INTERNATIONAL STANDARD

ISO 817

Second edition
2005-01-15

Refrigerants — Designation system

Fluides frigorigènes — Système de désignation

Reference number
ISO 817:2005(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 817 was prepared by Technical Committee ISO/TC 86, *Refrigeration and air-conditioning*, Subcommittee SC 8, *Refrigerants and refrigeration lubricants*.

This second edition cancels and replaces the first edition (ISO 817:1974), which has been technically revised.

Refrigerants — Designation system

1 Scope

This International Standard provides an unambiguous system for numbering and assigning composition-designating prefixes to refrigerants. Tables listing the refrigerant designations are included. It is intended to be used with other relevant safety standards such as ISO 5149, IEC 60335-2-24 and IEC 60335-2-40.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
azeotrope
blend composed of two or more refrigerants whose equilibrium vapor and liquid phase compositions are the same at a given pressure, but may be different at other conditions

2.2
blends
mixtures composed of two or more refrigerants

2.3
compound
substance composed of two or more atoms chemically bonded in definite proportions

2.4
cyclic compound
organic compound whose structure is characterized by a closed ring of atoms

2.5
isomers
two or more compounds having the same chemical composition with differing molecular configurations

NOTE Isomers will have different physical properties.

EXAMPLE R-600 ($CH_3CH_2CH_2CH_3$), with a boiling point of 0 °C and R-600a ($CH(CH_3)_2CH_3$) with a boiling point of −12 °C. Both of these compounds contain 4 carbon and 10 hydrogen atoms.

2.6
nominal composition
liquid phase composition of refrigerant blends

NOTE For the refrigerant blends, see Tables 2 and 3.

2.7
refrigerant
fluid used for heat transfer in a mechanical 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

2.8
relative molar mass
mass numerically equal to the molecular mass expressed in grams per mol, except that it is dimensionless

2.9
unsaturated organic compound
organic (carbon-containing) compound containing at least one double or triple bond between carbon atoms

2.10
saturated organic compound
organic (carbon-containing) compound that has only single bonds between carbon atoms

2.11
zeotrope
blend composed of two or more refrigerants whose equilibrium vapour and liquid phase compositions are not the same at any point

3 Numbering of refrigerants

3.1 An identifying number of 2 to 4 digits shall be assigned to each refrigerant, as follows.

3.2 The identifying numbers assigned to the hydrocarbons, halocarbons and ethers of the methane, ethane, propane, and cyclobutane series are such that the chemical composition of the compounds can be explicitly determined from the refrigerant numbers, and vice versa, without ambiguity. The molecular structure can be similarly determined for the methane, ethane, and most of the propane series.

3.2.1 The first digit on the right is the number of fluorine (F) atoms in the compound.

3.2.2 The second digit from the right is one more than the number of hydrogen (H) atoms in the compound.

3.2.3 The third digit from the right is one less than the number of carbon (C) atoms in the compound. When this digit is zero, it is omitted from the number.

3.2.4 The fourth digit from the right is equal to the number of carbon-carbon double bonds in the compound. When this digit is zero, it is omitted from the number.

3.2.5 In those instances where bromine (Br) or iodine (I) is present, the same rules apply, except that the upper case letter B or I after the designation for the chlorofluoro compound shows the presence of bromine or iodine. The number following the letter B or I shows the number of bromine or iodine atoms present.

3.2.6 The number of chlorine (Cl) atoms in the compound is found by subtracting the sum of fluorine (F), bromine (Br), Iodine (I) and hydrogen (H) atoms from the total number of atoms that can be connected to the carbon (C) atoms. For saturated organic compounds, this number is $2n + 2$, where n is the number of carbon atoms. The number is $2n$ for compounds with one double bond and saturated cyclic compounds.

3.2.7 The carbon atoms shall be numbered sequentially, in order of appearance, with the number 1 assigned to the end carbon with the greatest number of hydrogen substituents. In the case where both end carbons contain the same number of (but different) halogen atoms, the number 1 shall be assigned to the first end carbon, defined as having the largest number of bromine then chlorine then fluorine, and then iodine atoms.

3.2.8 For cyclic compounds, the letter C is used before the identifying refrigerant numbers.

EXAMPLE R-C318, PFC-C318.

3.2.9 In the case of isomers in the ethane series, each has the same number, with the most symmetrical one indicated by the number alone. As the isomers become more and more unsymmetrical, successive lower case letters (i.e., a, b, or c) are appended. Symmetry is determined by first summing the atomic mass of the halogen and hydrogen atoms attached to each carbon atom. One sum is subtracted from the other; the smaller the absolute value of the difference, the more symmetrical the isomer.

3.2.10 In the case of isomers in the propane series, each has the same number, with the isomers distinguished by two appended lower case letters. The first appended letter indicates the substitution on the central carbon atom (C2):

$-CCl_2-$	a
-CClF-	b
$-CF_2-$	c
-CClH-	d
-CFH-	e
$-CH_2-$	f

For halogenated derivatives of cyclopropane, the carbon atom with the largest sum of attached atomic masses shall be considered the central carbon atom; for these compounds, the first appended letter is omitted. The second appended letter indicates the relative symmetry of the substituents on the end carbon atoms (C1 and C3). Symmetry is determined by first summing the atomic masses of the halogen and hydrogen atoms attached to the C1 and C3 carbon atoms. One sum is subtracted from the other; the smaller the absolute value of this difference, the more symmetrical the isomer. In contrast to the ethane series, however, the most symmetrical isomer has a second appended letter of "a" (as opposed to no appended letter for ethane isomers); increasingly asymmetrical isomers are assigned successive letters. Appended letters are omitted when no isomers are possible, and the number alone represents the molecular structure unequivocally; for example, $CF_3CF_2CF_3$ is designated R-218, not R218ca. An example of this system is given in Annex A. Bromine containing propane series isomers are not covered by the appended letters tabulated above because no such refrigerants have been identified.

3.3 Ether-based refrigerants shall be designated with the prefix "E" (for "ethers") immediately preceding the number. Except for the following differences, the basic number designations for the hydrocarbon atoms shall be determined according to the current standard for hydrocarbon nomenclature (see 3.2).

3.3.1 Two-carbon, dimethyl ethers (e.g. R-E125, CHF_2-0-CF_3) require no suffixes other than those specified in 3.2.9, as the presence of the "E" prefix provides an unambiguous description.

3.3.2 For straight-chain, three carbon ethers, the carbon atoms shall be numbered sequentially, in order of appearance, with the number 1 assigned to the end carbon with the highest number of halogens. In the case where both end carbons contain the same number of (but different) halogen atoms, the number 1 shall be assigned to the first end carbon, defined as having the largest number of bromine, then chlorine, then fluorine and then iodine atoms.

3.3.2.1 An additional integer identifying the first carbon to which the ether oxygen is attached shall be appended to the suffix letters (e.g. R-E236ea2, CHF_2-O-CHF-CF_3).

3.3.2.2 In the case of otherwise symmetric hydrocarbon structures, the ether oxygen shall be assigned to the carbon which has the leading position in the formula.

3.3.2.3 In those cases where only a single isomer exists for the hydrocarbon portion of the ether structure, such as CF3-O-CF2-CF3, the suffix letters described in 3.2.9 shall be omitted. In this cited example, the correct designation shall be R-E218.

3.3.2.4 Structures containing two oxygen atoms, di-ethers, shall be designated with two suffix integers to designate the positions of the ether oxygen atoms.

3.3.3 For cyclic ethers carrying both the "C" and "E" prefixes, the "C" shall precede the "E," as "CE," to designate "cyclic ethers." For four-membered cyclic ethers, including three carbon and one ether oxygen atom, the basic number designations for the hydrocarbon atoms shall be constructed according to the current standard for hydrocarbon nomenclature (subsection 3.2).

3.4 Blends are assigned a refrigerant number in the 400 or 500 series.

3.4.1 Zeotropes shall be serially assigned an identifying number in the 400 series. In order to differentiate among the different zeotropes having the same refrigerants but a different composition, a capital letter (A, B, C...) is added after the number.

3.4.2 Azeotropes shall be serially assigned an identifying number in the 500 series. In order to differentiate among the different azeotropes having the same refrigerants but a different composition, a capital letter (A, B, C...) is added after the number.

3.5 Miscellaneous organic compounds shall be serially assigned an identifying number in the 600 series.

3.6 Inorganic compounds shall be assigned identifying numbers in the 700 series and 7 000 series.

3.6.1 For compounds with molecular masses less than 100, the number shall be the sum of 700 and the relative molar mass, rounded to the nearest integer.

3.6.2 For compounds with molar masses equal to or greater than 100, the identifying number shall be the sum of 7 000 and the relative molar mass, rounded to the nearest integer.

3.6.3 When two or more inorganic refrigerants have the same molar masses, capital letters (i.e., A, B, C, etc.) shall be added in serial order of designation to distinguish among them.

4 Designation prefixes

4.1 General prefixes

The identifying number, as determined according to Clause 3, may be preceded by the letter R or the word “Refrigerant” (“Refrigerants” if more than one).

EXAMPLE R134a, Refrigerant 134a, R 134a, R-134a.

4.2 Composition-designating prefixes

For the fluorocarbon and the hydrocarbon families, the identifying number, as determined according to Clause 3, may be prefixed by a letter sequence which designates the elements which constitute the specific compound. The composition-designating prefix shall consist of the first letter of elements contained in the compound. The first element listed shall be “H” for hydrogen if present and the last shall be “C” for carbon. The intermediate letters shall represent the halogens listed in the following order: “I” for Iodine, “B” for bromine, “C” for chlorine and “F” for fluorine. The compositional designating prefixes for ethers shall substitute an “E” for “C” (carbon), such that HFE, HCFE, and CFE refer to hydrofluoroether, hydrochlorofluoroether, and chlorofluoroether, respectively. In addition, when a refrigerant compound is fully fluorinated, the notation PFC shall be used.

EXAMPLE 1	Chlorofluorocarbon 12	CCl_2F_2	CFC-12
EXAMPLE 2	Hydrochlorofluorocarbon 22	$CHClF_2$	HCFC-22
EXAMPLE 3	Hydrofluorocarbon 134a	CH_2FCF_3	HFC-134a
EXAMPLE 4	Perfluorocarbon 116	CF_3CF_3	PFC-116
EXAMPLE 5	Hydrocarbon 600a	$CH_3CH_2CH_2CH_3$	HC-600a
EXAMPLE 6	Perfluorocarbon C318	$\underbrace{CF_2CF_2CF_2CF_2}$	PFC-C318

Blends with assigned numbers may be identified by linking the appropriate composition-designating prefixes of individual components.

EXAMPLE 7 (CFC/HFC-500).

Blends without assigned numbers may be identified using appropriate composition-designating prefixes for each component.

EXAMPLE 8 HCFC-22/HFC-152a/CFC-114 [36/24/40].

5 Refrigerant and refrigerant blend designations

See Tables 1 to 3.

Table 1 — Refrigerant designations

Refrigerant number	Composition designating prefix	Chemical name [b]	Chemical formula	Molar mass [a] g/mole	Normal boiling point [a] °C
Methane series					
R-11	CFC	trichlorofluoromethane	CCl_3F	137,4	24
R-12	CFC	dichlorodifluoromethane	CCl_2F_2	120,9	−30
R-12B1	BCFC	bromochlorodifluoromethane	$CBrClF_2$	165,4	−4
R-13	CFC	chlorotrifluoromethane	$CClF_3$	104,5	−81
R-13B1	BFC	bromotrifluoromethane	$CBrF_3$	148,9	−58
R-14	PFC	tetrafluoromethane (carbon tetrafluoride)	CF_4	88,0	−128
R-21	HCFC	dichlorofluoromethane	$CHCl_2F$	102,9	9
R-22	HCFC	chlorodifluoromethane	$CHClF_2$	86,5	−41
R-23	HFC	trifluoromethane	CHF_3	70,0	−82
R-30	HCC	dichloromethane (methylene chloride)	CH_2Cl_2	84,9	40
R-31	HCFC	chlorofluoromethane	CH_2ClF	68,5	−9
R-32	HFC	difluoromethane (methylene fluoride)	CH_2F_2	52,0	−52
R-40	HCC	chloromethane (methyl chloride)	CH_3Cl	50,5	−24
R-41	HFC	fluoromethane (methyl fluoride)	CH_3F	34,0	−78
R-50	HC	methane	CH_4	16,0	−161
Ethane series					
R-113	CFC	1,1,2-trichloro-1,2,2-trifluoroethane	CCl_2FCClF_2	187,4	48
R-114	CFC	1,2-dichloro-1,1,2,2-tetrafluoroethane	$CClF_2CClF_2$	170,9	4
R-115	CFC	chloropentafluoroethane	$CClF_2CF_3$	154,5	−39
R-116	PFC	hexafluoroethane	CF_3CF_3	138,0	−78
R-123	HCFC	2,2-dichloro-1,1,1-trifluoroethane	$CHCl_2CF_3$	153,0	27
R-124	HCFC	2-chloro-1,1,1,2-tetrafluoroethane	$CHClFCF_3$	136,5	−12
R-125	HFC	pentafluoroethane	CHF_2CF_3	120,0	−49
R-134a	HFC	1,1,1,2-tetrafluoroethane	CH_2FCF_3	102,0	−26
R-141b	HCFC	1,1-dichloro-1-fluoroethane	CH_3CCl_2F	117,0	32
R-142b	HCFC	1-chloro-1,1-difluoroethane	CH_3CClF_2	100,5	−10
R-143a	HFC	1,1,1-trifluoroethane	CH_3CF_3	84,0	−47
R-152a	HFC	1,1-difluoroethane	CH_3CHF_2	66,0	−25
R-170	HC	ethane	CH_3CH_3	30,0	−89

5

Table 1 (*Continued*)

Refrigerant number	Composition designating prefix	Chemical name [b]	Chemical formula	Molar mass [a] g/mole	Normal boiling point [a] °C
Propane series					
R-218	PFC	octafluoropropane	$CF_3CF_2CF_3$	188,0	−37
R-225ea	HCFC	1,3-dichloro-1,1,2,3,3-pentafluoropropane	$CClF_2CHFCClF_2$	202,9	
R-227ea	HFC	1,1,1,2,3,3,3-heptafluoropropane	CF_3CFHCF_3	170,0	−16
R-236fa	HFC	1,1,1,3,3,3-hexafluroropropane	$CF_3CH_2CF_3$	152,0	−1
R-245fa	HFC	1,1,1,3,3-pentafluoropropane	$CHF_2CH_2CF_3$	134,0	15
R-290	HC	Propane	$CH_3CH_2CH_3$	44,0	−42
Cyclic organic compound					
R-C318	PFC	octafluorocyclobutane	$CF_2CF_2CF_2CF_2$ (cyclic)	200,0	−6
Misc. organic compounds/Hydrocarbons					
R-600	HC	butane	$CH_3CH_2CH_2CH_3$	58,1	0
R-600a	HC	2-methyl propane (isobutane)	$CH(CH_3)_2CH_3$	58,1	−12
Oxygen compounds					
R-610		ethyl ether	$CH_3CH_2OCH_2CH_3$	74,1	35
R-611		methyl formate	$HCOOCH_3$	60,0	32
Sulfur compounds					
R-620		[d]	[d]	[d]	[d]
Nitrogen compounds					
R-630		methyl amine	CH_3NH_2	31,1	−7
R-631		ethyl amine	$CH_3CH_2(NH_2)$	45,1	17
Inorganic compounds					
R-702		hydrogen	H_2	2,0	−253
R-704		helium	He	4,0	−269
R-717		ammonia	NH_3	17,0	−33
R-718		water	H_2O	18,0	100
R-720		neon	Ne	20,2	−246
R-728		nitrogen	N_2	28,1	−196
R-732		oxygen	O_2	32,0	−183
R-740		argon	Ar	39,9	−186
R-744		carbon dioxide	CO_2	44,0	−78 [c]
R-744A		nitrous oxide	N_2O	44,0	−90
R-764		sulfur dioxide	SO_2	64,1	−10
Unsaturated organic compounds					
R-1132a	HFC	1,1-difluoroethene (vinylidene fluoride)	$CH_2 = CF_2$	64,0	−82
R-1150	HC	ethene (ethylene)	$CH_2 = CH_2$	28,1	−104
R-1270	HC	propene (propylene)	$CH_3CH = CH_2$	42,1	−48

[a] The molecular mass and normal boiling point are not part of this International Standard. The normal boiling point is the temperature at which a liquid substance boils at standard atmospheric pressure (101,3 kPa).

[b] The preferred chemical name is followed by the popular name in parentheses. The preferred chemical name and formula are in accordance with [4] and [5]. See Bibliography.

[c] Sublimes.

[d] Reserved for future assignment.

Table 2 — Refrigerant designations of R400 blends

Refrigerant number	Nominal composition [c] mass %	Composition tolerances %	Bubble point/ Dew point [a] °C
R-400	R-12/114 [d]		
R-401A	R-22/152a/124 (53/13/34)	±2,0/+0,5–1,5/±1,0	–33,3/–26,4
R-401B	R-22/152a/124 (61/11/28)	±2,0/+0,5–1,5/±1,0	–34,9/–28,8
R-401C	R-22/152a/124 (33/15/52)	±2,0/+0,5–1,5/±1,0	–30,5/–23,8
R-402A	R-125/290/22 (60/2/38)	±2,0/+0,1–1,0/±2,0	–49,0/–46,9
R-402B	R-125/290/22 (38/2/60)	±2,0/+0,1–1,0/±2,0	–47,0/–44,7
R-403A	R-290/22/218 (5/75/20)	+0,2–2,0/±2,0/±2,0	–47,8/–44,3
R-403B	R-290/22/218 (5/56/39)	+0,2–2,0/±2,0/±2,0	–49,2/–46,8
R-404A	R-125/143a/134a (44/52/4)	±2,0/±1,0/±2,0	–46,2/–45,5
R-405A	R-22/152a/142b/C318 (45/7/5,5/42,5)	±2,0/±1,0/±1,0/±2,0 [b]	–35,9/–24,5
R-406A	R-22/600a/142b (55/4/41)	±2,0/±1,0/±1,0	–32,7/–23,5
R-407A	R-32/125/134a (20/40/40)	±2,0/±2,0/±2,0	–45,3/–38,9
R-407B	R-32/125/134a (10/70/20)	±2,0/±2,0/±2,0	–46,8/–42,5
R-407C	R-32/125/134a (23/25/52)	±2,0/±2,0/±2,0	–43,6/–36,6
R-407D	R-32/125/134a (15/15/70)	±2,0/±2,0/±2,0	–39,5/–32,9
R-407E	R-32/125/134a (25/15/60)	±2,0/±2,0/±2,0	–42,9/–35,8
R-408A	R-125/143a/22 (7/46/47)	±2,0/±1,0/±2,0	–44,6/–44,1
R-409A	R-22/124/142b (60/25/15)	±2,0/±2,0/±1,0	–34,7/–26,4
R-409B	R-22/124/142b (65/25/10)	±2,0/±2,0/±1,0	–35,6/–27,9
R-410A	R-32/125 (50/50)	+0,5–1,5/+1,5–0,5	–51,4/–51,4
R-410B	R-32/125 (45/55)	±1,0/±1,0	–51,3/–51,6
R-411A	R-1270/22/152a (1,5/87,5/11,0)	+0,0–1,0/+2,0–0,0/+0,0–1,0	–39,5/–36,6
R-411B	R-1270/22/152a (3/94/3)	+0,0–1,0/+2,0–0,0/+0,0–1,0	–41,6/–40,0
R-412A	R-22/218/142b (70/5/25)	±2,0/±2,0/±1,0	–38,0/–28,7
R-413A	R-218/134a/600a (9/88/3)	±1,0/±2,0/+0,0–1,0	–30,6/–27,9
R-414A	R-22/124/600a/142b (51,0/28,5/4,0/16,5)	±2,0/±2,0/±0,5/+0,5–1,0	–34,0/–25,8
R-414B	R-22/124/600a/142b (50,0/39,0/1,5/9,5)	±2,0/±2,0/±0,5/+0,5–1,0	–32,9/–24,3
R-415A	R-22/152a (82,0/18,0)	±1,0/±1,0	–37,5/–34,7
R-416A	R-134a/124/600 (59,0/39,5/1,5)	+0,5–1,0/+1,0–0,5/+0,1–0,2	–23,4/–21,8
R-417A	R-125/134a/600 (46,6/50,0/3,4)	±1,1/±1,0/+0,1–0,4	–38,0/–32,9
R-418A	R-290/22/152a (1,5/96,0/2,5)	±0,5/±1,0/±0,5	–41,2/–40,1

[a] The “bubble point” and the “dew point” temperatures are not part of this International Standard; they are provided for information only. The “bubble point” is defined as the liquid saturation temperature of a refrigerant: the temperature at which a liquid refrigerant first begins to boil. The bubble point of a zeotropic refrigerant blend, at constant pressure, is lower than the dew point. The “dew point” is defined as the vapour saturation temperature of a refrigerant: the temperature at which the last drop of liquid refrigerant boils. The dew point of a zeotropic refrigerant blend, at constant pressure, is higher than the bubble point.

[b] The composition tolerances for the sum of R152a and R142b are (+0/–2).

[c] Blend components are conventionally listed in order of increasing normal boiling point.

[d] Shall be specified.

Table 3 — Refrigerant designations of R500 blends [1)]

Refrigerant number	Nominal composition [d] mass %	Composition tolerances %	Azeotropic temperature [c] °C	Bubble point/Dew point [a] °C
R-500	R-12/152a (73,8/26,2)	+1,0–0,0/+0,0–1,0	0	–33,6/–33,6
R-501	R-22/12 (75,0/25,0) [b]		–41	–40,5/–40,3
R-502	R-22/115 (48,8/51,2)		19	–45,2/–45,0
R-503	R-23/13 (40,1/59,9)		88	–87,8/–87,8
R-504	R-32/115 (48,2/51,8)		17	–57,1/–56,2
R-505	R-12/31 (78,0/22,0) [b]		115	
R-506	R-31/114 (55,1/44,9)		18	
R-507A	R-125/143a (50/50)	+1,5–0,5/+0,5–1,5	–40	–46,7/–46,7
R-508A	R-23/116 (39/61)	±2,0/±2,0	–86	–87,4/–87,4
R-508B	R-23/116 (46/54)	±2,0/±2,0	–46	–87,0/–87,0
R-509A	R-22/218 (44/56)	±2,0/±2,0	0	–49,8/–48,1

[a] The “bubble point” and the “dew point” temperatures are not part of this International Standard; they are provided for information only. The “bubble point” is defined as the liquid saturation temperature of a refrigerant: the temperature at which a liquid refrigerant first begins to boil. The bubble point of a zeotropic refrigerant blend, at constant pressure, is lower than the dew point. The “dew point” is defined as the vapour saturation temperature of a refrigerant: the temperature at which the last drop of liquid refrigerant boils. The dew point of a zeotropic refrigerant blend, at constant pressure, is higher than the bubble point.

[b] The exact composition of this azeotrope is in question, and additional experimental studies are needed.

[c] Under vapour-liquid equilibrium (VLE) conditions.

[d] Blend components are conventionally listed in order of increasing normal boiling point.

1) Azeotropic refrigerants exhibit some segregation of components at conditions of temperature and pressure other than those at which they are formulated. The extent of segregation depends on the particular azeotrope and hardware system configuration.

Annex A
(informative)

Isomer designation examples

Table A.1 illustrates the designation of isomers for the ethane series with three isomers of dichlorotrifluoroethane.

Table A.1 — Ethane series isomers

Isomer	Chemical formula	W_1	W_2	$W_1 - W_2$
R-123	$CHCl_2CF_3$	71,9	57,0	14,9
R-123a	$CHClFCClF_2$	55,5	73,4	17,9
R-123b	CCl_2FCHF_2	89,9	39,0	50,9
where W_i is the sum of the atomic mass of halogens and hydrogens attached to carbon atom i.				

Table A.2 illustrates the designation of isomers for the propane series with nine isomers of dichloropentafluoropropane.

Table A.2 — Propane series isomers

Isomer	Chemical formula	C2 [a] group	W_1	W_2	$W_1 - W_3$
R-225aa	$CF_3CCl_2CHF_2$	CCl_2	57,0	39,0	18,0
R-225ba	$CHClFCClFCF_3$	CClF	55,5	57,0	1,5
R-225bb	$CClF_2CClFCHF_2$	CClF	73,4	39,0	34,4
R-225ca	$CHCl_2CF_2CF_3$	CF_2	71,9	57,0	14,9
R-225cb	$CHClFCF_2CClF_2$	CF_2	89,9	39,0	50,9
R-225da	$CClF_2CHClCF_3$	CHCl	73,4	57,0	16,4
R-225ea	$CClF_2CHFCClF_2$	CHF	73,4	73,4	0,0
R-225eb	$CCl_2FCHFCF_3$	CHF	89,9	57,0	32,9
where W_i is the sum of the atomic mass of halogens and hydrogens attached to carbon atom i.					
[a] Central (second) carbon atom.					

Bibliography

[1] ISO 5149:1993, *Mechanical refrigerating systems used for cooling and heating — Safety requirements*

[2] IEC 60335-2-24, *Safety of household and similar electrical appliances — Part 2-24: Particular requirements for refrigerating appliances, ice-cream appliances and ice-makers*

[3] IEC 60335-2-40, *Safety of household and similar electrical appliances — Part 2-40: Particular requirements for electrical heat pumps, air-conditioners and dehumidifiers*

[4] International Union of Pure and Applied Chemistry (IUPAC) Blue Book and Guide. *Nomenclature of Organic Chemistry, "Blue Book"*, IUPAC, Pergamon Press, 1979. Edited by J. Rigaudy and S.P., Lkesney [ISBN 0-08-022369-9]

[5] *A Guide to IUPAC Nomenclature of Organic Compounds*. Blackwell Scientific Publications, 1993. Edited by R. Panico, W.H. Powell and J.C. Richer. [ISBN 0-632-03488-2])

ICS 71.100.45

Price based on 10 pages