ADDENDA

ANSI/ASHRAE Addenda ac, ad, ae, and af to
ANSI/ASHRAE Standard 34-2010

Designation and Safety Classification of Refrigerants

Approved by the ASHRAE Standards Committee on January 26, 2013; by the ASHRAE Board of Directors on January 29, 2013; and by the American National Standards Institute on January 30, 2013.

These addenda were approved 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 website (www.ashrae.org) or in paper form from the Manager of Standards.

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FOREWORD

This addendum adds new zeotropic refrigerant R-444A to Table 2 and Table D2.

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

Addendum ac to Standard 34-2010

Add the following underlined data to Table 2 and Table D2 in the columns indicated.

TABLE 2 Data and Safety Classifications for Refrigerant Blends

Refrigerant Number = 444A
Composition (Mass %) = R-32/152a/1234ze(E) (12.0/5.0/83.0)
Composition tolerances = (±1.0/±1.0/±2.0)
OEL = 850
Safety Group = A2L
RCL = 21,000 ppm v/v; 81 g/m^3; 5.1 lb/Mcf
Highly Toxic or Toxic Under Code Classification = Neither

TABLE D2 Data for Refrigerant Blends

Refrigerant Number = 444A
Composition (Mass %) =
R-32/152a/1234ze(E) (12.0/5.0/83.0)
Average Molecular Mass = 96.7
Bubble Point (°C) = –34.3
Bubble Point (°F) = –29.7
Dew Point (°C) = –24.3
Dew Point (°F) = –11.7

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FOREWORD

This addendum deletes the use of the potential formation of CF_4 in Section 6.1.3.5(a) for heat of combustion calculations, as this is not possible when working at stoichiometric concentrations in air. SO_3 is deleted from the sample calculation table in Appendix F. The units in Appendix F example calculations and table are changed from kcal/mol to kJ/mol or kJ/kg, to be consistent with the definition of heat of combustion in this standard.

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Addendum ad to Standard 34-2010

Modify Section 6.1.3.5(a) and Appendix F of this standard as follows

6.1.3.5 The heat of combustion shall be calculated for conditions of 25°C (77°F) and 101.3 kPa (14.7 psia).

If there is insufficient hydrogen (H) available for the formation of HF(g), HCl(g), and H_2O(g), then the formation of HF(g) takes preference over the formation of HCl(g), which takes preference over the formation of H_2O. If there is insufficient hydrogen available for all of the fluorine (F) to form HF(g), then the remaining fluorine produces COF_2 (g) ~~or CF_4 (g)~~ in preference of carbon (C) forming CO_2. Any remaining chloride (Cl) produces Cl_2 (g) (chlorine).

INFORMATIVE APPENDIX F— EXAMPLE CALCULATIONS FOR HEATS OF COMBUSTION

F1. REACTION STOICHIOMETRY FOR A REFRIGERANT BLEND

Consider the combustion of the mixture R-125/290 (45/55), which corresponds to a mole fraction ratio of (0.2311/0.7689). If the R-125 and R-290 were to burn individually, they would undergo the following reactions:

$$\text{R-125: } C_2HF_5 + O_2 \rightarrow \cancel{CO_2 + CF_4}\ \underline{2\ COF_2} + HF \tag{F.1}$$

and

$$\text{R-290: } C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_20 \tag{F.2}$$

Taking $x = 0.2311$ (the mole fraction of R-125) and $y = 0.7689$ (the mole fraction of R-290), the mixture might be thought to undergo the following combustion reaction:

$$xC_2HF_5 + yC_3H_8 + (x + 5y)O_2 \rightarrow (\cancel{x +} 3y)CO_2 + \cancel{xCF_4}\ \underline{2xCOF_2} + xHF + 4yH_2O \tag{F.3}$$

But Equation F.3 would be incorrect. Instead combine the atoms of the R-125 and R-290 into a hypothetical molecule:

$$xC_2HF_5 + yC_3H_8 \rightarrow C_{2x + 3y}H_{x + 8y}F_{5x} \tag{F.4}$$

This hypothetical molecule is then reacted with oxygen:

$$C_{2x + 3y}H_{x + 8y}F_{5x} + (x + 5y)O_2 \rightarrow (2x + 3y)CO_2 + 5xHF + [(x + 8y - 5x)/2]H_2O \tag{F.5}$$

In comparing Equations F3 and F5, note that the products of combustion are different. There is no ~~CF_4~~ $\underline{COF_2}$ formed in Equation F5; instead, the hydrogen (H) from the R-290 combines with the fluorine (F) from the R-125 to form additional HF.

F2. HEAT OF COMBUSTION FOR A REFRIGERANT BLEND

The enthalpy of formation of the hypothetical blend molecule is the mole-fraction weighted average of the components:

$$\Delta h_f(\text{blend}) = x\Delta h_f(\text{R125}) + y\Delta h_f(\text{R290}) = 0.2311\,(\cancel{-264.0\text{ kcal}}\ \underline{-1104.58\text{ kJ}}/\text{mol}) + 0.7689(\cancel{-25.02\text{ kcal}}\ \underline{-104.70\text{ kJ}}/\text{mol}) = \cancel{-80.25\text{ kcal}}\ \underline{-335.77\text{ kJ}}/\text{mol} \tag{F.6}$$

The heat of combustion is the enthalpy of formation of the reactants (refrigerant and oxygen) minus the enthalpy of formation of the products of reaction:

$$\begin{aligned}\Delta h_{combustion} &= \textstyle\sum \Delta h_f(\text{reactants}) - \sum \Delta h_f(\text{products}) = \\ &\{\Delta h_f[C_{2x + 3y} + H_{x + 8y}F_{5x}] + [x + 5y]\Delta h_f(O_2)\} - \\ &\{[2x + 3y]\Delta h_f(CO_2) + [5x]\Delta h_f(HF) + \cancel{[-4x + 3y]}\ \underline{[(x + 8y - 5x)/2)]}\Delta h_f(H_2O)\} \\ &\cancel{= \{-80.25 + [0.2311 + 5[0.7689][0]\}\{[2(0.2311) + 3(0.7689)][94.05] + [5(0.2311)][65.32] + [-2(0.2311) + 4(0.7689)][57.80]\}} \\ &\cancel{= 406.70\text{ kcal/mol}}\ \underline{=} \\ &\underline{-335.77 + [0.2311 + 5(0.7689)][0]} \\ &\underline{-\{[2(0.2311) + 3(0.7689)][-393.51] + [5(0.2311)][-273.30]} \\ &\underline{+ [0.5][0.2311 + 8(0.7689) - 5(0.2311)][-241.83]\}} \\ &\underline{= 1701.6\text{ kJ/mol}}\end{aligned} \tag{F.7}$$

Note that the enthalpy of formation of any element (e.g., O_2) in its normal state at 25°C (77°F) is zero, by definition. Sample enthalpies of formation are shown in Table F1. To convert this result to a mass basis (e.g. for use in 6.1.3), divide by the average molar mass of the blend:

$$\underline{\Delta h_{combustion} = 1701.6\text{ kJ/mol} =}$$
$$\underline{1701.6/\{(0.2311)(120.021) + (0.7689)(44.096)\} =} \tag{F.8}$$
$$\underline{27.604\text{ kJ/g} = 27604\text{ kJ/kg}}$$

TABLE F1 Sample Enthalpies of Formation

Refrigerant	Enthalpy of Formation, ~~kcal/mol~~ kJ/mol	
CO_2 (g)	~~–94.05~~	–393.51
H_2O (g)	~~–57.796~~	–241.83
HF (g)	~~–65.32~~	–273.30
HCl (*g*)	~~–22.06~~	–92.31
HI (g)	~~–6.33~~	26.50
HBr (g)	~~–8.69~~	–36.29
SO_2 (*g*)	~~–70.94~~	–296.81
~~SO_3~~ (g)	~~105.41~~	
CF_4 (g)	~~–223.0~~	–930.00
~~CF_2O~~ COF_2 (g)	~~–152.7~~	–638.90
$COCl_2$ (g)	~~–52.32~~	–220.08
R-290 (g)	~~–25.02~~	–104.70
R-125 (g)	~~–264.0~~	–1104.58

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FOREWORD

This addendum changes the flammability safety classification from Class 2 to Class 1 for R-30 in Table 1, as published data show that at 60°C R-30 is nonflammable at 1 atm. pressure.

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

Addendum ae to Standard 34-2010

Change the following safety classification for R-30 in Table 1.

TABLE 1 Refrigerant Data and Safety Classifications

Refrigerant Number	Chemical Name[a,b]	Chemical Formula[a]	Safety Group
30	dichloromethane (methylene chloride)	CH_2Cl_2	~~B2~~ B1

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FOREWORD

This addendum changes the RCL values for R-402A, R-415A, R-415B, R-418A, and R-419A in Table 2 of Standard 34-2010, due to prior errors in the flammability properties for these refrigerants.

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

Addendum af to Standard 34-2010

Change the RCL values for the following refrigerants in Table 2.

TABLE 2 Data and Safety Classifications for Refrigerant Blends

Refrigerant Number	Composition (Mass %)	Composition Tolerances	RCL[a] (ppm v/v)	RCL[a] (g/m^3)	RCL[a] (lb/Mcf)
402A	R-125/290/22 (60.0/2.0/38.0)	(±2.0/+0.1, –1.0/±2.0)	~~33,000~~ 66,000	~~140~~ 270	~~8.5~~ 17
415A	R-22/152a (82.0/18.0)	(±1.0/±1.0)	~~57,000~~ 14,000	~~190~~ 47	~~12~~ 2.9
415B	R-22/152a (25.0/75.0)	(±1.0/±1.0)	~~52,000~~ 12,000	~~120~~ 34	~~9.3~~ 2.1
418A	R-290/22/152a (1.5/96.0/2.5)	(±0.5/±1.0/±0.5)	~~59,000~~ 22,000	~~200~~ 77	~~13~~ 4.8
419A	R-125/134a/E170 (77.0/19.0/4.0)	(±1.0/±1.0/±1.0)	~~70,000~~ 15,000	~~310~~ 67	~~19~~ 4.2

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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.

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