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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., “A2B1” or “B1A2L”). 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 classes or four classes and one optional subclass 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) 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).

6.1.1.1 Class 1 (No Flame Propagation)

6.1.1.2 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/ft³ (0.10 kg/m³) (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.

6.1.3.3 Class 2 (Flammable)

6.1.3.4 Class 3 (Inflammable)

6.1.3.5 Class 4 (Flammable Gas)

6.1.3.6 Class 5 (Inflammable Gas)

6.1.3.7 Class 6 (Inflammable Liquid)

6.1.3.8 Class 7 (Inflammable Solid)

6.1.3.9 Class 8 (Inflammable Liquid)

6.1.3.10 Class 9 (Inflammable Solid)

6.1.3.11 Class 10 (Inflammable Gas)

6.1.3.12 Class 11 (Inflammable Liquid)

6.1.3.13 Class 12 (Inflammable Solid)

6.1.3.14 Class 13 (Inflammable Liquid)

6.1.3.15 Class 14 (Inflammable Solid)

6.1.3.16 Class 15 (Inflammable Gas)

6.1.3.17 Class 16 (Inflammable Liquid)

6.1.3.18 Class 17 (Inflammable Solid)

6.1.3.19 Class 18 (Inflammable Liquid)

6.1.3.20 Class 19 (Inflammable Solid)
Table 6.1.3 Flammability Classifications

<table>
<thead>
<tr>
<th>Class</th>
<th>Single-Component Refrigerant</th>
<th>WCF of a Refrigerant Blend</th>
<th>WCFF of a Refrigerant Blend</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa)</td>
<td>No flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa)</td>
<td>No flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa)</td>
</tr>
<tr>
<td>2L</td>
<td>Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) and LFL &gt; 0.0062 lb/ft³ (0.10 kg/m³) and heat of combustion &lt; 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</td>
<td>Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) and LFL &gt; 0.0062 lb/ft³ (0.10 kg/m³) and heat of combustion &lt; 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</td>
<td>Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) and LFL &gt; 0.0062 lb/ft³ (0.10 kg/m³) and heat of combustion &lt; 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</td>
</tr>
<tr>
<td>2</td>
<td>Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) and LFL &gt; 0.0062 lb/ft³ (0.10 kg/m³) and heat of combustion &lt; 8169 Btu/lb (19,000 kJ/kg)</td>
<td>Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) and LFL &gt; 0.0062 lb/ft³ (0.10 kg/m³) and heat of combustion &lt; 8169 Btu/lb (19,000 kJ/kg)</td>
<td>Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) and LFL &gt; 0.0062 lb/ft³ (0.10 kg/m³) and heat of combustion &lt; 8169 Btu/lb (19,000 kJ/kg)</td>
</tr>
<tr>
<td>3</td>
<td>Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) and LFL ≤ 0.0062 lb/ft³ (0.10 kg/m³) or heat of combustion ≥ 8169 Btu/lb (19,000 kJ/kg)</td>
<td>Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) and LFL ≤ 0.0062 lb/ft³ (0.10 kg/m³) or heat of combustion ≥ 8169 Btu/lb (19,000 kJ/kg)</td>
<td>Flame propagation when tested at 140°F (60°C) and 14.7 psia (101.3 kPa) and LFL ≤ 0.0062 lb/ft³ (0.10 kg/m³) or heat of combustion ≥ 8169 Btu/lb (19,000 kJ/kg)</td>
</tr>
</tbody>
</table>

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.

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/ft³ (0.10 kg/m³) (see Section 6.1.3.4 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).

6.1.3.2.1 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 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 (60.0°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 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 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 140°F (60.0°C) and 101.3 kPa (14.7 psia).
Safety Group Classification

<table>
<thead>
<tr>
<th>Increasing Toxicity</th>
<th>A3</th>
<th>B3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower Flammability</td>
<td>A2</td>
<td>B2</td>
</tr>
<tr>
<td>No Flame Propagation</td>
<td>A1</td>
<td>B1</td>
</tr>
<tr>
<td>Higher Flammability</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 6.1.4 Refrigerant safety group classification.**

2. Has an LFL \( \leq 0.0062 \text{ lb/ft}^3 \) (0.10 kg/m\(^3\)) (see Section 6.1.3.4 and 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 \( \geq 8169 \text{ Btu/lb (19,000 kJ/kg)} \).

3. 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 \( \leq 0.0062 \text{ lb/ft}^3 \) (0.10 kg/m\(^3\)) (see Section 6.1.3.4 and 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 \( \geq 8169 \text{ Btu/lb (19,000 kJ/kg)} \).

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 azeotropic or azeotropically, 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. 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.

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 ft\(^3\) (12 L) spherical glass flask (see Figure B1-1).
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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