

## Summary of Substitute Foam Blowing Agents Listed in SNAP Notice 25

The table below provides additional information on the substitutes listed as acceptable in the end uses within foam blowing sector noted in SNAP Notice 25. The first column provides the name of the substitute. Alternate names or trade names, along with the 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 column for VOC status in Table 3 contain only compounds that are exempt from the definition of VOC under those regulations. “Flammable” indicates whether the blowing agent is flammable by flashpoint testing using ASTM E 681. Flammable blowing agents are hazardous waste when disposed and must be disposed of consistent with regulations under RCRA. In Table 3, “Exposure limit” indicates the workplace exposure limits for the components of the foam blowing agent, 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 Threshold Limit Value (TLV) from the American Council 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), or an EPA-recommended workplace AEL.

**Summary of Information on Foam Blowing Substitutes for HCFC-22, HCFC-142b, and Blends Thereof (see listings in Notice 25 for specific end uses allowed)**

Name of Substitute	Further Identification Information for Substitute	Previous SNAP Federal Register Listings	ODP	GWP	VOC status	Flam-mable	Exposure Limits <sup>1</sup> (ppm)
Acetone	2-propanone; CAS ID #67-64-1	SNAP Notice 8, February 24, 1998 (63 FR 9151)	0	0.5 <sup>2</sup>	exempt	yes	500 (TLV)
Blends of HFC-152a and saturated light hydrocarbons (C3-C6)	see below in this table for information on the component blowing agents.	SNAP Notice 1, August 26, 1994 (59 FR 44240)	0	3 to 124	saturated light hydrocarbons are VOCs; HFC-152a is exempt	yes	Depends on chemical. HFC-152a: 1000 (WEEL) Light hydrocarbons: range is 300 to 1000 (PEL, REL, or TLV)
Carbon dioxide	CO <sub>2</sub> ; CAS ID # 124-38-9	March 18, 1994 SNAP rule (58 FR 13044); SNAP Notice 10, June 8, 1999 (64 FR 30410)	0	1	exempt	no	5000 (PEL or 10-hr REL)
2-chloropropane	isopropyl chloride; CAS ID # 75-29-6	March 18, 1994 SNAP rule (58 FR 13044); Notice 13, June 19, 2000 (65 FR 37900)	0	5 or less <sup>3</sup>	VOC	yes	350 (EPA recommendation)
Ecomate™	Composition is claimed as CBI.	SNAP Notice 18, August 21, 2003 (68 FR 50533); SNAP Notice 19, October 1, 2004 (69 FR 58903); SNAP	0	5 or less <sup>4</sup>	Main component is VOC exempt	yes	100 (PEL)

<sup>1</sup> Eight-hour time-weighted average worker exposure limit expressed in parts per million (ppm), unless otherwise stated.

<sup>2</sup> Source: IPCC 4<sup>th</sup> Assessment Report, Table 2.15.

<sup>3</sup> EPA is unaware of any specific 100-yr GWP value in the peer reviewed literature for this compound. However, its GWP is expected to be low, based on the compound's relatively short lifetime in the atmosphere.

Name of Substitute	Further Identification Information for Substitute	Previous SNAP Federal Register Listings	ODP	GWP	VOC status	Flam-mable	Exposure Limits <sup>1</sup> (ppm)
		Notice 21, September 28, 2006 (71 FR 56884)					
Electroset technology	A proprietary process that makes organic resins electrically semiconductive	SNAP Notice 1, August 26, 1994 (59 FR 44240)	0	N/A	N/A	N/A	N/A
Exxsol blowing agents	blend containing light saturated hydrocarbons with 5 carbons	SNAP Notice 11, December 5, 1999 (64 FR 68039)	0	5 or less <sup>5</sup>	VOC	yes <sup>6</sup>	504 (Manufacturer AEL)
Formacel® B	A series of blends with different percentage contents of the same compounds. Composition is claimed as CBI.	SNAP Notice 23, January 2, 2009 (74 FR 21)	0	140 to 1500	exempt	some components and some blends are flammable	1000 (Manufacturer AEL)
Formacel® TI	A series of blends with different percentage contents of the same compounds.	SNAP Notice 24, September 30, 2009 (74 FR 50129)	0	1330 to 1500	exempt	no	1000 (Manufacturer AEL)

<sup>4</sup> EPA is unaware of any specific 100-yr GWP value in the peer reviewed literature for this substitute. However, its GWP is expected to be low, based on similarity to other compounds with GWPs that have been published in the peer-reviewed literature (see IPCC 4<sup>th</sup> Assessment Report, Table 2.15).

<sup>5</sup> EPA is unaware of any specific 100-yr GWP value in the peer reviewed literature for this substitute. However, its GWP is expected to be low, based on similarity to other compounds with GWPs that have been published in the peer-reviewed literature (see IPCC 4<sup>th</sup> Assessment Report, Table 2.15).

<sup>6</sup> Exsol blowing agents are flammable. EPA expects that Exxon will work with its customers to ensure that they are aware of potential risks associated with Exxsol and that systems manufacturers provide adequate training on safe storage, handling and application to customers, contractors, and applicators.

Name of Substitute	Further Identification Information for Substitute	Previous SNAP Federal Register Listings	ODP	GWP	VOC status	Flammable	Exposure Limits <sup>1</sup> (ppm)
	Composition is claimed as CBI.						
Formic acid	methanoic acid, CAS ID #64-18-6 First listed as Proprietary Blowing Agent 1, or PBA 1.	SNAP Notice 5, September 5, 1996 (61 FR 47012)	0	5 or less <sup>7</sup>	VOC	yes <sup>8</sup>	5 <sup>9</sup> (PEL)
HFC-134a	1,1,1,2-tetrafluoroethane, CAS ID # 811-97-2	March 18, 1994 SNAP rule (58 FR 13044); SNAP Notice 10, June 8, 1999 (64 FR 30410)	0	1470	exempt	no	1000 (WEEL)
HFC-152a	1,2-difluoroethane, CAS ID #75-37-6	March 18, 1994 SNAP rule (58 FR 13044); SNAP Notice 10, June 8, 1999 (64 FR 30410)	0	124	exempt	yes	1000 (WEEL)
HFC-245fa	1,1,1,3,3-pentafluoroethane, CAS ID# 460-73-1	SNAP Notice 18, August 21, 2003 (68 FR 50533)	0	1030	exempt	no	300 (WEEL)
HFC-365mfc	1,1,1,3,3-pentafluorobutane, CAS ID# 405-58-6	SNAP Notice 24, September 30, 2009 (74 FR 50129)	0	794	exempt	yes	1000 (Manufacturer AEL)
HFO-1234ze	trans-1,3,3,3-tetrafluoroprop-1-ene, CAS ID# 29118-24-9	SNAP Notice 24, September 30, 2009 (74 FR 50129)	0	6	VOC	no	1000 <sup>10</sup> (EPA recommended AEL)

<sup>7</sup> EPA is unaware of any specific 100-yr GWP value in the peer reviewed literature for this compound. However, its GWP is expected to be low, based on similarity to other compounds with GWPs that have been published in the peer-reviewed literature (see IPCC 4<sup>th</sup> Assessment Report, Table 2.15).

<sup>8</sup> Formic acid is mildly flammable with flashpoint of 68.9 °C (156 °F), lower flammability limit of 18.0% by volume, and NFPA flammability rating of 2. .

<sup>9</sup> Formic acid is corrosive and highly irritating to skin and eyes. EPA considers it a hazardous waste and has assigned the waste number U123.

Name of Substitute	Further Identification Information for Substitute	Previous SNAP Federal Register Listings	ODP	GWP	VOC status	Flam-mable	Exposure Limits <sup>1</sup> (ppm)
Methyl formate	formic acid, methyl ester; methyl methanoate; CAS ID# 107-31-3	SNAP Notice 14, December 18, 2000 (65 FR 78977)	0	5 or less <sup>11</sup>	exempt	yes	100 (PEL)
Saturated light hydrocarbons C3-C6	examples: propane, butane, isobutane, pentane, cyclopentane, hexane, cyclohexane	March 18, 1994 SNAP rule (58 FR 13044)	0	3 to 10 <sup>12</sup>	VOC	yes	Depends on chemical; Range of 300 to 1000 (PEL, REL, or TLV)
Transcend <sup>TM</sup> Technologies, as an additive to SNAP-approved blowing agents in blends making up to 5% by weight of the total foam formulation	Composition is claimed as CBI.	SNAP Notice 20, March 29, 2006 (71 FR 15589)	0	5 or less	VOC	yes <sup>13</sup>	Main component: 200 (PEL)
Vacuum panels		March 18, 1994 SNAP rule (58 FR 13044)	0	N/A	N/A	N/A	N/A
Water	H <sub>2</sub> O; CAS ID # 7732-18-5	SNAP Notice 10, June 8, 1999 (64 FR 30410)	0	N/A	exempt	no	N/A

<sup>10</sup> The derivation of EPA's recommended AEL is available at [www.regulations.gov](http://www.regulations.gov) as item EPA-HQ-OAR-2003-0118-0250.

<sup>11</sup> EPA is unaware of any specific 100-yr GWP value in the peer reviewed literature for this compound. However, its GWP is expected to be low, based on similarity to other compounds with GWPs that have been published in the peer-reviewed literature (see IPCC 4<sup>th</sup> Assessment Report, Table 2.15).

<sup>12</sup> Only some of these compounds have 100-yr GWP value in the peer reviewed literature for this substitute (e.g., 3.3 for propane and 4.0 for butane). However, the GWPs of all these hydrocarbons are expected to be low, based on similarity to other compounds with GWPs that have been published in the peer-reviewed literature (see IPCC 4<sup>th</sup> Assessment Report, Table 2.15).

<sup>13</sup> When blended with fire retardant and/or other SNAP-approved alternatives, the flammability of Transcend<sup>TM</sup> Technologies can be reduced to make a formulation that is either combustible or non-flammable (contact the manufacturer of Transcend<sup>TM</sup> Technologies for more information).