – a, delete “Toxicity limit × Room volume or see A.5” from Location classification column I and add “Toxicity limit × Room volume” in its place. Add the following note:

NOTE The national variations to this table do not alter any requirements from those specified in this document. This table was revised to remove the incorrect inference that Clause A.5 can be applied to location Classification I. The text of Clause A.5 states that it is only application to location Classification II.

### *A.5.1, list*

Replace the third dashed indent with the following:

- for appliances with more than one indoor unit, individual indoor unit cooling capacity shall not exceed 35 kW when tested in accordance with ISO 5151, ISO 13253, or ISO 15042 at T1 conditions;
- for heating, only appliances with more than one indoor unit, individual indoor unit heating capacity shall not exceed 35 kW when tested in accordance with ISO 5151, ISO 13253, or ISO 15042 at H1 conditions;

### *A.5.2.3*

Replace the reference to "Table B.1" with "Table A.3".

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### *Annex B, Tables B.1, B.2 and B.3.*

Replace [Tables B.1](#), [B.2](#) and [B.3](#) with the following:  
<https://standards.iteh.ai/catalog/standards/sist/12142180-347f-4dd8-9ca1-20e67557fc66/iso-5149-1-2014-amd-2-2021>

Table B.1 — Refrigerants designation

Refrigerant number	Chemical name <sup>b</sup>	Chemical formula	Safety group	Practical limit kg/m <sup>3</sup>	ATEL/ ODL <sup>f</sup> kg/m <sup>3</sup>	Flammability LFL <sup>g</sup> kg/m <sup>3</sup>	Vapour density 25°C, 101,3 kPa <sup>a</sup> kg/m <sup>3</sup>	Relative molar mass <sup>a</sup>	Normal boiling point <sup>a</sup> °C	ODP <sup>a,d</sup>	GWP <sup>a,e</sup> (100 yr ITH)	Auto-ignition temperature °C
Methane series												
11	Trichlorofluoromethane	CCl <sub>3</sub> F	A1	0,3	0,006 2	NF	5,62	137,4	24	1	4 750	ND
12	Dichlorodifluoromethane	CCl <sub>2</sub> F <sub>2</sub>	A1	0,5	0,088	NF	4,94	120,9	-30	1	10 900	ND
12B1	Bromochlorodifluoromethane	CBrClF <sub>2</sub>	ND	0,2	ND	NF	6,76	165,4	-4	3	1 890	ND
13	Chlorotrifluoromethane	CClF <sub>3</sub>	A1	0,5	ND	NF	4,27	104,5	-81	1	14 400	ND
13B1	Bromotrifluoromethane	CBrF <sub>3</sub>	A1	0,6	ND	NF	6,09	148,9	-58	10	7 140	ND
14	Carbon tetrafluoride	CF <sub>4</sub>	A1	0,4	0,40	NF	3,60	88,0	-128	0	7 390	ND
22	Chlorodifluoromethane	CHClF <sub>2</sub>	A1	0,3	0,21	NF	3,54	86,5	-41	0,055	1 810	635
23	Trifluoromethane	CHF <sub>3</sub>	A1	0,68	0,15	NF	2,86	70,0	-82	0	14 800	765
30	Dichloromethane (methylene chloride)	CH <sub>2</sub> Cl <sub>2</sub>	B1	0,017	ND	NF	3,47	84,9	40	ND	8,7	662
32	Difluoromethane (methylene fluoride)	CH <sub>2</sub> F <sub>2</sub>	A2L	0,061	0,30	0,307	2,13	52,0	-52	0	675	648
50	Methane	CH <sub>4</sub>	A3	0,006	ND	0,032	0,654	16,0	-161	0	25	645

NOTE 1 See Tables B.2 and B.3 for zeotropic and azeotropic blends.  
 NOTE 2 NA signifies not applicable.  
 NOTE 3 ND signifies not determined.  
 NOTE 4 NF signifies non flammable.

<sup>a</sup> The vapour density, normal boiling point, ODP, and GWP are not part of this International Standard, and are provided for information purposes only.  
<sup>b</sup> The preferred chemical name is followed by the popular name in parentheses.  
<sup>c</sup> Sublimes. Triple point is -56,6 °C at 5,2 bar.  
<sup>d</sup> Adopted under the Montreal Protocol.  
<sup>e</sup> Data from IPCC 4th assessment report 2007. When not available, WMO Scientific assessment of ozone depletion 2010 is used as first priority and then the UNEP RTOC 2010 report.  
<sup>f</sup> Acute-Toxicity Exposure Limit or Oxygen Deprivation Limit, whichever is lower, values taken from ISO 817.  
<sup>g</sup> Lower Flammability Limit.  
<sup>h</sup> Data from UNEP RTOC 2010 report.  
<sup>i</sup> Data from WMO Scientific assessment of ozone depletion 2010.

Table B.1 (continued)

Refrigerant number	Chemical name <sup>b</sup>	Chemical formula	Safety group	Practical limit kg/m <sup>3</sup>	ATEL/ ODL <sup>f</sup> kg/m <sup>3</sup>	Flammability LFL <sup>g</sup> kg/m <sup>3</sup>	Vapour density 25°C, 101,3 kPa <sup>a</sup> kg/m <sup>3</sup>	Relative molar mass <sup>a</sup>	Normal boiling point <sup>a</sup> °C	ODP <sup>a,d</sup>	GWP <sup>a,e</sup> (100 yr ITH)	Auto-ignition temperature °C
Ethane series												
113	1,1,2-trichloro-1,2,2-trifluoroethane	CCl <sub>2</sub> FCClF <sub>2</sub>	A1	0,4	0,02	NF	7,66	187,4	48	0,8	6 130	ND
114	1,2-dichloro-1,1,2,2-tetrafluoroethane	CClF <sub>2</sub> CClF <sub>2</sub>	A1	0,7	0,14	NF	6,99	170,9	4	1	10 000	ND
115	Chloropentafluoroethane	CClF <sub>2</sub> CF <sub>3</sub>	A1	0,76	0,76	NF	6,32	154,5	-39	0,6	7 370	ND
116	Hexafluoroethane	CF <sub>3</sub> CF <sub>3</sub>	A1	0,68	0,68	NF	5,64	138,0	-78	0	12 200	ND
123	2,2-dichloro-1,1,1-trifluoroethane	CHCl <sub>2</sub> CF <sub>3</sub>	B1	0,10	0,057	NF	6,25	152,9	27	0,02	77	730
124	2-chloro-1,1,1,2-tetrafluoroethane	CHClFCF <sub>3</sub>	A1	0,11	0,056	NF	5,58	136,5	-12	0,022	609	ND
125	Pentafluoroethane	CHF <sub>2</sub> CF <sub>3</sub>	A1	0,39	0,37	NF	4,91	120,0	-49	0	3 500	733
134a	1,1,1,2-tetrafluoroethane	CH <sub>2</sub> FCF <sub>3</sub>	A1	0,25	0,21	NF	4,17	102,0	-26	0	1 430	743
141b	1,1-dichloro-1-fluoroethane	CH <sub>3</sub> CCl <sub>2</sub> F	ND	0,053	0,012	0,363	4,78	116,9	32	0,11	725	532
142b	1-chloro-1,1-difluoroethane	CH <sub>3</sub> CClF <sub>2</sub>	A2	0,049	0,10	0,229	4,11	100,5	-10	0,065	2 310	750
143a	1,1,1-trifluoroethane	CH <sub>3</sub> CF <sub>3</sub>	A2L	0,048	0,48	0,282	3,44	84,0	-47	0	4 470	750

NOTE 1 See Tables B.2 and B.3 for zeotropic and azeotropic blends.

NOTE 2 NA signifies not applicable.

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<sup>a</sup> The vapour density, normal boiling point, ODP, and GWP are not part of this International Standard, and are provided for information purposes only.

<sup>b</sup> The preferred chemical name is followed by the popular name in parentheses.

<sup>c</sup> Sublimes. Triple point is -56,6 °C at 5,2 bar.

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<sup>e</sup> Data from IPCC 4th assessment report 2007. When not available, WMO Scientific assessment of ozone depletion 2010 is used as first priority and then the UNEP RTOC 2010 report.

<sup>f</sup> Acute-Toxicity Exposure Limit or Oxygen Deprivation Limit, whichever is lower, values taken from ISO 817.

<sup>g</sup> Lower Flammability Limit.

<sup>h</sup> Data from UNEP RTOC 2010 report.

<sup>i</sup> Data from WMO Scientific assessment of ozone depletion 2010.



Table B.1 (continued)

Refrigerant number	Chemical name <sup>b</sup>	Chemical formula	Safety group	Practical limit kg/m <sup>3</sup>	ATEL/ ODL <sup>i</sup>	Flammability LFL <sup>g</sup>	Vapour density 25°C, 101,3 kPa <sup>a</sup>	Relative molar mass <sup>a</sup>	Normal boiling point <sup>a</sup> °C	ODP <sup>a,d</sup>	GWP <sup>a,e</sup> (100 yr ITH)	Auto-ignition temperature °C
152a	1,1-difluoroethane	CH <sub>3</sub> CHF <sub>2</sub>	A2	0,027	0,14	0,130	2,70	66,0	-25	0	124	455
170	Ethane	CH <sub>3</sub> CH <sub>3</sub>	A3	0,008 6	0,008 6	0,038	1,23	30,1	-89	0	5,5	515
Propane series												
218	Octafluoropropane	CF <sub>3</sub> CF <sub>2</sub> CF <sub>3</sub>	A1	1,84	0,85	NF	7,69	188,0	-37	0	8 830	ND
227ea	1,1,1,2,3,3,3-heptafluoropropane	CF <sub>3</sub> CHF <sub>2</sub> CF <sub>3</sub>	A1	0,63	0,63	NF	6,95	170,0	-15	0	3 220	ND
236fa	1,1,1,3,3,3-hexafluoropropane	CF <sub>3</sub> CH <sub>2</sub> CF <sub>3</sub>	A1	0,59	0,34	NF	6,22	152,0	-1	0	9 810	ND
245fa	1,1,1,3,3-pentafluoropropane	CF <sub>3</sub> CH <sub>2</sub> CHF <sub>2</sub>	B1	0,19	0,19	NF	5,48	134,0	15	0	1 030	ND
290	Propane	CH <sub>3</sub> CH <sub>2</sub> CH <sub>3</sub>	A3	0,008	0,09	0,038	1,80	44,1	-42	0	3,3	470
Ethene Series												
E170	Dimethyl Ether	CH <sub>3</sub> OCH <sub>3</sub>	A3	0,013	0,079	0,064	1,88	46	-25	0	1	235
1130 (E)	Trans-1,2-dichloroethene	CHCl=CHCl	B2	0,004	0,004	0,258	1,15	96,9	48	0	0	ND
1132a	1,1-difluoroethylene	CF <sub>2</sub> =CH <sub>2</sub>	A2	0,026	0,073	0,131		64,0	-83	0	1	ND
1150	Ethene (ethylene)	CH <sub>2</sub> = CH <sub>2</sub>	A3	0,006	ND	0,036	1,15	28,1	-104	0	3,7	ND
NOTE 1 See Tables B.2 and B.3 for zeotropic and azeotropic blends.												
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Table B.1 (continued)

Refrigerant number	Chemical name <sup>b</sup>	Chemical formula	Safety group	Practical limit kg/m <sup>3</sup>	ATEL/ ODL <sup>f</sup> kg/m <sup>3</sup>	Flammability LFL <sup>g</sup> kg/m <sup>3</sup>	Vapour density 25°C, 101,3 kPa <sup>a</sup> kg/m <sup>3</sup>	Relative molar mass <sup>a</sup>	Normal boiling point <sup>a</sup> °C	ODP <sup>a,d</sup>	GWP <sup>a,e</sup> (100 yr ITH)	Auto-ignition temperature °C
Propene series												
1224yd (Z)	cis-2,3,3,3-tetrafluoro-1-chloro-1-propene	CF <sub>3</sub> CH=CHCF <sub>3</sub>	A1	0,364	0,364	NF		148,5	14	~0		ND
1233zd (E)	Trans-1-chloro-3,3,3-trifluoroprop-1-ene	CF <sub>3</sub> CH=CHCl	A1	0,086	0,086	NF	5,34	130,5	18,1	~0	4,5	ND
1234yf	2,3,3,3-tetrafluoroprop-1-ene	CF <sub>3</sub> CF=CH <sub>2</sub>	A2L	0,058	0,47	0,289	4,66	114,0	-26	0	4 <sup>i</sup>	405
1234ze (E)	trans-1,3,3,3-tetrafluoroprop-1-ene	CF <sub>3</sub> CH=CFH	A2L	0,061	0,28	0,303	4,66	114,0	-19	0	7 <sup>i</sup>	368
1270	Propene (propylene)	CH <sub>3</sub> CH=CH <sub>2</sub>	A3	0,008	0,001 7	0,046	1,72	42,1	-48	0	1,8	455
Butene series												
1336mzz (E)	trans-1,1,1,4,4,4-hexafluoro-2-butene	CF <sub>3</sub> CH=CHCF <sub>3</sub>	A1	0,048	0,048	NF	6,93	164,1	7,4	0	16	ND
1336mzz (Z)	cis-1,1,1,4,4,4-hexafluoro-2-butene	CF <sub>3</sub> CH=CHCF <sub>3</sub>	A1	0,087	0,087	NF	6,93	164,1	33,4	0	9	ND

NOTE 1 See Tables B.2 and B.3 for zeotropic and azeotropic blends.  
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<sup>f</sup> Acute-Toxicity Exposure Limit or Oxygen Deprivation Limit, whichever is lower, values taken from ISO 817.  
<sup>g</sup> Lower Flammability Limit.  
<sup>h</sup> Data from UNEP RTOC 2010 report.  
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Table B.1 (continued)

Refrigerant number	Chemical name <sup>b</sup>	Chemical formula	Safety group	Practical limit kg/m <sup>3</sup>	ATEL/ ODL <sup>i</sup>	Flammability LFL <sup>g</sup>	Vapour density 25°C, 101,3 kPa <sup>a</sup>	Relative molar mass <sup>a</sup>	Normal boiling point <sup>a</sup> °C	ODP <sup>a,d</sup>	GWP <sup>a,e</sup> (100 yr ITH)	Auto-ignition temperature °C
Other hydrocarbons												
600	Butane	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub>	A3	0,008 9	0,002 4	0,038	2,38	58,1	0	0	4,0	365
600a	2-methyl propane (isobutane)	CH(CH <sub>3</sub> ) <sub>2</sub> CH <sub>3</sub>	A3	0,011	0,059	0,043	2,38	58,1	-12	0	~20 <sup>h</sup>	460
601	Pentane	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub>	A3	0,008	0,002 9	0,035	2,95	72,1	36	0	~20 <sup>h</sup>	ND
601a	2-methyl butane (isopentane)	(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> CH <sub>3</sub>	A3	0,008	0,002 9	0,038	2,95	72,1	27	0	~20 <sup>h</sup>	ND
Cyclic organic compounds												
C318	Octafluorocyclobutane	-(CF <sub>2</sub> ) <sub>4</sub> -	A1	0,81	0,65	NF	8,18	200,0	-6	0	10 300	ND
Inorganic compounds												
717	Ammonia	NH <sub>3</sub>	B2L	0,000 35	0,000 22	0,116	0,700	17,0	-33	0	<1 <sup>h</sup>	630
744	Carbon dioxide	CO <sub>2</sub>	A1	0,1	0,072	NF	1,80	44,0	-78 <sup>c</sup>	0	1	NA
NOTE 1 See Tables B.2 and B.3 for zeotropic and azeotropic blends.												
NOTE 2 NA signifies not applicable.												
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