ARC Technical Resources

Refrigerant Types and Properties

Below are the following resources to identify the types and properties of refrigerants

1. **AS/NZS ISO 817:2016 Refrigerants-Designation and safety classification**
   Tables 5, 6 and 7.

2. **WhatGas?**
   This is an information and identification tool for refrigerants including ozone depleting substances (ODS), HFCs and other alternatives.
   It is an easy-to-use tool that can be accessed via mobile devices or the OzonAction website to facilitate work in the field, when dealing with or inspecting ODS and alternatives, and as a useful reference tool. To access the website and download the App go to:
   https://www.unep.org/ozonaction/resources/mobile-app-whatgas/whatgas

3. **Danfoss Ref Tools (previously Refrigerant Slider)**
   This is an all-in-one mobile app for air conditioning and refrigeration technicians can be accessed via mobile devices or the website which provides guidance, support, information, and tools needed on the job including refrigerant pressure/temperatures, superheat and trouble shooter. To access the website and download the App go to: https://www.danfoss.com/en/service-and-support/downloads/dcs/ref-tools/#tab-overview

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AS/NZS ISO 817:2016 Refrigerants-Designation and safety classification

Table 5 — Refrigerant designations

Refrigerant number	Composition designating prefix	Chemical name[b]	Chemical formula	Relative molar mass[a] g/mol	Normal boiling point[a] °C	Safety group[d]	LFL (ppm by volume)	ATEL (ppm by volume)	RCL (ppm by volume)
		Methane series							
R-11	CFC	trichlorofluoromethane	CCl_3F	137,4	24	A1		1 100	1 100
R-12	CFC	dichlorodifluoromethane	CCl_2F_2	120,9	-30	A1		18 000	18 000
R-14	PFC	tetrafluoromethane (carbon tetrafluoride)	CF_4	88,0	-128	A1		110 000	110 000
R-22	HCFC	chlorodifluoromethane	$CHClF_2$	86,5	-41	A1		59 000	59 000
R-23	HFC	trifluoromethane	CHF_3	70,0	-82	A1		51 000	51 000
R-32	HFC	difluoromethane (methylene fluoride)	CH_2F_2	52,0	-52	A2L	144 000	220 000	29 000
		Ethane series							
R-113	CFC	1,1,2-trichloro-1,2,2-trifluoroethane	CCl_2FCClF_2	187,4	48	A1		2 600	2 600
R-114	CFC	1,2-dichloro-1,1,2,2-tetrafluoroethane	$CClF_2CClF_2$	170,9	4	A1		20 000	20 000
R-115	CFC	chloropentafluoroethane	$CClF_2CF_3$	154,5	-39	A1		120 000	120 000
R-116	PFC	hexafluoroethane	CF_3CF_3	138,0	-78	A1		120 000	120 000
R-123	HCFC	2,2-dichloro-1,1,1-trifluoroethane	$CHCl_2CF_3$	153,0	27	B1		9 100	9 100
R-124	HCFC	2-chloro-1,1,1,2-tetrafluoroethane	$CHClFCF_3$	136,5	-12	A1		10 000	10 000
R-125	HFC	pentafluoroethane	CHF_2CF_3	120,0	-49	A1		75 000	75 000
R-134a	HFC	1,1,1,2-tetrafluoroethane	CH_2FCF_3	102,0	-26	A1		50 000	50 000
R-142b	HCFC	1-chloro-1,1-difluoroethane	CH_3CClF_2	100,5	-10	A2	80 000	25 000	16 000
R-143a	HFC	1,1,1-trifluoroethane	CH_3CF_3	84,0	-47	A2L	82 000	170 000	16 000
R-152a	HFC	1,1-difluoroethane	CH_3CHF_2	66,0	-25	A2	48 000	50 000	9 600
R-170	HC	ethane	CH_3CH_3	30,0	-89	A3	31 000	7 000	6 200
R-E170		methoxymethane (dimethyl ether)	CH_3OCH_3	46,1	-25	A3	34 000	42 000	6 800
		Propane series							
R-218	PFC	octafluoropropane	$CF_3CF_2CF_3$	188,0	-37	A1		110 000	110 000
R-227ea	HFC	1,1,1,2,3,3,3-heptafluoropropane	CF_3CHFCF_3	170,0	-16	A1		90 000	90 000
R-236fa	HFC	1,1,1,3,3,3-hexafluoropropane	$CF_3CH_2CF_3$	152,0	-1	A1		55 000	55 000
R-245fa	HFC	1,1,1,3,3-pentafluoropropane	$CHF_2CH_2CF_3$	134,0	15	B1		34 000	34 000
R-290	HC	propane	$CH_3CH_2CH_3$	44,0	-42	A3	21 000	50 000	4 200

Table 5 *(continued)*

Refrigerant number	Composition designating prefix	Chemical name[b]	Chemical formula	Relative molar mass[a] g/mol	Normal boiling point[a] °C	Safety group[d]	LFL (ppm by volume)	ATEL (ppm by volume)	RCL (ppm by volume)
		Cyclic organic compound							
R-C318	PFC	octafluorocyclobutane	$CF_2CF_2CF_2CF_2$	200,0	-6	A1		80 000	80 000
		Misc. organic compounds							
		Hydrocarbons							
R-600	HC	butane	$CH_3CH_2CH_2CH_3$	58,1	0	A3	16 000	1 000	1 000
R-600a	HC	2-methylpropane (isobutane)	$(CH_3)_2CHCH_3$	58,1	-12	A3	18 000	25 000	3 600
R-601	HC	pentane	$CH_3CH_2CH_2CH_2CH_3$	72,2	36	A3	12 000	1 000	1 000
R-601a	HC	2-methylbutane (isopentane)	$(CH_3)_2CHCH_2CH_3$	72,2	27	A3	10 000	1 000	1 000
		Inorganic compounds							
R-702		hydrogen	H_2	2,0	-253	A3	40 000		
R-704		helium	He	4,0	-269	A1			
R-717		ammonia	NH_3	17,0	-33	B2L	167 000	320	320
R-744		carbon dioxide	CO_2	44,0	-78[c]	A1		40 000	40 000
		Propene series							
R-1234yf	HFO	2,3,3,3-tetrafluoro-1-propene	$CF_3CF=CH_2$	114,0	-29,4	A2L	62 000	100 000	12 000
R-1234ze(E)	HFO	trans-1,3,3,3-tetrafluoro-1-propene	$CF_3CH=CHF$	114,0	-19,0	A2L	65 000	59 000	13 000
R-1270	HC	propene (propylene)	$CH_3CH=CH_2$	42,1	-48	A3	27 000	1 000	1 000

[a] The relative molar 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 Reference [3] or Reference [4].

[c] Sublimes.

[d] Table E.4 provides designations for single-compound refrigerants for which insufficient data are available for safety classification or determination of an ATEL or RCL value.

Table 6 — Refrigerant designations of R400 blends

Refrigerant number	Nominal composition[c] mass fraction %	Composition tolerance %	Bubble point/ dew point at 101,3 kPa °C[a]	Safety group[d]	LFL (ppm by volume)	ATEL (ppm by volume)	RCL (ppm by volume)
R-401A	R-22/152a/124 (53,0/13,0/34,0)	±2,0/+0,5-1,5/±1,0	-34,4/-28,8	A1/A1		27 000	27 000
R-401B	R-22/152a/124 (61,0/11,0/28,0)	±2,0/+0,5-1,5/±1,0	-35,7/-30,8	A1/A1		30 000	30 000
R-401C	R-22/152a/124 (33,0/15,0/52,0)	±2,0/+0,5-1,5/±1,0	-30,5/-23,8	A1/A1		20 000	20 000
R-402A	R-125/290/22 (60,0/2,0/38,0)	±2,0/+0,1-1,0/±2,0	-49,2/-47,0	A1/A1		66 000	66 000
R-402B	R-125/290/22 (38,0/2,0/60,0)	±2,0/+0,1-1,0/±2,0	-47,2/-44,9	A1/A1		63 000	63 000
R-403A	R-290/22/218 (5,0/75,0/20,0)	+0,2-2,0/±2,0/±2,0	-44,0/-42,3	A1/A2	130 000	63 000	26 000
R-403B	R-290/22/218 (5,0/56,0/39,0)	+0,2-2,0/±2,0/±2,0	-43,8/-42,3	A1/A1		68 000	68 000
R-404A	R-125/143a/134a (44,0/52,0/4,0)	±2,0/±1,0/±2,0	-46,6/-45,8	A1/A1		130 000	130 000
R-406A	R-22/600a/142b (55,0/4,0/41,0)	±2,0/±1,0/±1,0	-32,7/-23,5	A2/A2	82 000	37 000	16 000
R-407A	R-32/125/134a (20,0/40,0/40,0)	±2,0/±2,0/±2,0	-45,2/-38,7	A1/A1		83 000	83 000
R-407B	R-32/125/134a (10,0/70,0/20,0)	±2,0/±2,0/±2,0	-46,8/-42,4	A1/A1		79 000	79 000
R-407C	R-32/125/134a (23,0/25,0/52,0)	±2,0/±2,0/±2,0	-43,8/-36,7	A1/A1		81 000	81 000
R-407D	R-32/125/134a (15,0/15,0/70,0)	±2,0/±2,0/±2,0	-39,4/-32,7	A1/A1		68 000	68 000
R-407E	R-32/125/134a (25,0/15,0/60,0)	±2,0/±2,0/±2,0	-42,8/-35,6	A1/A1		80 000	80 000
R-407F	R-32/125/134a (30,0/30,0/40,0)	±2,0/±2,0/±2,0	-46,1/-39,7	A1/A1		95 000	95 000
R-408A	R-125/143a/22 (7,0/46,0/47,0)	±2,0/±1,0/±2,0	-45,5/-45,0	A1/A1		94 000	94 000
R-409A	R-22/124/142b (60,0/25,0/15,0)	±2,0/±2,0/±1,0	-35,4/-27,5	A1/A1		29 000	29 000
R-409B	R-22/124/142b (65,0/25,0/10,0)	±2,0/±2,0/±1,0	-36,5/-29,7	A1/A1		30 000	30 000
R-410A	R-32/125 (50,0/50,0)	+0,5-1,5/+1,5-0,5	-51,6/-51,5	A1/A1		170 000	140 000
R-410B	R-32/125 (45,0/55,0)	±1,0/±1,0	-51,5/-51,4	A1/A1		150 000	140 000
R-411A	R-1270/22/152a (1,5/87,5/11,0)	+0,0-1,0/+2,0-0,0/+0,0-1,0	-39,7/-37,2	A1/A2	55 000	22 000	11 000
R-411B	R-1270/22/152a (3,0/94,0/3,0)	+0,0-1,0/+2,0-0,0/+0,0-1,0	-41,6/-41,3	A1/A2	70 000	13 000	13 000
R-412A	R-22/218/142b (70,0/5,0/25,0)	±2,0/±2,0/±1,0	-36,4/-28,8	A1/A2	87 000	46 000	17 000
R-413A	R-218/134a/600a (9,0/88,0/3,0)	±1,0/±2,0/+0,0-1,0	-29,3/-27,6	A1/A2	88 000	49 000	18 000
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	A1/A1		26 000	26 000
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	-34,4/-26,1	A1/A1		23 000	23 000
R-415A	R-22/152a (82,0/18,0)	±1,0/±1,0	-37,5/-34,7	A1/A2	56 000	57 000	11 000

Table 6 *(continued)*

Refrigerant number	Nominal composition[c] mass fraction %	Composition tolerance %	Bubble point/ dew point at 101,3 kPa °C[a]	Safety group[d]	LFL (ppm by volume)	ATEL (ppm by volume)	RCL (ppm by volume)
R-415B	R-22/152a (25,0/75,0)	±1,0/±1,0	-23,4/-21,8	A2/A2	47 000	52 000	9 400
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	A1/A1		14 000	14 000
R-417A	R-125/134a/600 (46,6/50,0/3,4)	±1,1/±1,0/+0,1-0,4	-38,0/-32,9	A1/A1		13 000	13 000
R-417B	R-125/134a/600 (79,0/18,3/2,7)	±1,0/±1,0/+0,1-0,5	-44,9/-41.5	A1/A1		15,000	15,000
R-418A	R-290/22/152a (1,5/96,0/2,5)	±0,5/±1,0/±0,5	-41,2/-40,1	A1/A2	89 000	59 000	18 000
R-419A	R-125/134a/E170 (77,0/19,0/4,0)	±1,0/±1,0/±1,0	-42,6/-36,0	A1/A2	60 000	70 000	12 000
R-420A	R-134a/142b (88,0/12,0)	+1,0 −0,0/+0,0 −1,0	-25,0/-24,2	A1/A1		45 000	45 000
R-421A	R-125/134a (58,0/42,0)	±1,0/±1,0	-40,8/-35,5	A1/A1		61 000	61 000
R-421B	R-125/134a (85,0/15,0)	±1,0/±1,0	-45,7/-42,6	A1/A1		69 000	69 000
R-422A	R-125/134a/600a (85,1/11,5/3,4)	±1,0/±1,0/+0,1 −0,4	-46,5/-44,1	A1/A1		63 000	63 000
R-422B	R-125/134a/600a (55,0/42,0/3,0)	±1,0/±1,0/+0,1 −0,5	-40,5/-35,6	A1/A1		56 000	56 000
R-422C	R-125/134a/600a (82,0/15,0/3,0)	±1,0/±1,0/+0,1 −0,5	-45,3/-42,3	A1/A1		62 000	62 000
R-422D	R-125/134a/600a (65,1/31,5/3,4)	+0,9 −1,1/±1,0/+0,1 −0,4	-43,2/-38,4	A1/A1		58 000	58 000
R-423A	R-134a/227ea (52,5/47,5)	±1,0/±1,0	-24,2/-23,5	A1/A1		59 000	59 000
R-424A	R-125/134a/600a/600/601a (50,5/47,0/0,9/1,0/0,6)	±1,0/±1,0/+0,1 −0,2/+0,1 −0,2/+0,1 −0,2	-39,1/-33,3	A1/A1		23 000	23 000
R-425A	R-32/134a/227ea (18,5/69,5/12,0)	±0,5/±0,5/±0,5	-38,1/-31,3	A1/A1		72 000	72 000
R-426A	R-125/134a/600/601a (5,1/93,0/1,3/0,6)	±1,0/±1,0/+0,1 −0,2/+0,1 −0,2	-28,5/-26,7	A1/A1		20 000	20 000
R-427A	R-32/125/143a/134a (15,0/25,0/10,0/50,0)	±2,0/±2,0/±2,0/±2,0	-43,0/-36,3	A1/A1		79 000	79 000
R-428A	R-125/143a/290/600a (77,5/20,0/0,6/1,9)	±1,0/±1,0/+0,1 −0,2/+0,1 −0,2	-48,3/-47,5	A1/A1		83 000	83 000
R-429A	R-E170/152a/600a (60,0/10,0/30,0)	±1,0/±1,0/±1,0	-26,0/-25.6	A3/A3	25 000	47 000	5 000
R-430A	R-152a/600a (76,0/24,0)	±1,0/±1,0	-27,6/-27,4	A3/A3	32 000	40 000	6 400
R-431A	R-290/152a (71,0/29,0)	±1,0/±1,0	-43,1/-43,1	A3/A3	22 000	50 000	4 400
R-432A	R-1270/E170 (80,0/20,0)	±1,0/±1,0	-46,6/-45,6	A3/A3	22 000	1 200	1 200
R-433A	R-1270/290 (30,0/70,0)	±1,0/±1,0	-44,6/-44,2	A3/A3	20 000	3 100	3 100
R-433B	R-1270/290 (5,0/95,0)	±1,0/±1,0	-42,7/-42,5	A3/A3	18 000	14 000	3 600
R-433C	R-1270/290 (25,0/75,0)	±1,0/±1,0	-44,3/-43,9	A3/A3	18,000	3 600	3 600
R-434A	R-125/143a/134a/600a (63,2/18,0/16,0/2,8)	±1,0/±1,0/±1,0/+0,1 −0,2	-45,0/-42,3	A1/A1		73 000	73 000
R-435A	R-E170/152a (80,0/20,0)	±1,0/±1,0	-26,1/-25,9	A3/A3	34 000	45 000	6 800

Table 6 *(continued)*

Refrigerant number	Nominal composition[c] mass fraction %	Composition tolerance %	Bubble point/ dew point at 101,3 kPa °C[a]	Safety group[d]	LFL (ppm by volume)	ATEL (ppm by volume)	RCL (ppm by volume)
R-436A	R-290/600a (56,0/44,0)	±1,0/±1,0	-34,3/-26,2	A3/A3	16 000	36 000	3 200
R-436B	R-290/600a (52,0/48,0)	±1,0/±1,0	-33,4/-25,0	A3/A3	16 000	35 000	3 200
R-437A	R-125/134a/600/601 (19,5/78.5/1,4/0,6)	+0,5 −1,8/+1,5 −0,7/+0,1 −0,2/+0,1 −0,2	-32,9/-29,2	A1/A1		19 000	19 000
R-438A	R-32/125/134a/600/601a (8,5/45,0/44,2/1,7/0,6)	+0,5 −1,5/±1,5/±1,5/+0,1 −0,2/+0,1 −0,2	-43,0/-36,4	A1/A1		19 000	19 000
R-439A	R-32/125/600a (50,0/47,0/3,0)	±1,0/±1,0/±0,5	-52,0/-51,8	A2/A2	104 000	140 000	21 000
R-440A	R-290/134a/152a (0,6/1,6/97,8)	±0,1/±0,6/±0,5	-25,5/-24,3	A2/A2	46 000	50 000	9 200
R-441A	R-170/290/600a/600 (3,1/54,8/6,0/36,1)	±0,3/±2,0/±0,6/±2,0	-41,9/-20,4	A3/A3	16 000	3 200	3 200
R-442A	R-32/125/134a/152a/227ea (31,0/31,0/30,0/3,0/5,0)	±1,0/± 1,0± 1,0/±0,5/±1,0	-46,5/-52,7	A1/A1		100 000	100 000

[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 "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] Table E.5 provides designations for R400 refrigerant blends for which insufficient data are available for safety classification or determination of an ATEL or RCL value.

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Table 7 — Refrigerant designations of R500 blends

Refrigerant number	Nominal composition[e] (mass %)	Composition tolerance %	Azeotropic temperature °C[d]	Bubble point/ dew point at 101,3 kPa °C[ab]	Safety group[f]	LFL (ppm by volume)	ATEL (ppm by volume)	RCL (ppm by volume)
R-500	R-12/152a (73,8/26,2)	+1,0-0,0/+0,0-1,0	0	-33,6/-33,6	A1/A1		30 000	30 000
R-501	R-22/12 (75,0/25,0)[c]		-41	-40,5/-40,3	A1/A1		54 000	54 000
R-502	R-22/115 (48,8/51,2)		19	-45,3/-45,0	A1/A1		73 000	73 000
R-507A	R-125/143a (50,0/50,0)	+1,5-0,5/+0,5-1,5	-40	-47,1/-47,1	A1/A1		130 000	130 000
R-508A	R-23/116 (39,0/61,0)	±2,0/±2,0	-86	-87,4/-87,4	A1/A1		69 000	69 000
R-508B	R-23/116 (46,0/54,0)	±2,0/±2,0	-46	-87,4/-87,0	A1/A1		65 000	65 000
R-509A	R-22/218 (44,0/56,0)	±2,0/±2,0	0	-40,4/-40,4	A1/A1		75 000	75 000
R-510A	R-E170/600a (88,0/12,0)	±0,5/±0,5	-25,2	-25,2/-25,2	A3/A3	29 000	45 000	5 800
R-511A	R-290/E170 (95,0/5,0)	±1,0/± 1,0	–20 to 40	-42,18/-42,1	A3/A3	21 000	51 000	4 200
R-512A	R-134a/152a (5,0/95,0)	±1,0/± 1,0	-20 to 40	-24,0/-24,0	A2/A2	45 000	50 000	9 000

[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 "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] 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.

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

[d] Under vapour-liquid equilibrium conditions.

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

[f] Table E.6 provides designations for R500 refrigerant blends for which insufficient data are available for safety classification or determination of an ATEL or RCL value.