

## Summary of Substitute Refrigerants Listed in SNAP Notice 25

The table below provides additional information on the substitutes listed as acceptable in the end uses within the refrigeration and air conditioning sector noted in SNAP Notice 25. The first column provides the name of the substitute. Where available, we have listed the refrigerant using the ASHRAE designation (available at <http://www.ashrae.org/technology/page/1933#mo>). Alternate names or trade names, along with the Chemical Abstract Service Registry Number (CAS ID#), are in the second column. The third column refers to the previous *Federal Register* actions in which we found the substitute acceptable for one or more end uses within the refrigeration and air conditioning sector. The fourth through eighth columns provide information about the environmental, health, and safety properties. “ODP” is the ozone depletion potential of the substitute, relative to a value of 1.0 for CFC-11. “GWP” is the 100-year integrated global warming potential of a chemical or the weighted average of the GWPs of the chemicals in a blend, relative to a value of 1 for CO<sub>2</sub>. (Technically, GWP only applies to individual chemicals; however, for a blend, an average weighted by the percentage composition provides a rough approximation of a blend’s impact.) “VOC status” indicates whether the substitute contains any components that are defined as, or are exempt from the definition of, volatile organic compounds under Clean Air Act regulations (see 40 CFR 51.100(s)) addressing the development of SIPs to attain and maintain the national ambient air quality standards. Substitutes listed as “exempt” in the VOC status column contain only components that are not VOCs or that are exempt from the definition of VOC under those regulations. “Flammable” indicates whether the refrigerant is flammable, either through an ASHRAE classification of “2” or “3” in ASHRAE 34, or by flashpoint testing using ASTM E 681. Flammable refrigerants are hazardous waste and must be disposed of consistent with regulations under the Resource Conservation and Recovery

Act (RCRA). “Exposure limit” indicates the workplace exposure limits for the components of the refrigerant, typically as an 8-hour time-weighted average. “Type of exposure limit” indicates the source of the exposure limit, such as a Permissible Exposure Limit (PEL) from the U.S. Occupational Safety and Health Administration (OSHA), a Recommended Exposure Limit (REL) from the National Institutes of Occupational Safety and Health (NIOSH), a Threshold Limit Value (TLV) from the American Conference of Government Industrial Hygienists (ACGIH), a Workplace Environmental Exposure Limit (WEEL) from the American Industrial Hygiene Association (AIHA), an acceptable exposure limit from the substitute’s manufacturer (manufacturer AEL), a Continuous Exposure Guidance Level (CEGL) from the National Research Council (NRC), or a recommendation from EPA (either a workplace acceptable exposure limit – AEL – or consumer exposure limit – CEL).

**Summary of Information on Refrigerant Substitutes for HCFC-22 and  
Blends Containing HCFC-22 and/or HCFC-142b (see Notice 25 for specific end uses allowed)**

Name of Substitute	Further Identification Information for Substitute <sup>1</sup>	Previous SNAP Federal Register Listings	ODP	GWP <sup>2</sup>	VOC status	Flammable	Exposure limits <sup>3</sup> (ppm)
Ammonia absorption; Ammonia/water absorption; Ammonia vapor compression/ secondary loop	NH <sub>3</sub> ; R-717; CAS ID # 7664-41-7	March 18, 1994 rule, 59 FR 13044; Notice 3, July 28, 1995; 60 FR 38729; Notice 5, September 5, 1996, 61 FR 47011	0	0	exempt	yes (ASHRAE class 2)	Ammonia: 50 (PEL)
C6 perfluoroketone	1,1,1,2,2,4,5,5,5-nonafluoro-4-(trifluoromethyl)-3-pentanone or FK-5-1-12mmv2; CAS ID # 756-13-8; Novec <sup>TM</sup> 649	Notice 24, September 30, 2009, 74 FR 50129	0	0.6-1.8	VOC	no	150 (Manufacturer AEL)
Cryogenic system using recaptured liquid CO <sub>2</sub> or liquid nitrogen		Notice 11, December 6, 1999, 64 FR 68039	0	N/A	exempt	no	N/A
Desiccant cooling		March 18, 1994 rule, 59 FR 13044; Notice 5, September 5, 1996, 61 FR 47011	0	N/A	N/A	N/A	N/A
Evaporative cooling		March 18, 1994 rule, 59 FR 13044; Notice 5, September 5, 1996, 61 FR 47011	0	N/A	N/A	N/A	N/A
HC Blend A	OZ-12	March 18, 1994 rule, 59 FR 13044	0	3	all components are VOCs	yes (ASHRAE class 3)	1000 (Manufacturer AEL)
HC Blend B	HC-12a	Notice 2, January 13, 1995; 60 FR 3318	0	4	all components are VOCs	yes (ASHRAE class 3)	1000 (Manufacturer AEL)

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HFC-134a	1,1,1,2-tetrafluoroethane; CAS ID # 811-97-2	March 18, 1994 SNAP rule (58 FR 13044); Notice 19, October 1, 2004; 69 FR 58903	0	1,430	exempt	no	1000 (WEEL)
HFC-152a	1,1-difluoroethane; CAS ID # 75-34-3	March 18, 1994 rule, 59 FR 13044; Notice 11, December 6, 1999, 64 FR 68039	0	124	exempt	yes (ASHRAE class 2)	1000 (WEEL)
HFC-227ea	1,1,1,2,3,3,3-heptafluoropropane; CAS ID # 431-89-0	March 18, 1994 SNAP rule (58 FR 13044)	0	3,220	exempt	no	1000 (Manufacturer AEL)
HFC-245fa	1,1,1,3,3-pentafluoropropane: CAS ID # 460-73-1	Notice 13, June 19, 2000, 65 FR 37900; Notice 20, March 29, 2006; 71 FR 15589	0	1,030	exempt	no	300 (WEEL)
HFC-4310mee	1,1,1,2,3,4,4,5,5,5-decafluoropentane; CAS ID # 138495-42-8	Notice 10, June 8, 1999; 64 FR 30410	0	1,640	exempt	no	200 (Manufacturer 8-hr AEL) 400 (Manufacturer ceiling limit AEL)
HFE-7000	1,1,1,2,2,3,3-heptafluoro-3-methoxy-propane; HFE-347mcc3; CAS ID # 375-03-1	Notice 16, March 22, 2002; 76 FR 13272	0	575	exempt	no	75 (Manufacturer AEL)
HFE-7100	Methoxynonafluor-obutane, iso and normal; HFE-449s1; CAS ID # 163702-07-6	Notice 10, June 8, 1999; 64 FR 30410; Notice 14, December 18, 2000; 65 FR 78977	0	297	exempt	no	750 (WEEL)
HFE-7200	Ethoxynonafluoro-butane, iso and normal; HFE-569sf2; CAS # 163702-05-4	Notice 14, December 18, 2000; 65 FR 78977	0	59	exempt	no	200 (Manufacturer AEL)
HFO-1234ze	HFC-1234ze; trans-1,3,3,3-tetrafluoroprop-1-ene; CAS ID # 29118-24-9	Notice 24, September 30, 2009, 74 FR 50129	0	6	VOC <sup>4</sup>	no	1000 (EPA Recommended 8-hr AEL) 10000 (Preliminary EPA Recommended 30- min consumer exposure limit) <sup>5</sup>

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Nitrogen direct gas expansion		March 18, 1994 rule, 59 FR 13044	0	N/A	exempt	no	N/A; ACGIH lists nitrogen as a simple asphyxiant.
Pressure stepdown		March 18, 1994 rule, 59 FR 13044	0	N/A	exempt	N/A	N/A
R-125/134a/600a (28.1%/70.0%/1.9% by weight)	Blend of HFC-125/HFC-134a/isobutane (HFC-125 is 1,1,1,2,2-pentafluoroethane, CAS ID # 354-33-6; R-600a is isobutane, CAS ID # 75-28-5) (NU-22 original composition)	Notice 16, March 22, 2002, 67 FR 13272	0	1,990	one component is VOC	blend not flammable	R-125: 1000 (WEEL) R-134a: 1000 (WEEL) R-600a: 800 (10-hr REL)
R-125/290/134a/600a (55.0%/1.0%/42.5%/1.5% by weight)	Blend of HFC-125/ propane/HFC-134a/isobutane (ICOR AT-22)	Notice 20, March 29, 2006; 71 FR 15589	0	2,530	some components are VOCs	blend not flammable	R-125: 1000 (WEEL) R-290: 1000 (PEL) R-134a: 1000 (WEEL) R-600a: 800 (10-hr REL)
R-290	Propane; CAS ID # 74-98-6	March 18, 1994 rule, 59 FR 13044	0	3	VOC	yes (ASHRAE class 3)	1000 (PEL)
R-404A	R-125/143a/134a (44.0/52.0/4.0) (HFC-143a is 1,1,1-trifluoroethane, CAS ID # 420-46-2)	March 18, 1994 rule, 59 FR 13044; Notice 16, March 22, 2002; 67 FR 13272; Notice 17, December 20, 2002, 67 FR 77927	0	3,920	exempt	blend not flammable	R-125: 1000 (WEEL) R-143a: 1000 (WEEL) R-134a: 1000 (WEEL)
R-407A	R-32/125/134a (20.0/40.0/40.0) (HFC-32 is difluoromethane, CAS ID # 75-10-5)	Notice 1, August 26, 1994; 59 FR 44240; Notice 23, January 2, 2009; 74 FR 21	0	2,110	exempt	blend not flammable	R-134a: 1000 (WEEL) R-32: 1000 (WEEL) R-125: 1000 (WEEL)
R-407B	R-32/125/134a (10.0/70.0/20.0)	Notice 1, August 26, 1994; 59 FR 44240	0	2,800	exempt	blend not flammable	R-134a: 1000 (WEEL) R-32: 1000 (WEEL) R-125: 1000 (WEEL)

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R-407C	R-32/125/134a (23.0/25.0/52.0)	Notice 4, February 8, 1996, 61 FR 4736; Notice 17, December 20, 2002; 67 FR 77927; Notice 18, August 21, 2003; 68 FR 50533; Notice 19, October 1, 2004; 69 FR 58903	0	1,770	exempt	blend not flammable	R-125: 1000 (WEEL) R-32: 1000 (WEEL) R-134a: 1000 (WEEL)
R-407D	R-32/125/134a (15.0/15.0/70.0)	Notice 21; September 28, 2006, 71 FR 56884	0	1,630	exempt	blend not flammable	R-32: 1000 (WEEL) R-125: 1000 (WEEL) R-134a: 1000 (WEEL)
R-410A	R-32/125 (50.0/50.0)	Notice 4, February 8, 1996, 61 FR 4736; Notice 17, December 20, 2002; 67 FR 77927; Notice 19, October 1, 2004; 69 FR 58903	0	2,090	exempt	blend not flammable	R-32: 1000 (WEEL) R-125: 1000 (WEEL)
R-410B	R-32/125 (45.0/55.0)	Notice 4, February 8, 1996, 61 FR 4736	0	2,230	exempt	blend not flammable	R-32: 1000 (WEEL) R-125: 1000 (WEEL)
R-417A	R-125/134a/600a (46.6/50.0/3.4) ISCEON-59/NU-22 (new formulation)	Notice 11, December 6, 1999, 64 FR 68039; Notice 16, March 22, 2002; 67 FR 13272; Notice 17, December 20, 2002; 67 FR 77927; Notice 20, March 29, 2006; 71 FR 15589	0	2,350	one component is VOC	blend not flammable	R-125: 1000 (WEEL) R-134a: 1000 (WEEL) R-600a: 800 (10-hr REL)
R-421A	Choice R421A; R-125/134a (58.0/42.0)	Notice 21; September 28, 2006, 71 FR 56884	0	2,630	exempt	no	R-125: 1000 (WEEL) R-134a: 1000 (WEEL)
R-421B	Choice R421B; R-125/134a (85.0/15.0)	Notice 21; September 28, 2006, 71 FR 56884	0	3,190	exempt	no	R-125: 1000 (WEEL) R-134a: 1000 (WEEL)

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R-422A	ISCEON 79; R-125/134a/600a (85.1/11.5/3.4)	Notice 19, October 1, 2004; 69 FR 58903	0	3,140	one component is VOC	blend not flammable	R-125: 1000 (WEEL) R-134a: 1000 (WEEL) R-600a: 800 (10-hr REL)
R-422B	ICOR XAC1; R-125/134a/600a (55.0/42.0/3.0)	Notice 20, March 29, 2006; 71 FR 15589	0	2,530	one component is VOC	blend not flammable	R-125: 1000 (WEEL) R-134a: 1000 (WEEL) R-600a: 800 (10-hr REL)
R-422C	ICOR XLT1; R-125/134a/600a (82.0/15.0/3.0)	Notice 20, March 29, 2006; 71 FR 15589	0	3,390	one component is VOC	blend not flammable	R-125: 1000 (WEEL) R-134a: 1000 (WEEL) R-600a: 800 (10-hr REL)
R-422D	ISCEON MO29; R-125/134a/600a (65.1/31.5/3.4)	Notice 21; September 28, 2006, 71 FR 56884	0	2,730	one component is VOC	blend not flammable	R-125: 1000 (WEEL) R-134a: 1000 (WEEL) R-600a: 800 (10-hr REL)
R-423A	ISCEON 39TC, Centri-Cool; R-134a/227ea (52.5/47.5)	Notice 16, March 22, 2002; 76 FR 13272	0	2,280	exempt	no	R-134a: 1000 (WEEL) R-227ea: 1000 (Manufacturer AEL)
R-424A	RS-44 (new composition); R-125/134a/600a/600/601a (50.5/47.0/0.9/1.0/0.6)	Notice 21; September 28, 2006, 71 FR 56884; Notice 23; January 2, 2009, 74 FR 21	0	2,440	some components are VOCs	blend not flammable	R-125: 1000 (WEEL) R-134a: 1000 (WEEL) R-600a: 800 (10-hr REL) R-600: 800 (10-hr REL) R-601a: 600 (TLV)
R-426A	RS-24 (new composition); R-125/134a/600/601a (5.1/93.0/1.3/0.6)	Notice 21; September 28, 2006, 71 FR 56884	0	1,510	some components are VOCs	blend not flammable	R-125: 1000 (WEEL) R-134a: 1000 (WEEL) R-600: 800 (10-hr REL) R-601a: 600 (TLV)
R-427A	R-32/125/143a/134a (15.0/25.0/10.0/50.0)	Notice 23; January 2, 2009, 74 FR 21	0	2,140	exempt	no	R-32: 1000 (WEEL) R-125: 1000 (WEEL) R-143a: 1000 (WEEL) R-134a: 1000 (WEEL)

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R-428A	R-125/143a/290/600a (77.5/20.0/0.6/1.9)	Notice 22, October 4, 2007; 72 FR 56628	0	3,610	some components are VOCs	blend not flammable	R-125: 1000 (WEEL) R-143a: 1000 (WEEL) R-290: 1000 (PEL) R-600a: 800 (10-hr REL)
R-434A	RS-45; R-125/143a/134a/600a (63.2/18.0/16.0/2.8)	Notice 22, October 4, 2007; 72 FR 56628	0	3,250	some components are VOCs	blend not flammable	R-125: 1000 (WEEL) R-143a: 1000 (WEEL) R-134a: 1000 (WEEL) R-600a: 800 (10-hr REL)
R-437A	KDD6; MO49 Plus™; R-125/134a/600/601 (19.5/78.5/1.4/0.6)	Notice 23, January 2, 2009, 74 FR 21	0	1,810	some components are VOCs	blend not flammable	Blend: 994 (Manufacturer AEL) R-125: 1000 (WEEL) R-134a: 1000 (WEEL) R-600: 800 (10-hr REL) R-601: 600 (TLV)
R-438A	KDD5, ISCEON MO99; R-32/125/134a/600/ 601a (8.5/45.0/44.2/1.7/ 0.6)	Notice 22, October 4, 2007; 72 FR 56628; Notice 24, September 30, 2009	0	2,270	some components are VOCs	blend not flammable	Blend: 995 (Manufacturer AEL) R-32: 1000 (WEEL) R-125: 1000 (WEEL) R-134a: 1000 (WEEL) R-600: 800 (10-hr REL) R-601a: 600 (TLV)
R-507A	R-125/143a (50.0/50.0)	March 18, 1994 rule, 59 FR 13044; Notice 5, September 5, 1996, 61 FR 47011; Notice 17, December 20, 2002; 67 FR 77927	0	3,990	exempt	blend not flammable	R-125: 1000 (WEEL) R-143a: 1000 (WEEL)
R-600	Butane; CAS ID # 106-97-8	March 18, 1994 rule, 59 FR 13044	0	3	VOC	yes (ASHRAE class 3)	800 (10-hr REL)
R-744	Carbon dioxide, CO <sub>2</sub> ; CAS ID # 124-38-9	March 18, 1994 rule, 59 FR 13044; Notice 2, January 13, 1995; 60 FR 3318	0	1	exempt	no	5000 (PEL or 10-hr REL)



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R-1270	Propylene;1-propene; CAS ID # 115-07-1	March 18, 1994 rule, 59 FR 13044	0	5	VOC	yes (ASHRAE class 3)	500 (TLV)
RS-24 (2002 formulation)		Notice 17, December 20, 2002; 67 FR 77927	0	1,510	some components are VOCs	blend not flammable	Blend: 1000 (Manufacturer AEL) Components have TLVs, RELs, or WEELs ranging from 600-1000.
RS-44 (2003 formulation)		Notice 18, August 21, 2003, 68 FR 50533	0	2,420	some components are VOCs	blend not flammable	Blend: 1000 (Manufacturer AEL) Components have TLVs, RELs, or WEELs ranging from 600-1000.
Self-chilling can using recycled CO <sub>2</sub>		Notice 8, February 24, 1998; 63 FR 9151	0	1	exempt	no	5000 (PEL or 10-hr REL)
SP34E		Notice 14, December 18, 2000, 65 FR 78977; Notice 15, May 23, 2001; 66 FR 28379	0	1,470 or less	one component is VOC	blend not flammable	1000 (Manufacturer AEL)
Stirling cycle		March 18, 1994 SNAP rule (58 FR 13044)	0	N/A	exempt	N/A	N/A
Volatile Methyl Siloxanes	Octamethylcyclo-tetrasiloxanes (e.g., D4, CAS ID # 556-67-2) and decamethylcyclo-pentasiloxanes (e.g., D5, CAS ID # 541-02-6) for heat transfer	Notice 3, July 28, 1995; 60 FR 38729	0	Low (< 20)	exempt	some compounds are flammable	Depends on compound D4: 10 (Manufacturer AEL) D5: 10 (Manufacturer AEL)
Water		Notice 3, July 28, 1995; 60 FR 38729	0	0	exempt	no	N/A

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Water/lithium bromide absorption	LiBr has CAS ID # 7550-35-8.	March 18, 1994 rule, 59 FR 13044; Notice 5, September 5, 1996, 61 FR 47011	0	0	exempt	no	LiBr: 1 mg/m <sup>3</sup> for 24 hr/day, 90 day exposure (CEGL); 3 mg/m <sup>3</sup> for 8 hr/day, 90 day exposure (CEGL adjusted for 8 hr workday) <sup>6</sup>

<sup>1</sup> Refrigerant blend compositions are identified by the ASHRAE convention of listing component compounds by their refrigerant (“R-”) designation, separated by “/”, followed by the percentage of each component in the same order, separated by “.”.

<sup>2</sup> Hundred year Global Warming Potential, relative to 1 for CO<sub>2</sub>. Blend values are averages, weighting the GWP of individual components by their percentage in the composition and rounding. For some blends with a confidential formulation, the blend value may be presented as a range. For some short-lived compounds that do not have a GWP value in the peer reviewed literature, EPA has provided an estimate with an upper limit, such as “< 20” or “≤5.”

<sup>3</sup> Eight-hour time-weighted average worker exposure limit expressed in parts per million (ppm), unless otherwise stated.

<sup>4</sup> EPA has received a petition to exempt HFO-1234ze from the definition of VOC for purposes of SIPs to attain and maintain the NAAQS on the basis that the chemical has a low photochemical reactivity. EPA intends to address the request through notice-and-comment rulemaking.

<sup>5</sup> The derivations of EPA’s recommended workplace AEL and preliminary consumer exposure limit (acute) are available at [www.regulations.gov](http://www.regulations.gov) as item EPA-HQ-OAR-2003-0118-0250.

<sup>6</sup> EPA’s analysis of the National Research Council CEGL and rationale for preliminary workplace exposure limit are available at [www.regulations.gov](http://www.regulations.gov) as item EPA-HQ-OAR-2003-0118-0243.