ADDENDA

ANSI/ASHRAE Addendum g to
ANSI/ASHRAE Standard 34-2016

Designation and Safety Classification of Refrigerants

Approved by the ASHRAE Standards Committee on June 23, 2018; by the ASHRAE Technology Council on June 27, 2018; and by the American National Standards Institute on June 28, 2018.

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FOREWORD

Addendum g makes several changes with the intent to make 2L a separate classification of 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 g to Standard 34-2016

Modify Section 6 as follows. Delete current Figure 6.1.4 and replace it with the revised Figure 6.1.4.

6. SAFETY GROUP CLASSIFICATIONS

6.1 Refrigerants shall be classified into safety groups according to the following criteria.

6.1.1 Classification. The safety group classification shall consist of two or three alphanumeric characters (e.g., "~~A2~~B1" or "~~B1~~A2L"). The ~~capital letter~~ first character indicates the toxicity as determined by Section 6.1.2; the Arabic numeral with or without suffix letter denotes the flammability as determined by Section 6.1.3.

[. . .]

6.1.3 Flammability Classification. Refrigerants shall be assigned to one of ~~three~~ four classes (1, 2L, 2, or 3) ~~and one optional subclass (2L)~~ based on lower flammability limit testing, heat of combustion, and the optional burning velocity measurement. Flammability tests shall be conducted in accordance with ASTM E681, *Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases)*[7] using a spark ignition source. Testing of all halocarbon refrigerants shall be in accordance with the Annex of ASTM E681. Single-compound refrigerants shall be assigned a single flammability classification. Refrigerant blends shall be assigned flammability classifications as specified in Section 6.1.5. Blends shall be assigned a flammability classification based on their WCF and WCFF, as determined from a fractionation analysis (see Normative Appendix B, Section B2). A fractionation analysis for flammability is not required if the components of the blend are all in one class; the blend shall be assigned the same class (see Table 6.1.3).

6.1.3.1 Class 1 (No Flame Propagation)

[. . .]

6.1.3.2 Class 2L (Lower Flammability)

a. A single-compound refrigerant shall be classified as Class 2L if the refrigerant meets all four of the following conditions:
   1. Exhibits flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa).
   2. Has an LFL >0.0062 lb/ft^3 (0.10 kg/m^3) (see Section 6.1.3.5 if the refrigerant has no LFL at 73.4°F [23.0°C] and 14.7 psia [101.3 kPa]).
   3. Has a heat of combustion <8169 Btu/lb (19,000 kJ/kg) (see Section 6.1.3.6).
   4. Has a maximum burning velocity of ≤ 3.9 in./s (10 cm/s) when tested at 73.4°F (23.0°C) and 14.7 psia (101.3 kPa) in dry air
b. The WCF of a refrigerant blend shall be classified as Class 2L if it meets all four of the following conditions:
   1. Exhibits flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa).
   2. Has an LFL >0.0062 lb/ft³ (0.10 kg/m³) (see Section 6.1.3.5 if the WCF of the blend has no LFL at 73.4°F [23.0°C] and 14.7 psia [101.3 kPa]).
   3. Has a heat of combustion <8169 Btu/lb (19,000 kJ/kg) (see Section 6.1.3.6).
   4. Has a maximum burning velocity of ≤3.9 in./s (10 cm/s) when tested at 73.4°F (23.0°C) and 14.7 psia (101.3 kPa) in dry air.
c. The WCFF of a refrigerant blend shall be classified as Class 2L if it meets all four of the following conditions:
   1. Exhibits flame propagation when tested at 140°F (60.0°C) and 14.7 psia (101.3 kPa).
   2. Has an LFL >0.0062 lb/ft^3 (0.10 kg/m^3) (see Section 6.1.3.5 if the WCFF of the blend has no LFL at 73.4°F [23.0°C] and 14.7 psia [101.3 kPa]).
   3. Has a heat of combustion <8169 Btu/lb (19,000 kJ/kg) (see Section 6.1.3.6).
   4. Has a maximum burning velocity of ≤3.9 in./s (10 cm/s) when tested at 73.4°F (23.0°C) and 14.7 psia (101.3 kPa) in dry air.

~~6.1.3.2~~6.1.3.3 Class 2 (Flammable)

a. A single-compound refrigerant shall be classified as Class 2 if the refrigerant meets all three of the following conditions:
   1. Exhibits flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa).
   2. Has an LFL >0.0062 lb/ft^3 (0.10 kg/m^3) (see Section ~~6.1.3.4~~ 6.1.3.5 if the refrigerant has no LFL at 73.4°F [23.0°C] and 14.7 psia [101.3 kPa]).
   3. Has a heat of combustion <8169 Btu/lb (19,000 kJ/kg) (see Section ~~6.1.3.5~~ 6.1.3.6).
b. The WCF of a refrigerant blend shall be classified as Class 2 if it meets all three of the following conditions:
   1. Exhibits flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa).
   2. Has an LFL >0.0062 lb/ft^3 (0.10 kg/m^3) (see Section ~~6.1.3.4~~ 6.1.3.5 if the WCF of the blend has no LFL at 73.4°F [23.0°C] and 14.7 psia [101.3 kPa]).
   3. Has a heat of combustion <8169 Btu/lb (19,000 kJ/kg) (see Section ~~6.1.3.5~~ 6.1.3.6).
c. The WCFF of a refrigerant blend shall be classified as Class 2 if it meets all three of the following conditions:

Table 6.1.3 Flammability Classifications

Class	Single-Component Refrigerant	WCF of a Refrigerant Blend	WCFF of a Refrigerant Blend
1	No flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa)	No flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa)	No flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa)
2L	Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) *and* LFL[a] > 0.0062 lb/ft^3 (0.10 kg/m^3) *and* heat of combustion < 8169 Btu/lb (19,000 kJ/kg) *and* burning velocity ≤ 3.9 in./s (10 cm/s) when tested at 73.4°F (23°C), 14.7 psia (101.3 kPa) in dry air	Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) *and* LFL[a] > 0.0062 lb/ft^3 (0.10 kg/m^3) *and* heat of combustion <8169 Btu/lb (19,000 kJ/kg) *and* burning velocity ≤ 3.9 in./s (10 cm/s) when tested at 73.4°F (23°C) and 14.7 psia (101.3 kPa) in dry air	Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) *and* LFL[a] > 0.0062 lb/ft^3 (0.10 kg/m^3) *and* heat of combustion <8169 Btu/lb (19,000 kJ/kg) *and* burning velocity ≤ 3.9 in./s (10 cm/s) when tested at 73.4°F (23°C) and 14.7 psia (101.3 kPa) in dry air
2	Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) *and* LFL[a] > 0.0062 lb/ft^3 (0.10 kg/m^3) *and* heat of combustion < 8169 Btu/lb (19,000 kJ/kg)	Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) *and* LFL[a] > 0.0062 lb/ft^3 (0.10 kg/m^3) *and* heat of combustion < 8169 Btu/lb (19,000 kJ/kg)	Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) *and* LFL[a] > 0.0062 lb/ft^3 (0.10 kg/m^3) *and* heat of combustion < 8169 Btu/lb (19,000 kJ/kg)
3	Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) *and* LFL[a] ≤ 0.0062 lb/ft^3 (0.10 kg/m^3) *or* heat of combustion ≥ 8169 Btu/lb (19,000 kJ/kg)	Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) *and* LFL[a] ≤ 0.0062 lb/ft^3 (0.10 kg/m^3) *or* heat of combustion ≥ 8169 Btu/lb (19,000 kJ/kg)	Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) *and* LFL[a] ≤ 0.0062 lb/ft^3 (0.10 kg/m^3) *or* heat of combustion ≥ 8169 Btu/lb (19,000 kJ/kg)

a. Lower flammability limit (LFL) is determined at ambient temperature and pressure. If an LFL does not exist at 73.4°F (23.0°C) and 14.7 psia (101.3 kPa), refer to Section ~~6.1.3.4~~ 6.1.3.5.

1. Exhibits flame propagation when tested at 140°F (60.0°C) and 14.7 psia (101.3 kPa).[3]
2. Has an LFL >0.0062 lb/ft^3 (0.10 kg/m^3) (see Section ~~6.1.3.4~~ 6.1.3.5 if the WCFF of the blend has no LFL at 73.4°F [23.0°C] and 14.7 psia [101.3 kPa]).
3. Has a heat of combustion <8169 Btu/lb (19,000 kJ/kg) (see Section ~~6.1.3.5~~ 6.1.3.6).

~~**6.1.3.2.1 Subclass 2L (Optional).** Refrigerants that meet the following additional condition: have a maximum burning velocity of ≤3.9 in./s (10 cm/s) when tested at 73.4°F (23.0°C) and 14.7 psia (101.3 kPa).~~

~~6.1.3.3~~ 6.1.3.4 Class 3 (Higher Flammability)

a. 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 140°F (60°C) and 101.3 kPa (14.7 psia).
   2. Has an LFL ≥0.0062 lb/ft3 (0.10 kg/m3) (see Section ~~6.1.3.4~~ 6.1.3.5 if the refrigerant has no LFL at 73.4°F [23.0°C] and 14.7 psia [101.3 kPa]) or it has a heat of combustion that is ≥8169 Btu/lb (19,000 kJ/kg)
b. The WCF of a refrigerant blend shall be classified as Class 3 if it meets both of the following conditions:
   1. Exhibits flame propagation when tested at 140°F (60°C) and 101.3 kPa (14.7 psia).

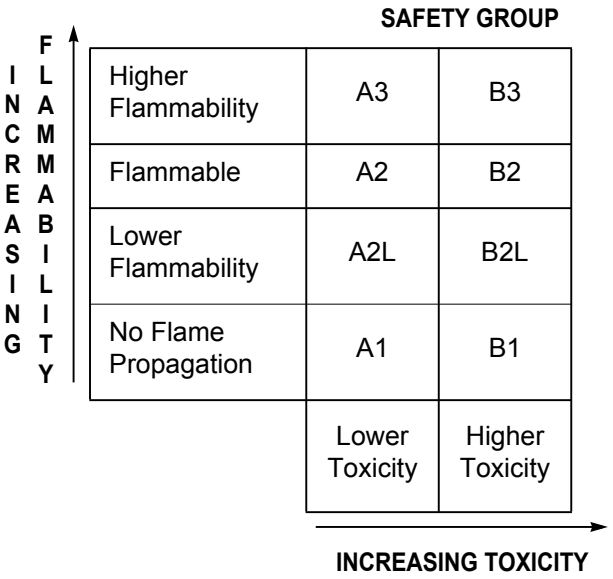

Figure 6.1.4 Refrigerant safety group classification.

2. Has an LFL ≤0.0062 lb/ft^3 (0.10 kg/m^3) (see Section ~~6.1.3.4~~ 6.1.3.5 if the refrigerant has no LFL at 73.4°F [23.0°C] and 14.7 psia [101.3 kPa]) or it has a heat of combustion that is ≥8169 Btu/lb (19,000 kJ/kg).

c. The WCFF of a refrigerant blend shall be classified as Class 3 if it meets both of the following conditions:
   1. Exhibits flame propagation when tested at 60.0°C (140°F) and 101.3 kPa (14.7 psia).
   2. Has an LFL ≤0.0062 lb/ft^3 (0.10 kg/m^3) (see Section ~~6.1.3.4~~ 6.1.3.5 if the refrigerant has no LFL at 73.4°F [23.0°C] and 14.7 psia [101.3 kPa]) or it has a heat of combustion that is ≥8169 Btu/lb (19,000 kJ/kg).

~~6.1.3.4~~ 6.1.3.5 For Class 2L, Class 2, or Class 3 refrigerants or refrigerant blends, the LFL shall be determined. For those Class 2L, Class 2, or Class 3 refrigerants or refrigerant blends that show no flame propagation when tested at 73.4°F (23.0°C) and 14.7 psia (101.3 kPa) (i.e., no LFL), an elevated temperature flame limit at 140°F (60°C) ($ETFL_{60}$) shall be used in lieu of the LFL for determining their flammability classifications.

~~6.1.3.5~~ 6.1.3.6 The heat of combustion shall be calculated for conditions of 77°F (25°C) and 14.7 psia (101.3 kPa).

[. . .]

6.1.4 Matrix Diagram of Safety Group Classification System. The toxicity and flammability classifications described in Sections 6.1.1, 6.1.2, and 6.1.3 yield ~~six~~ eight separate safety group classifications (A1, A2L, A2, A3, B1, B2L, B2, and B3)~~ and two subclasses (A2L and B2L)~~ for refrigerants. These safety group classifications are represented by the matrix shown in Figure 6.1.4.

6.1.5 Safety Classification of Refrigerant Blends. Blends, whether zeotropic or azeotropic, whose flammability and/or toxicity characteristics may change as the composition changes during fractionation, shall be assigned a safety group classification based on the worst case of fractionation. This classification shall be determined according to the same criteria as that for a single-compound refrigerant.

[. . .]

6.2 Other Standards. ~~This~~The safety group classification in accordance with Section 6.1 is to be used in conjunction with other relevant safety standards, such as ANSI/ASHRAE Standard 15, Safety Standard for Refrigeration Systems [10].

Modify Section 8 as follows.

8. REFRIGERANT CLASSIFICATIONS

Refrigerants are assigned the safety group classifications indicated in Tables 4-1 and 4-2.Toxicity and flammability data used to determine RCL values are summarized in Informative Appendix E.

Modify Section 9 as follows.

9. APPLICATION INSTRUCTIONS

This section identifies requirements to apply for designations and safety group classifications for refrigerants, including blends, in addenda or revisions to the standard.

9.1 Eligibility

9.1.1 Applicants. Any interested party may request designations and safety group classifications for refrigerants. Applicants may be individuals, organizations, businesses, or government agencies. A primary contact shall be identified for groups of individuals, organizations, businesses, or agencies. Neither the individuals nor primary contacts need be members of ASHRAE.

[. . .]

9.1.6 Blends

9.1.6.1 Components. The components of refrigerant blends must be individually classified before safety group classifications will be assigned to blends containing them. Applications for designation and classification of blends, therefore, shall be accompanied or preceded by applications for all components not yet classified in this standard.

9.1.6.2 Single Application. Designations, formulation tolerances, and safety group classifications (both as formulated and for the worst case of fractionation) shall be requested in a single application for blends. None of these will be assigned separately. Revisions of these items may be requested separately.

[. . .]

9.3 Cover. The cover shall identify the applicant and primary contact, the refrigerant in accordance with Section 9.5.1, and the requested action. Requested actions may include assignment or revision of a designation, safety group classification, or—for blends—formulation tolerance. Commercial and trade names for refrigerants shall not be used on the cover.

[. . .]

9.7.2 Burning Velocity Information (optional). Applications seeking an assignment of Class 2L shall include the following:

a. A full description of the test method employed
b. Results of standards testing with the specified test approach to ensure agreement with accepted values:
   1. Burning velocity for R-32 (acceptable range is 6.7 ±0.7 cm/s) and burning velocity for R-152a (acceptable range is 23.0 ± 2.3 cm/s)
   2. Other evidence supporting the accuracy of the method against accepted burning velocity values for other Class 2 and Class 2L refrigerants above and below 10 cm/s
c. Duplicate test results from the LFL to at least 125% of the stoichiometric concentration

Modify Normative Appendix B as follows.

NORMATIVE APPENDIX B
DETAILS OF TESTING—FLAMMABILITY

B1. FLAMMABILITY TESTING

Flammability tests shall be conducted in accordance with ASTM E681 [6]. For classification of Class 2, Class 2L, or Class 1 materials, testing shall be in a nominal 0.424 ft³ (12 L) spherical glass flask (see Figure B1-1).

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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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