

ANSI/ASHRAE Addenda z, ah, ai, and aj to
ANSI/ASHRAE Standard 34-2007



ASHRAE STANDARD

Designation and Safety Classification of Refrigerants

Approved by the ASHRAE Standards Committee on January 23, 2010; by the ASHRAE Board of Directors on January 27, 2010; and by the American National Standards Institute on January 28, 2010.

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ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review.

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- c. offering constructive criticism for improving the Standard, or
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FOREWORD

This addendum extends the rules for numbering refrigerants to include ethene and propene based refrigerants. The rules being added are consistent with industry and academic nomenclature conventions.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~striking through~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum z to 34-2007

Add the following definitions to Section 3. DEFINITIONS OF TERMS:

olefin: an organic (carbon containing) compound characterized by the presence of one or more double bonds between carbon atoms in the molecule. Such a compound can also be described as being unsaturated.

unsaturated: as used in this standard, an organic (carbon-containing) compound in which one or more carbon atom is (are) joined to other carbon atoms by a carbon-carbon double bond. Such a compound can also be described as an olefin.

Revise clauses 4.1 and 4.1.7 as follows:

4.1 The identifying numbers assigned to the hydrocarbons and halocarbons of the methane, ethane, ethene, propane, propene, and cyclobutane series are such that the chemical composition of the compounds can be explicitly determined from the refrigerant numbers, and vice versa, without ambiguity. The molecular structure can be similarly determined for the methane, ethane, ethene, and most of the propane and propene series from only the identification number.

4.1.7 The carbon atoms shall be numbered sequentially, in order of appearance, with the number 1 assigned to the end carbon with the ~~most greatest~~ number of hydrogen substituents (i.e., number of halogenated atoms substituted for hydrogen on the alkane end carbon atoms). In the case where both end carbons of a saturated compound contain the same number of (but different) halogen atoms the number 1 shall be assigned to the ~~first~~ end carbon, defined as having the largest number of bromine, then chlorine, then fluorine, and then iodine atoms. If the compound is an olefin, then the end carbon nearest to the double bond will be assigned the number "1", as the presence of a double bond in the backbone of the molecule has priority over substituent groups on the molecule.

Add new clause 4.1.10 and renumber existing clause 4.1.10 to 4.1.11:

4.1.10 In the case of isomers of propene series, each has the same number, with the isomers distinguished by two appended lowercase letters. The first appended letter indicates the substitution on the central carbon atom (C2):

<u>—Cl</u>	<u>x</u>
<u>—F</u>	<u>y</u>
<u>—H</u>	<u>z</u>

The second letter designates the substitution on the terminal methylene carbon as defined for the methylene carbon of the propane, consistent with the methodology described in Section 4.1.9:

<u>=CCl₂</u>	<u>a</u>
<u>=CCIF</u>	<u>b</u>
<u>=CF₂</u>	<u>c</u>
<u>=CHCl</u>	<u>d</u>
<u>=CHF</u>	<u>e</u>
<u>=CH₂</u>	<u>f</u>

In the case where stereoisomers can exist, the opposed (Entgegen) isomer will be identified by the suffix (E) and the same side (Zusammen) isomer will be identified by the suffix (Z). An example of this system is given in Appendix A3.

Revise clause 5.2.2 as follows:

5.2.2 Composition-Designating Prefixes. The identifying number, as determined by Section 4, shall be prefixed by the letter C, for carbon, and preceded by B, C, or F—or a combination thereof in this sequence—to signify the presence of bromine, chlorine, or fluorine, respectively. Compounds that also contain hydrogen shall be further preceded by the letter H to signify the increased deterioration potential before reaching the stratosphere.³ The compositional designating prefixes for ether shall substitute an "E" for "C," such that "HFE," "HCFE," and "CFE" refer to hydrofluoroethers, hydrochloro-fluoroethers, and chloro-fluoroethers, respectively. The composition designating prefixes for halogenated olefins shall be either "CFC", "HCFC", or "HFC" to refer to chlorofluorocarbon, hydrochlorofluorocarbon, or hydrofluorocarbon, respectively, or with substitution of an "O" for the carbon "C" as "CFO", "HCFO", or "HFO" to refer to chlorofluoro-olefin, hydrochlorofluoro-olefin, or hydrofluoro-olefin, respectively. Halogenated olefins are a subset of halogenated organic [or carbon-containing] compounds having significantly shorter atmospheric lifetimes than their saturated counterparts. Examples include: CFC-11, CFC-12, BCFC-12B1, BFC-13B1, HCFC-22, HC-50, CFC-113, CFC-114, CFC-115, HCFC-123, HCFC-124, HFC-125, HFC-134a, HCFC-141b, HCFC-142b, HFC-143a, HFC-152a, HC-170, ~~and~~ FC-C318, and HFC-1234yf or HFO-1234yf.

Add Table A3 to Informative Appendix A as follows:

INFORMATIVE APPENDIX A ISOMER DESIGNATION EXAMPLES

Table A3 illustrates the designation of isomers for the Propene series with seven isomers for Tetrafluoropropene. Example of Stereoisomers:

TABLE A3 Propene Series Isomers

Isomer	Chemical Formula	Stereoisomer	
		IUPAC	ACS
R-1234yc	$\text{CH}_2\text{F}-\text{CF}=\text{CF}_2$		
R-1234zc	$\text{CHF}_2-\text{CH}=\text{CF}_2$		
R-1234ye(E)	$\text{CHF}_2-\text{CF}=\text{CHF}$	<u>Entgegen</u>	<u>Trans</u>
R-1234ye(Z)	$\text{CHF}_2-\text{CF}=\text{CHF}$	<u>Zusammen</u>	<u>Cis</u>
R-1234ze(E)	$\text{CF}_3-\text{CH}=\text{CHF}$	<u>Entgegen</u>	<u>Trans</u>
R-1234ze(Z)	$\text{CF}_3-\text{CH}=\text{CHF}$	<u>Zusammen</u>	<u>Cis</u>
R-1234yf	$\text{CF}_3-\text{CF}=\text{CH}_2$		

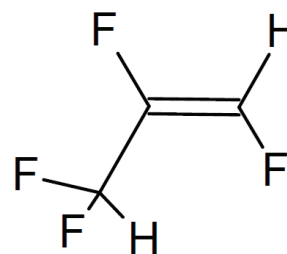
The configuration of atoms around the double bond is specified by using “E” or “Z” organic nomenclature rules. The letters “E” or “Z” are appended at the end of the refrigerant number to show the precedence of the atoms or groups which are attached to the carbon atoms at either end of the double bond. “E” for *Entgegen* is similar to trans, where priority atoms or groups are across the double bond from each other. “Z” for *Zusammen* is similar to cis, signifying that priority atoms or groups are on the same side of a double bond. Priority order of atoms connected to either of the unsaturated carbons is determined by standard CIP (Cahn-Ingold-Prelog) rules of organic nomenclature. In essence, attached atoms of higher atomic number have higher priority. Hence, in order of priority, $\text{I} > \text{Br} > \text{Cl} > \text{F} > \text{O} > \text{C} > \text{H}$. In case of a priority tie, the next attached atoms or substituents on the next attached carbon atom are considered, until a priority is determined. In the case of refrigerants, it is more exact and less cumbersome to use atomic mass rather than atomic numbers of the atoms. This is because the sum of the atomic numbers of substituents on CHF_2 and CHCl are the same, while the summed atomic masses do differentiate. These nomenclature rules can be reviewed in many organic chemistry textbooks, or at the IUPAC web site, or at the Wikipedia web site (see reference below).

References:

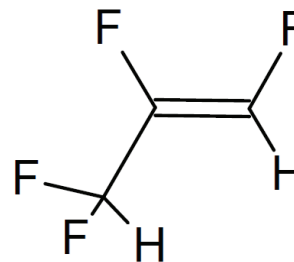
A Guide to IUPAC Nomenclature of Organic Compounds (recommendations 1993) - A guide to the Blue Book-Panico, R.; Powell, W.H. and Richer, J-C. Blackwell Science, 1993 [ISBN 0-63203-4882]

Also the software that IUPAC recommends for naming is described at this link:

<http://old.iupac.org/nomenclature/>



1(E)-1,2,3,3-tetrafluoro-1-propene, or HFO-1234ye(E)



1(Z)-1,2,3,3-tetrafluoro-1-propene or HFO-1234ye(Z)

see also:

http://en.wikipedia.org/wiki/Sequence_rule (December 2007)

http://en.wikipedia.org/wiki/Cahn-Ingold-Prelog_priority_rule (December 2007)

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FOREWORD

This addendum modifies sections 5.2 and 5.2.4 to clarify the intent of SSPC 34 that composition designating prefixes may be appropriate for non-technical public and regulatory communications addressing compounds having environmental impact, not limited to ozone depletion.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strike through~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum ah to 34-2007

5.2 Identification. Refrigerants shall be identified in accordance with Section 5.2.1, 5.2.2, or 5.2.3. Section 5.2.1 shall be

used in technical publications (for international uniformity and to preserve archival consistency), on equipment nameplates, and in specifications. Section 5.2.2 can be used for single-component halocarbon refrigerants, where distinction between the presence or absence of chlorine or bromine is pertinent. Composition designation may be appropriate for nontechnical, public, and regulatory communications addressing compounds having environmental impact~~ozone-depleting compounds, such as ozone depletion or global warming potential~~. Section 5.2.3 can be used, under the same circumstances as Section 5.2.2, for blends (both azeotropic and zeotropic). Section 5.2.1 shall be used for miscellaneous organic and inorganic compounds.

5.2.4 Composition-designating prefixes should be used only in nontechnical publications in which the potential for environmental impact~~ozone depletion~~ is pertinent. The prefixes specified in Section 5.2.1, augmented if necessary as indicated in Section 5.4, are preferred in other communications. Section 5.2.1 also may be preferable for blends when the number of components makes composition-designating prefixes awkward, such as for those containing more than three individual components (e.g., in tetrary and pentary blends).

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FOREWORD

This addendum modifies sections 9.1.2 to allow for an application fee and indicates that the applicant is required to pay for the cost of distributing copies of the application to members of the project committee. The initial application fee is expected to be \$1,000. The cost to distribute copies of the application will vary depending on the size of the

application and the number of PC members requesting hard copies versus CDs.

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~striketrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum ai to 34-2007

~~9.1.2 Fee. There is no application fee.~~ **Fee.** There is an application fee. In addition the applicant is required to pay for the cost of distributing copies of the application to members of the project committee. Please contact the ASHRAE Manager of Standards for more information.

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FOREWORD

This addendum changes the required testing temperatures for flammability. All tests previously required at 100 °C are replaced by testing at 60 °C.

ISO 817, the international standard designed to function the same as ASHRAE Standard 34, is expected to be published and in effect about 2011. Most manufacturing firms prefer a single world-wide standard. It is best that ISO 817 and Standard 34 be harmonized as closely as possible.

One of the disagreements between ISO 817 and Standard 34 is differences in the flammability test temperature. European countries usually test substances for flammability at ambient temperature and prefer to minimize the number of additional test temperatures for consideration. As a compromise, ISO 817 accepted the 60°C flammability test temperature for fractionated blends, applying this test temperature to studies of both the WCF and WCFE, and single component refrigerants. The 100°C flammability test temperature requirement for non-fractionated blends and single component refrigerants was eliminated resulting in much simplified requirements.

To harmonize ISO 817 and Standard 34, it is proposed to use 60°C as the test temperature in place of 100°C. The SSPC 34 committee carefully examined the potential safety impacts of this change and concluded that they would be minimal. Furthermore, in cases of marginally flammable refrigerant blends (cases that might be expected to be most impacted by a change in test conditions), it was found that the testing of the WCFE (which is currently conducted at 60 °C) was the determining test for the flammability classification rather than the test of the WCF at 100 °C. A review of the refrigerants currently classified by Standard 34 revealed that just a single refrigerant—R30—would change its classification by this change, and R30 (methylene chloride) is currently not used as a refrigerant.

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Addendum aj to 34-2007

3. DEFINITIONS OF TERMS

elevated temperature flame limit (ETFL): the minimum concentration of refrigerant that is capable of propagating a flame through a homogeneous mixture of the refrigerant and air using test equipment and procedures specified in Section B1.1 (in Normative Appendix B) at 101.3 kPa (14.7 psia) ~~and either 60.0°C (140°F) or 100°C (212°F) above 23°C.~~ It is

normally expressed as a refrigerant percentage by volume. When tested at 60.0°C, it is called the ETFL60. ~~When tested at 100°C, it is called the ETFL100.~~

6.1.3.1 Class 1

- A single-compound refrigerant shall be classified as Class 1 if the refrigerant does not show flame propagation when tested in air at ~~100°C (212°F)~~ 60 °C (140 °F) and 101.3 kPa (14.7 psia).
- The WCF of a refrigerant blend shall be classified as Class 1 if the WCF of the blend does not show flame propagation when tested in air at ~~100°C (212°F)~~ 60 °C (140 °F) and 101.3 kPa (14.7 psia).
- The WCFE of a refrigerant blend shall be classified as Class 1 if the WCFE of the blend, as determined from a fractionation analysis specified by Section B.2 in Normative Appendix B, does not show flame propagation when tested at 60.0°C (140°F) and 101.3 kPa (14.7 psia).

6.1.3.2 Class 2

- A single-compound refrigerant shall be classified as Class 2 if the refrigerant meets all three of the following conditions:
 - exhibits flame propagation when tested at ~~100°C (212°F)~~ 60 °C (140 °F) and 101.3 kPa (14.7 psia),
 - has an LFL > 0.10 kg/m³ (0.0062 lb/ft³) (see Section 6.1.3.4 if the refrigerant has no LFL at 23.0°C and 101.3 kPa), and
 - has a heat of combustion <19,000 kJ/kg (8,169 Btu/lb) (see Section 6.1.3.5).
- The WCF of a refrigerant blend shall be classified as Class 2 if it meets all three of the following conditions:
 - exhibits flame propagation when tested at ~~100°C (212°F)~~ 60 °C (140 °F) and 101.3 kPa (14.7 psia),
 - has an LFL > 0.10 kg/m³ (0.0062 lb/ft³) (see Section 6.1.3.4 if the WCF of the blend has no LFL at 23.0°C and 101.3 kPa), and
 - has a heat of combustion <19,000 kJ/kg (8,169 Btu/lb) (see Section 6.1.3.5).
- The WCFE of a refrigerant blend shall be classified as Class 2 if it meets all three of the following conditions:
 - exhibits flame propagation when tested at 60.0°C (140°F) and 101.3 kPa (14.7 psia),
 - has an LFL > 0.10 kg/m³ (0.0062 lb/ft³) (see Section 6.1.3.4 if the WCFE of the blend has no LFL at 23.0°C and 101.3 kPa), and
 - has a heat of combustion <19,000 kJ/kg (8,169 Btu/lb) (see Section 6.1.3.5).

6.1.3.3 Class 3

- A single-compound refrigerant shall be classified as Class 3 if the refrigerant meets both of the following conditions:

1. exhibits flame propagation when tested at ~~100°C (212°F)~~60 °C (140 °F) and 101.3 kPa (14.7 psia) and
 2. has an LFL ≤ 0.10 kg/m³ (0.0062 lb/ft³) (see Section 6.1.3.4 if the refrigerant has no LFL at 23.0°C and 101.3 kPa) or it has a heat of combustion that is $\geq 19,000$ kJ/kg (8,169 Btu/lb).
- b. The WCF of a refrigerant blend shall be classified as Class 3 if it meets both of the following conditions:
1. the WCF exhibits flame propagation when tested at ~~100°C (212°F)~~60 °C (140 °F) and 101.3 kPa (14.7 psia) and
 2. the WCF has an LFL ≤ 0.10 kg/m³ (0.0062 lb/ft³) (see Section 6.1.3.4 if the WCF of the blend has no LFL at 23.0°C and 101.3 kPa) or the WCF of the blend has a heat of combustion that is $\geq 19,000$ kJ/kg (8,169 Btu/lb).
- c. The WCFF of a refrigerant blend shall be classified as Class 3 if it meets both of the following conditions:
1. the WCFF exhibits flame propagation when tested at 60.0°C (140°F) and 101.3 kPa (14.7 psia) and
 2. the WCFF has an LFL ≤ 0.10 kg/m³ (0.0062 lb/ft³) (see Section 6.1.3.4 if the WCFF of the blend has no LFL at 23.0°C and 101.3 kPa) or the WCFF of the blend has a heat of combustion that is $\geq 19,000$ kJ/kg (8,169 Btu/lb).

6.1.3.4 For Class 2 or Class 3 refrigerants or refrigerant blends, the LFL shall be determined. For those Class 2 or Class 3 refrigerants or refrigerant blends that show no flame propagation when tested at 23.0°C (73.4°F) and 101.3 kPa (14.7 psia) (i.e., no LFL), an elevated temperature flame limit at 60°C (140°F) (ETFL₆₀) shall be used in lieu of the LFL for determining their flammability classifications, as follows.

- a. ~~For a single compound refrigerant, the ETFL100 shall be used in lieu of the LFL.~~
- b. ~~For the WCF of a refrigerant blend, the ETFL100 shall be used in lieu of the LFL.~~

- e. ~~For the WCFF of a refrigerant blend, the ETFL60 shall be used in lieu of the LFL.~~

TABLE 3 Flammability Classifications

Class Single-Component Refrigerant WCF of a Refrigerant Blend WCFF of a Refrigerant Blend

Replace the 6 occurrences of “100 °C (212 °F)” with “60 °C (140 °F)”

B1.1 Test Conditions

- a. For single-compound refrigerants, flammability tests shall be conducted at ~~100°C (212°F)~~60 °C (140 °F) and 101.3 kPa (14.7 psia). Testing shall be conducted up to and including the point at which flame propagation is demonstrated. If no flame propagation is apparent, testing shall be done until at least three consecutive concentration increments have been made beyond the stoichiometric composition and beyond the point that combustion around the spark has diminished.
- b. For refrigerant blends, flammability tests shall be conducted on the WCF at ~~100°C (212°F)~~60 °C (140 °F) and 101.3 kPa (14.7 psia) and also shall be conducted on the WCFF at 60.0°C (140°F) and 101.3 kPa (14.7 psia). The WCFF shall be determined by the method specified in Section B2. When application of the composition tolerances to the nominal formulation produces several possible WCFF formulations, the applicant shall conduct flammability testing on all possible WCFF formulations or provide sufficient justification for eliminating one or more of the possible WCFF formulations.

B1.3 When the ETFL~~100~~60 of the flammable component(s) is known, testing for ~~the ETFL100~~, the ETFL₆₀; or the LFL shall begin at 1%, by volume, lower than the lowest ETFL~~100~~60. When the ETFL~~100~~60 is not known, testing shall begin at 1% refrigerant by volume. If the test of the initial concentration results in a flame propagation, then subsequent testing concentrations shall be reduced in 1% volume increments until the appropriate flame limit is determined.

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.