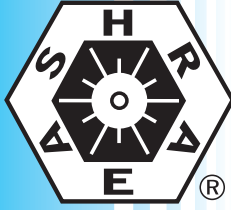


**ANSI/ASHRAE Addendum g to  
ANSI/ASHRAE Standard 34-2004**



# **ASHRAE STANDARD**

## **Designation and Safety Classification of Refrigerants**

Approved by the ASHRAE Standards Committee on June 24, 2006; by the ASHRAE Board of Directors on June 29, 2006; and by the American National Standards Institute on July 27, 2006.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site, <http://www.ashrae.org>, or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: [orders@ashrae.org](mailto:orders@ashrae.org). Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada).

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**American Society of Heating, Refrigerating  
and Air-Conditioning Engineers, Inc.**

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## FOREWORD

This addendum adds a column to Tables 1 and 2 titled “Highly Toxic or Toxic,” with each refrigerant designated as highly toxic, toxic (as defined by the International Fire Code, Uniform Fire Code, and OSHA), or neither (for refrigerants less toxic than as defined above), adds definitions for these terms, and updates the references.

### Addendum g to ANSI/ASHRAE Standard 34-2004

**TABLE 1 Refrigerant Data and Safety Classifications**

Refrigerant Number	Chemical Name <sup>a, b</sup>	Chemical Formula <sup>a</sup>	Molecular Mass <sup>a</sup>	Normal Boiling Point <sup>a</sup>		Safety Group	Highly Toxic or Toxic <sup>c</sup> Under Code Classification
				(°C)	(°F)		
<i>Methane Series</i>							
11	trichlorofluoromethane	CCl <sub>3</sub> F	137.4	24	75	A1	<u>Neither</u>
12	dichlorodifluoromethane	CCl <sub>2</sub> F <sub>2</sub>	120.9	-30	-22	A1	<u>Neither</u>
12B1	bromochlorodifluoromethane	CBrClF <sub>2</sub>	165.4	-4	25		<u>Neither</u>
13	chlorotrifluoromethane	CClF <sub>3</sub>	104.5	-81	-115	A1	<u>Neither</u>
13B1	bromotrifluoromethane	CBrF <sub>3</sub>	148.9	-58	-72	A1	<u>Neither</u>
14	tetrafluoromethane (carbon tetrafluoride)CF <sub>4</sub>		88.0	-128	-198	A1	<u>Neither</u>
21	dichlorofluoromethane	CHCl <sub>2</sub> F	102.9	9	48	B1	<u>Toxic</u>
22	chlorodifluoromethane	CHClF <sub>2</sub>	86.5	-41	-41	A1	<u>Neither</u>
23	trifluoromethane	CHF <sub>3</sub>	70.0	-82	-116	A1	<u>Neither</u>
30	dichloromethane (methylene chloride)	CH <sub>2</sub> Cl <sub>2</sub>	84.9	40	104	B2	<u>Neither</u>
31	chlorofluoromethane	CH <sub>2</sub> ClF	68.5	-9	16		<u>Neither</u>
32	difluoromethane (methylene fluoride)	CH <sub>2</sub> F <sub>2</sub>	52.0	-52	-62	A2	<u>Neither</u>
40	chloromethane (methyl chloride)	CH <sub>3</sub> Cl	50.5	-24	-12	B2	<u>Toxic</u>
41	fluoromethane (methyl fluoride)	CH <sub>3</sub> F	34.0	-78	-108		<u>Neither</u>
50	methane	CH <sub>4</sub>	16.0	-161	-259	A3	<u>Neither</u>
<i>Ethane Series</i>							
113	1,1,2-trichloro-1,2,2-trifluoroethane	CCl <sub>2</sub> FCClF <sub>2</sub>	187.4	48	118	A1	<u>Neither</u>
114	1,2-dichloro-1,1,2,2-tetrafluoroethane	CClF <sub>2</sub> CClF <sub>2</sub>	170.9	4	38	A1	<u>Neither</u>
115	chloropentafluoroethane	CClF <sub>2</sub> CF <sub>3</sub>	154.5	-39	-38	A1	<u>Neither</u>
116	hexafluoroethane	CF <sub>3</sub> CF <sub>3</sub>	138.0	-78	-109	A1	<u>Neither</u>
123	2,2-dichloro-1,1,1-trifluoroethane	CHCl <sub>2</sub> CF <sub>3</sub>	153.0	27	81	B1	<u>Neither</u>
124	2-chloro-1,1,1,2-tetrafluoroethane	CHClFCF <sub>3</sub>	136.5	-12	10	A1	<u>Neither</u>
125	pentafluoroethane	CHF <sub>2</sub> CF <sub>3</sub>	120.0	-49	-56	A1	<u>Neither</u>
134a	1,1,1,2-tetrafluoroethane	CH <sub>2</sub> FCF <sub>3</sub>	102.0	-26	-15	A1	<u>Neither</u>
141b	1,1-dichloro-1-fluoroethane	CH <sub>3</sub> CCl <sub>2</sub> F	117.0	32	90		<u>Neither</u>
142b	1-chloro-1,1-difluoroethane	CH <sub>3</sub> CClF <sub>2</sub>	100.5	-10	14	A2	<u>Neither</u>
143a	1,1,1-trifluoroethane	CH <sub>3</sub> CF <sub>3</sub>	84.0	-47	-53	A2	<u>Neither</u>
152a	1,1-difluoroethane	CH <sub>3</sub> CHF <sub>2</sub>	66.0	-25	-13	A2	<u>Neither</u>
170	ethane	CH <sub>3</sub> CH <sub>3</sub>	30.0	-89	-128	A3	<u>Neither</u>

**TABLE 1 Refrigerant Data and Safety Classifications (Continued)**

Refrigerant Number	Chemical Name <sup>a, b</sup>	Chemical Formula <sup>a</sup>	Molecular Mass <sup>a</sup>	Normal Boiling Point <sup>a</sup>		Safety Group	Highly Toxic or Toxic <sup>c</sup> Under Code Classification
				(°C)	(°F)		
<i>Ethers</i>							
E170	dimethyl ether	CH <sub>3</sub> OCH <sub>3</sub>	46	-25	-13	A3	<u>Neither</u>
<i>Propane Series</i>							
218	octafluoropropane	CF <sub>3</sub> CF <sub>2</sub> CF <sub>3</sub>	188.0	-37	-35	A1	<u>Neither</u>
236fa	1,1,1,3,3,3-hexafluoropropane	CF <sub>3</sub> CH <sub>2</sub> CF <sub>3</sub>	152.0	-1	29	A1	<u>Neither</u>
245fa	1,1,1,3,3-pentafluoropropane	CHF <sub>2</sub> CH <sub>2</sub> CF <sub>3</sub>	134.0	15	59	B1	<u>Neither</u>
290	propane	CH <sub>3</sub> CH <sub>2</sub> CH <sub>3</sub>	44.0	-42	-44	A3	<u>Neither</u>
<i>Cyclic Organic Compounds</i>							
C318	octafluorocyclobutane	-(CF <sub>2</sub> ) <sub>4</sub> -	200.0	-6	21	A1	<u>Neither</u>
<b>See Table 2 for Blends</b>							
<i>Miscellaneous Organic Compounds</i>							
<i>hydrocarbons</i>							
600	butane	CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>3</sub>	58.1	0	31	A3	<u>Neither</u>
600a	isobutane	CH(CH <sub>3</sub> ) <sub>2</sub> CH <sub>3</sub>	58.1	-12	11	A3	<u>Neither</u>
<i>oxygen compounds</i>							
610	ethyl ether	CH <sub>3</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>3</sub>	74.1	35	94		<u>Neither</u>
611	methyl formate	HCOOCH <sub>3</sub>	60.0	32	89	B2	<u>Neither</u>
<i>sulfur compounds</i>							
620	(Reserved for future assignment)						
<i>Nitrogen Compounds</i>							
630	methyl amine	CH <sub>3</sub> NH <sub>2</sub>	31.1	-7	20		<u>Toxic</u>
631	ethyl amine	CH <sub>3</sub> CH <sub>2</sub> (NH <sub>2</sub> )	45.1	17	62		<u>Neither</u>
<i>Inorganic Compounds</i>							
702	hydrogen	H <sub>2</sub>	2.0	-253	-423	A3	<u>Neither</u>
704	helium	He	4.0	-269	-452	A1	<u>Neither</u>
717	ammonia	NH <sub>3</sub>	17.0	-33	-28	B2	<u>Neither</u>
718	water	H <sub>2</sub> O	18.0	100	212	A1	<u>Neither</u>
720	neon	Ne	20.2	-246	-411	A1	<u>Neither</u>
728	nitrogen	N <sub>2</sub>	28.1	-196	-320	A1	<u>Neither</u>
732	oxygen	O <sub>2</sub>	32.0	-183	-297		<u>Neither</u>
740	argon	Ar	39.9	-186	-303	A1	<u>Neither</u>
744	carbon dioxide	CO <sub>2</sub>	44.0	-78	-109	A1	<u>Neither</u>
744A	nitrous oxide	N <sub>2</sub> O	44.0	-90	-129		<u>Neither</u>
764	sulfur dioxide	SO <sub>2</sub>	64.1	-10	14	B1	<u>Neither</u>
<i>Unsaturated Organic Compounds</i>							
1150	ethene (ethylene)	CH <sub>2</sub> =CH <sub>2</sub>	28.1	-104	-155	A3	<u>Neither</u>
1270	propene (propylene)	CH <sub>3</sub> CH=CH <sub>2</sub>	42.1	-48	-54	A3	<u>Neither</u>

<sup>a</sup> The chemical name, chemical formula, molecular mass, and normal boiling point are not part of this standard.

<sup>b</sup> The preferred chemical name is followed by the popular name in parentheses.

<sup>c</sup> "Highly toxic," "toxic" or "neither" where "highly toxic" and "toxic" are as defined in the *International Fire Code*, *Uniform Fire Code*, and OSHA regulations, and "neither" identifies those refrigerants having lesser toxicity than either of those groups.

**TABLE 2 Data and Safety Classifications for Refrigerant Blends**

Refrigerant Number	Composition (Mass %)	Composition Tolerances	Azeotropic Temperature		Molecular Mass <sup>a</sup>	Normal Boiling Point <sup>a</sup>		Safety Group	Highly Toxic or Toxic <sup>e</sup> Under Code Classification
			(°C)	(°F)		(°C)	(°F)		
<i>Zeotropes</i>									
400	R-12/114 (must be specified)		none	none				A1	Neither
401A	R-22/152a/124 (53.0/13.0/34.0)	(±2/+0.5,-1.5/±1)						A1	Neither
401B	R-22/152a/124 (61.0/11.0/28.0)	(±2/+0.5,-1.5/±1)						A1	Neither
401C	R-22/152a/124 (33.0/15.0/52.0)	(±2/+0.5,-1.5/±1)						A1	Neither
402A	R-125/290/22 (60.0/2.0/38.0)	(±2.0/±0.1,-1.0/±2.0)						A1	Neither
402B	R-125/290/22 (38.0/2.0/60.0)	(±2.0/±0.1,-1.0/±2.0)						A1	Neither
403A	R-290/22/218 (5.0/75.0/20.0)	(+ 0.2,-2/±2/±2)						A1	Neither
403B	R-290/22/218 (5.0/56.0/39.0)	(+ 0.2,-2/±2/±2)						A1	Neither
404A	R-125/143a/134a (44.0/52.0/4.0)	(±2/±1/±2)						A1	Neither
405A	R-22/152a/142b/C318 (45.0/7.0/5.5/42.5)	(±2/±1/±1/±2)							Neither
406A	R-22/600a/142b (55.0/4.0/41.0)	(±2/±1/±1)						A2	Neither
407A	R-32/125/134a (20.0/40.0/40.0)	(±2/±2/±2)						A1	Neither
407B	R-32/125/134a (10.0/70.0/20.0)	(±2/±2/±2)						A1	Neither
407C	R-32/125/134a (23.0/25.0/52.0)	(±2/±2/±2)						A1	Neither
407D	R-32/125/134a (15.0/15.0/70.0)	(±2/±2/±2)						A1	Neither
407E	R-32/125/134a (25.0/15.0/60.0)	(±2, ±2, ±2)						A1	Neither
408A	R-125/143a/22 (7.0/46.0/47.0)	(±2/±1/±2)						A1	Neither
409A	R-22/124/142b (60.0/25.0/15.0)	(±2/±2/±1)						A1	Neither
409B	R-22/124/142b (65.0/25.0/10.0)	(±2/±2/±1)						A1	Neither
410A	R-32/125 (50.0/50.0)	(+0.5,-1.5/+1.5,-0.5)						A1	Neither
410B	R-32/125 (45.0/55.0)	(±1/±1)						A1	Neither
411A	R-1270/22/152a (1.5/87.5/11.0)	(+0,-1/+2,-0/+0,-1)						A2	Neither
411B	R-1270/22/152a (3.0/94.0/3.0)	(+0,-1/+2,-0/+0,-1)						A2	Neither
412A	R-22/218/142b (70.0/5.0/25.0)	(±2/±2/±1)						A2	Neither
413A	R-218/134a/600a (9.0/88.0/3.0)	(±1/±2/+0,-1)						A2	Neither
414A	R-22/124/600a/142b (51.0/28.5/4.0/16.5)	(±2.0/±2.0/±0.5/+0.5,-1.0)						A1	Neither
414B	R-22/124/600a/142b (50.0/39.0/1.5/9.5)	(±2.0/±2.0/±0.5/+0.5,-1.0)						A1	Neither
415A	R-22/152a (82.0/18.0)	(±1.0/±1.0)						A2	Neither
415B	R-22/152a (25.0/75.0)	(±1.0/±1.0)						A2	Neither
416A	R-134a/124/600 (59.0/39.5/1.5)	(+0.5,-1.0/+1.0,-0.5/+0.1,-0.2)						A1	Neither
417A	R-125/134a/600 (46.6/50.0/3.4)	(±1.1/±1.0/+0.1,-0.4)						A1	Neither
418A	R-290/22/152a (1.5/96.0/2.5)	(±0.5/±1.0/±0.5)						A2	Neither
419A	R-125/134a/E170 (77.0/19.0/4.0)	(±1.0/±1.0/±1.0)						A2	Neither
420A	R-134a/142b (88.0/12.0)	(±1.0,-0.0/+0.0,-1.0)						A1	Neither
421A	R-125/134a	(±1.0/±1.0)						A1	Neither

**TABLE 2 Data and Safety Classifications for Refrigerant Blends (Continued)**

Refrigerant Number	Composition (Mass %)	Composition Tolerances	Azeotropic Temperature		Molecular Mass <sup>a</sup>	Normal Boiling Point <sup>a</sup>		Safety Group	Highly Toxic or Toxic <sup>e</sup> Under Code Classification
			(°C)	(°F)		(°C)	(°F)		
<i>Azeotropes<sup>b</sup></i>									
500	R-12/152a (73.8/26.2)		0	32	99.3	-33	-27	A1	Neither
501	R-22/12 (75.0/25.0) <sup>c</sup>		-41	-42	93.1	-41	-42	A1	Neither
502	R-22/115 (48.8/51.2)		19	66	112.0	-45	-49	A1	Neither
503	R-23/13 (40.1/59.9)		88	126	87.5	-88	-126		Neither
504	R-32/115 (48.2/51.8)		17	63	79.2	-57	-71		Neither
505	R-12/31 (78.0/22.0) <sup>c</sup>		115	239	103.5	-30	-22		Neither
506	R-31/114 (55.1/44.9)		18	64	93.7	-12	10		Neither
507A <sup>d</sup>	R-125/143a (50.0/50.0)		-40	-40	98.9	-46.7	-52.1	A1	Neither
508A <sup>d</sup>	R-23/116 (39.0/61.0)		-86	-122	100.1	-86	-122	A1	Neither
508B	R-23/116 (46.0/54.0)		-45.6	-50.1	95.4	-88.3	-126.9	A1	Neither
509A <sup>d</sup>	R-22/218 (44.0/56.0)		0	32	124.0	-47	-53	A1	Neither

<sup>a</sup> The molecular mass and normal boiling point are not part of this standard.

<sup>b</sup> Azeotropic refrigerants exhibit some segregation of components at conditions of temperature and pressure other than those at which they were formulated. The extent of segregation depends on the particular azeotrope and hardware system configuration.

<sup>c</sup> The exact composition of this azeotrope is in question, and additional experimental studies are needed.

<sup>d</sup> R-507, R-508, and R-509 are allowed alternative designations for R-507A, R-508A, and R-509A due to a change in designations after assignment of R500 through R-509. Corresponding changes were not made for R-500 through R-506.

<sup>e</sup> "Highly toxic," "toxic" or "neither," where "highly toxic" and "toxic" are as defined in the *International Fire Code*, *Uniform Fire Code*, and OSHA regulations and "neither" identifies those refrigerants having lesser toxicity than either of those groups.

*All other columns in Tables 1 and 2 remain unchanged.*

**Add to the definitions referenced to the IFC, UFC, and CFR:**

**highly toxic:** A material that produces a lethal dose or lethal concentration that falls within any of the following categories:

1. A chemical that has a median lethal dose (LD<sub>50</sub>) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
2. A chemical that has a median lethal dose (LD<sub>50</sub>) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.
3. A chemical that has a median lethal concentration (LC<sub>50</sub>) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

**toxic:** A chemical falling within any of the following categories:

1. A chemical that has a median lethal dose (LD<sub>50</sub>) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when

administered orally to albino rats weighing between 200 and 300 grams each.

2. A chemical that has a median lethal dose (LD<sub>50</sub>) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.
3. A chemical that has a median lethal concentration (LC<sub>50</sub>) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than 2 milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

**Add to the references (with reference numbers in editorial sequence):**

International Fire Code (IFC), International Code Council, Fairfax, VA, section 3702, 2003.

Uniform Fire Code (UFC), Western Fire Chiefs Association, Walnut Creek, CA, sections 209 and 221, 2000.

Health Hazard Definitions (Mandatory), Occupational Safety And Health Administration (OSHA), US Department of Labor, 29 Code of Federal Regulations (CFR) 1910.1200 Subpart Z Appendix A, US Government Printing Office, Washington, DC, 2004.

**POLICY STATEMENT DEFINING ASHRAE'S CONCERN  
FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES**

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the standards and guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive technical committee structure, continue to generate up-to-date standards and guidelines where appropriate and adopt, recommend, and promote those new and revised standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating standards and guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.