

## Refrigerant Table: Explanation and Glossary of Terms

A reference list of refrigerants which is intended to provide an indication of the basic characteristics, properties and applications for a variety of refrigerants along with some replacement options was prepared upon the recommendation of HRAI's Task Team on the Future of Refrigerants.

This list is intended to assist contractors as a convenient reference when selecting suitable replacement/substitute refrigerants for those refrigerants (CFC and any HCFC) which are being phased out. While refrigerant manufacturers may indicate some products are suitable for retrofit applications, the contractor will need to consider the application in order to determine the extent of system modifications that may be required to accommodate the replacement refrigerant. Currently, one must verify with the Original Equipment Manufacturer (OEM) to determine compatibility of alternative refrigerants with the equipment, or have a Professional Engineer sign off. Unless otherwise specified, few if any replacement refrigerants in the table are certified as a direct drop-in replacement, in fact most are **certified for new equipment only** and are **not** suitable for retrofit applications. Contractors would still have to determine which products are suitable for their particular application, if equipment replacement or retrofit options exist, which system modifications may be required and choose accordingly. Depending on the age of the existing equipment and the extent of system modifications required to accommodate an alternate refrigerant, it may prove to be more cost effective in the long run to replace equipment outright. As the phase down of certain refrigerants causes them to become scarcer, decreasing availability and increasing cost can be expected to result in the change-out of entire systems to more energy efficient equipment and environmentally friendly refrigerants. Contractors must keep in mind as they transition to equipment using more environmentally friendly refrigerants that many of the replacements available today are, or will soon be, scheduled to be phased down. Products such as R-404A and R-507A will be phased down over the first few years due to their high Global Warming Potential (GWP).

The list is intended to make contractors aware of the possible alternatives for the products that they may find are becoming increasingly expensive and/or difficult to source. Choosing equipment that operate on the least damaging refrigerants will extend the expected effective lifespan and reduce the overall operating costs of the system. Keep in mind that although there may be several replacement options, not all replacements will be suitable for all applications.

The information contained is derived from various sources, and is **not** intended to be a comprehensive listing, but rather more of a guide to understanding of the relative merits and hazards of a) refrigerants scheduled to be phased down, as well as b) some of their potential replacements.

# Glossary of Terminology

## Refrigerant Classes:

- A non toxic
- B toxic
- 1 no flammability
- 2L very low/lesser flammability (hard to ignite, slow burning)
- 2 low flammability
- 3 high flammability

**FIGURE 3.** Refrigerant safety classification from ASHRAE Standard 34.

	lower toxicity	higher toxicity	
higher flammability	A3	B3	LFL $\leq$ 0.10 kg/m <sup>3</sup> or heat of combustion $\geq$ 19 000kJ/kg
lower flammability	A2	B2	LFL $\leq$ 0.10 kg/m <sup>3</sup> and heat of combustion $\geq$ 19 000kJ/kg
	A2L*	B2L*	
no flame propagation	A1	B1	no LFL based on modified ASTM E681-85 test
	no identified toxicity at concentrations $\leq$ 400 ppm	evidence of toxicity below 400 ppm (based on data for TLV-TWA or consistent indices)	

\*A2L and B2L are lower flammability refrigerants with a maximum burning velocity of <10 cm/s.

**Ozone Depletion Potential (ODP):** This is a relative indication of the effect of the substance on breaking down the ozone layer. Products are measured by comparing their effect on the ozone layer in relation to R-11, which is set to 1.0. The ODP for R-22 is 0.05, which is 20 times less than R-11.

**Global Warming Potential (GWP) :** this is the relative indication of the amount of heat trapped in the atmosphere by a certain mass of the gas in question relative to the amount of heat trapped by a similar mass of carbon dioxide. It is expressed as a factor of carbon dioxide, whose GWP is standardized to 1. The GWP for R22 is 1810 , which is eighteen hundred times more than CO2.

## Refrigerant types:

**CFC Refrigerant:** CFC refers to the chemical composition of the refrigerant. Chlorofluorocarbon indicates that the refrigerant is comprised of Chlorine, Fluorine, and Carbon. Common CFC refrigerants are R-11, R-12, R-13, R-113, R-114, and R-115. A blend that contains a CFC and any other product is still considered a CFC refrigerant.

**HCFC Refrigerant:** HCFC refers to the chemical composition of the refrigerant. Hydrochlorofluorocarbon indicates that the refrigerant is comprised of Hydrogen, Chlorine, Fluorine, and Carbon. Common HCFC refrigerants are R-22, R-123, R-124, and R-142b. A blend that contains both an HCFC and HFC is considered an HCFC refrigerant.

**HFC Refrigerant:** HFC refers to the chemical composition of the refrigerant. Hydrofluorocarbon indicates that the refrigerant is comprised of Hydrogen, Fluorine, and Carbon. Common HFC refrigerants are R-32, R-125, R134a, R-143a, and R-152a. A blend that contains different HFCs is considered an HFC refrigerant.

**HFO Refrigerant:** HFO refers to the chemical composition of the refrigerant.. (HFOs are organic compounds composed of hydrogen, fluorine and carbon. HFO refrigerants are categorized as having zero ODP (Ozone Depletion Potential) and low GWP (Global Warming Potential) and so offer a more environmentally friendly alternative to CFCs, HCFCs and HFCs.

**HC Refrigerant:** Chemically speaking, a hydrocarbon [HC] is an elementary compound of hydrogen and carbon which occurs naturally and is found in large concentrations in crude oil. Used as a modern refrigerant, non-toxic hydrocarbons are an ecofriendly alternative to the CFC/HCFC/HFC fluorocarbons linked to ozone damage and global warming potential.

## In general:

CFC	Chlorofluorocarbon	ozone depleting
HCFC	Hydrochlorofluorocarbon	less damaging to ozone (relative to CFC)
HFC	Hydrofluorocarbon	not ozone depleting, however high GWP
PFC	Perfluorocarbon	not ozone depleting, however high GWP
HFO	Hydrofluoroolefin	low GWP

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Refrigerant	Type	Chemical Composition	Class	GWP	ODP	Applications	May be a useful replacement for ___* *consult OEM to determine	Other Alternatives which may be considered* suitability/acceptability
R12	CFC	100% trichlorodifluoromethane	A1	10910	1	process cooling, chiller, high/med/low temp refrig	NA	R-426A
R22	HCFC	100% Chlorodifluoromethane	A1	1810	0.05	com/ind refrig, com/resi AC,	NA	R407a, R407c, R422b, R422c, R422d, R424A, R434A, R435A
R32	HFC	100% difluoromethane	A2L	675	0	industrial refrig, residential AC	new equip only	R410a
R134a	HFC	100% tetrafluoroethane	A1	1430	0	med-hgh temp refrig, centrifugal chillers, automotive	R12, R500, R22	R1234yf
R245fa		pentafluoropropane	B1	1030	0	niche refrig and AC, heat transfer and heat recovery	CFC11	R1336mzz
R404A	HFC blend	R125/143a/134a 44 / 52 / 4	A1	3920	0	low-med temp com/ind refrig and ice machines	new equipment not suitable for retrofit	R507, R407A, R442A, R464A
R407A	HFC blend	R32/R125/R134A 20 / 40 /40	A1	2110	0	commercial/industrial low-med temp refrigeration	R22, R404A	R404A
R407C	HFC blend	R32/R125/R134A 23 /25 /52	A1	1770	0	residential/commercial AC, commercial/industrial mid temp refrig	R22	R407A
R410A	HFC blend	R32/R125 50 / 50	A1	2088	0	AC and Heat pumps	R22 new equip only	R32
R422D	HFC blend	R125/134a/600a 65 / 32 / 4	A1	2729	0	low-med temp commercial refrig commercial supermarket	R22 dropin new and retrofit	R417A, R422A
R424A	HFC Blend	R-125/R-134a/R600/R-600a/R-601a 50.5/47/1/0.9/0.6	A1	2440	0	Commercial/Res/AC	R-22	
R426A	HFC	R-125/R-134A/R-600/R-601a 5.1/93/1.3/0.6	A1	1508	0	High/Med/Low temp Refrig.	R-12	
R428A	HFC	R-125/R-143a/R-290/R-600a 77.5/20/0.6/1.9	A1	3607	0	Med/Low Temp Refrig	R-502	
R434A	HFC	R-125/R-134a/R-143a/R-600a 63.2/16/18/2.8	A1	3245	0	A/C, High/Med/Low temp Refrig	R-22	
R442A	HFC	R-125/R-134a/R-152a/R-227ea/R-32 31/30/3/5/31	A1	1888	0	Med/low temp Refrig	R-404A, R-507A	
R448A	HFC/HFO blend	R32/125/134a/1234ze/1234yf 26 / 26 / 21 / 7 / 20	A1	1273	0	supermarket refrigeration	R22, R404A	
R449A	HFO	R32/125/1234YF/134a 24.3 / 24.7 / 25.3 / 25.7	A1	1282	0	industrial/commercial AC low-med temp commercial/industrial refrigeration	R22 retrofit R404A, R507A	R407A, R442A

Refrigerant	Type	Chemical Composition	Class	GWP	ODP	Applications	May be a useful replacement for ___* *consult OEM to determine	Other Alternatives which may be considered* suitability/acceptability
R450A	HFC/HFO blend	R134a/R1234ze 42 / 58	A1	547		med temp Heat Pump , vending machines air/water cooled chillers	R134a	
R453A	HFC	-125/R-134a/R-227ea/R-32/R-600/R-601 20/53.8/5/20/0.6/0.6	A1	1765	0	Commercial/Res/A/C, Med/Low temp Refrig	R-22	
R454C	HFO	R32/1234yf 21.5 / 78.5	A2L	148	0	low-med temp commercial/industrial refrigeration	R22, R404A	
R455A	HFC/HFO blend	R1234yf/32/744 75.5/ 21.5 / 3	A2L	146	0	low-med-high temp commercial refrig, new systems	R22, R407C, R404A, R290	
R464A	HFC/HFO Blend	R-125/R-1234ze/R-227ea/R-32 27/40/6/27	A1	1288	0	Med/Low temp Refrig.	R-404A, R-507A	
R502	CFC/HCFC Azeotrope	R-115/R-22 50/50	A1	4657	0.33	Med/Low temp Refrig.	N/A	R-428A
R507	HFC blend	R125/R143a 50 / 50	A1	3985	0	med-low temp com/ind refrig and ice machines	R22 new equip only not suitable for retrofit	R404A, R407A, R442A, R464A
R513A	HFO	R1234yf/134a 56 / 44	A1	573	0	med temp commercial/industrial refrigeration water chiller, AC, HP	R134A	
R1234yf	HFO	tetrafluoropropene	A2L	4	0	mobile AC, automotive	R134a	
R1234ze	HFO	tetrafluoropropene	A2L	0	0	chillers, med temp heat pump,frigeration	R134a, R410a	R134a, R744, R600a
R1233zd	HFO	Chlorotrifluoropropene	A1	1	0	chiller, industrial AC	R123	
R1336mzz	HFO		A1	18	0	high temp heat pump	R245fa	
R170	hydrocarbon	ethane	A3	6	0	very low temp refrigeration	R23 not suitable for retrofit	R1150
R290	hydrocarbon	propane	A3	3	0	com/ind/ refrigeration and resi AC	R22 not suitable for retrofit	R600a
R600a	hydrocarbon	isobutane	A3	3	0	med-high temp refrig , AC	R12, R134a not suitable for retrofit	R290, R134a
R717	natural	ammonia	B2L	0	0	low, med, high temp refrig, chillers	R22, R134a not suitable for retrofit	R134a
R744	natural	CO2	A1	1	0	low, med, high temp refrig, chillers	R22, R134a, R404A not suitable for retrofit	R290