



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.

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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 ~~striketrough~~ (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/m³; 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.

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 ad to Standard 34-2010

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

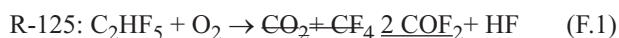
6.1.3.5 The heat of combustion shall be calculated for conditions of 25°C (77°F) and 101.3 kPa (14.7 psia).

If there is insufficient hydrogen (H) available for the formation of HF(g), HCl(g), and H₂O(g), then the formation of HF(g) takes preference over the formation of HCl(g), which takes preference over the formation of H₂O. If there is insufficient hydrogen available for all of the fluorine (F) to form HF(g), then the remaining fluorine produces COF₂ (g) or CF₄ (g) in preference of carbon (C) forming CO₂. Any remaining chloride (Cl) produces Cl₂ (g) (chlorine).

INFORMATIVE APPENDIX F— EXAMPLE CALCULATIONS FOR HEATS OF COMBUSTION

F1. REACTION STOICHIOMETRY FOR A REFRIGERANT BLEND

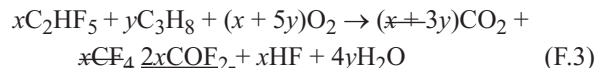
Consider the combustion of the mixture R-125/290 (45/55), which corresponds to a mole fraction ratio of (0.2311/0.7689). If the R-125 and R-290 were to burn individually, they would undergo the following reactions:



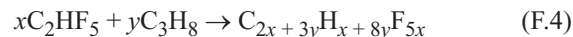
and



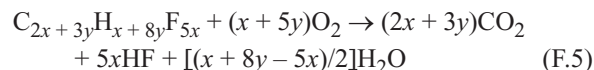
Taking $x=0.2311$ (the mole fraction of R-125) and $y=0.7689$ (the mole fraction of R-290), the mixture might be thought to undergo the following combustion reaction:



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



This hypothetical molecule is then reacted with oxygen:



In comparing Equations F3 and F5, note that the products of combustion are different. There is no CF₄COF₂ 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:

$$\Delta h_f(\text{blend}) = x\Delta h_f(R-125) + y\Delta h_f(R-290) = 0.2311(-264.0 \text{ kcal} - 1104.58 \text{ kJ/mol}) + 0.7689(-25.02 \text{ kcal} - 104.70 \text{ kJ/mol}) = -80.25 \text{ kcal} - 335.77 \text{ kJ/mol} \quad (F.6)$$

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:

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

Note that the enthalpy of formation of any element (e.g., O₂) 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:

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

TABLE F1 Sample Enthalpies of Formation

Refrigerant	Enthalpy of Formation,	
	keal/mol	<u>kJ/mol</u>
CO ₂ (g)	-94.05	<u>-393.51</u>
H ₂ O (g)	-57.796	<u>-241.83</u>
HF (g)	-65.32	<u>-273.30</u>
HCl (g)	-22.06	<u>-92.31</u>
HI (g)	-6.33	<u>26.50</u>
HBr (g)	-8.69	<u>-36.29</u>
SO ₂ (g)	-70.94	<u>-296.81</u>
SO ₃ (g)	105.41	
CF ₄ (g)	-223.0	<u>-930.00</u>
CF ₂ O <u>COF₂</u> (g)	-152.7	<u>-638.90</u>
COCl ₂ (g)	-52.32	<u>-220.08</u>
R-290 (g)	-25.02	<u>-104.70</u>
R-125 (g)	-264.0	<u>-1104.58</u>

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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 ~~striketrough~~ (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 ₂ Cl ₂	B2 <u>B1</u>

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Addendum af to Standard 34-2010

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

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.

TABLE 2 Data and Safety Classifications for Refrigerant Blends

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

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

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