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Standard Specification for HFC-236fa, 1,1,1,3,3,3–Hexafluoropropane, (CF₃CH₂CF₃)¹

This standard is issued under the fixed designation D6541; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers the requirements for HFC-236fa as a fire-fighting medium.

1.2 This specification does not address the fire-fighting equipment or hardware that employs HFC-236fa or the conditions of employing such equipment (for example, hand-helds, fixed installations, and so forth).

1.3 This specification does not address the storage or transportation of HFC-236fa. Storage, handling, and transportation issues are addressed in Practice ~~D6065~~D6427.

1.4 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only after SI units are provided for information only and are not considered standard.

1.5 The following safety hazards caveat pertains to the test methods portion, Section 6, of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* A specific warning statement is given in 4.3.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

~~D6065~~D6427 Practice for Handling, Transportation, and Storage of HFC-227ea 1,1,1,2,3,3,3-Heptafluoropropane HFC-236fa, 1,1,1,3,3,3-Hexafluoropropane (CF₃CHF₂CF₂CF₃)

D6806 Practice for Analysis of Halogenated Organic Solvents and Their Admixtures by Gas Chromatography

2.2 ISO–U.S. Government Standards:³

~~ISO 3427~~49 CFR Part 172 Gaseous Halogenated Hydrocarbons (Liquefied Gases)—Taking a Sample Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, Training Requirements, and Security Plans

49 CFR Part 172.101 Purpose and Use of Hazardous Materials Table

¹ This specification is under the jurisdiction of ASTM Committee D26 on Halogenated Organic Solvents and Fire Extinguishing Agents and is the direct responsibility of Subcommittee D26.09 on Fire Extinguishing Agents.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.

2.3 AHRI Standard:⁴

2008 Appendix C for Analytical Procedures for AHRI Standard 700-2006/700-2014

2.4 U.S. Government Standards:⁵

~~Code of Federal Regulations (CFR) Title 49, Part 172.101 Tables of Hazardous Materials and Special Provisions~~

~~Code of Federal Regulations (CFR) Title 49, Part 172 Subpart D Marking Requirements of Packaging for Transportation~~

2.4 ASHRAE Standard:⁵

ASHRAE Standard 34 Designation and Safety Classification of Refrigerants

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 ~~halogenated hydrocarbon~~ **hydrocarbon, n** (see ~~Note 1 Discussion~~)—saturated hydrocarbons in which one or more of the hydrogen atoms have been replaced by atoms of the halogen series (fluorine, chlorine, bromine, and iodine). It is convention to prefix the number with an abbreviation of the compound:

CFC = chlorofluorocarbon
 HCFC = hydrochlorofluorocarbon
 HFC = hydrofluorocarbon
 FC = fluorocarbon
 R = refrigerant

~~NOTE 1—The halogenated compound coding terminology system provides a convenient means to reference halogenated hydrocarbons (see ASRE 34). Discussion—The halogenated compound coding terminology system provides a convenient means to reference halogenated hydrocarbons (see ASHRAE 34).~~

3.1.1.1 By definition, the right-most digit of the numbering system is the number of fluorine atoms.

3.1.1.2 The second digit from the right is the number of hydrogen atoms plus one (+1).

3.1.1.3 The third digit from the right is one less ~~(+1)~~ (-1) than the number of carbon atoms in the compound (when this number is zero, it is omitted from the number).

3.1.1.4 Unaccounted for valance requirements are assumed to be chlorine atoms.

3.1.1.5 When the compound contains bromine or iodine, the same rules apply, except the letter B for bromine or I for iodine follows the parent compound designated number, and the number of the atoms is placed after the letter.

Example: $\text{CF}_3\text{CH}_2\text{CF}_3 = \text{R-236fa} = \text{HFC-236fa}$

3.1.2 ~~HFC-236fa~~ **HFC-236fa, n**—the compound 1,1,1,3,3,3-hexafluoropropane; $\text{CF}_3\text{CH}_2\text{CF}_3$.

4. Material Requirements

4.1 Type I—Mixtures of HFC-236fa and Nitrogen:

4.1.1 The nitrogen (N_2) partial pressure shall be such that the safe working pressure of the receiving vessel is not exceeded. To prevent excessive pressure, the fill density of the HFC-236fa/nitrogen within the container should not exceed that needed to achieve complete filling of the container at the maximum expected storage temperature. For example, the U.S. ~~DOT~~ Department of Transportation (DOT) 4BA500 cylinder partial pressure shall not exceed ~~24.4 bar~~ 24.4 bar at ~~21°C~~ 21 °C (340 psig at ~~70°F~~) 70 °F) for a ~~1153 kg/m³~~ 1153 kg/m³ (72 lb/ft³) fill density. For this example, the safe working pressure of the 4BA500 cylinder is not exceeded for temperatures below ~~54°C~~ 54°C (~~130°F~~) 54 °C (130 °F).

⁴ Available from Air-Conditioning, Heating, and Refrigeration Institute (AHRI), 2442311 Wilson Blvd., Suite 500, Arlington, VA 22201, <http://www.ahrinet.org>.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>. Code of Federal Regulations (CFR) documents are available from U.S. Government Publishing Office (GPO), 732 N. Capitol St., NW, Washington, DC 20401, <http://www.gpo.gov>.

⁵ Available from U.S. Government Publishing Office, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.gpo.gov>.

⁵ Available from American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle, NE, Atlanta, GA 30329, <http://www.ashrae.org>.

4.1.2 HFC-236fa shall conform to the requirements prescribed in **Table 1** when tested by the appropriate test method(s) listed in **6**.

4.1.3 When material analysis is required, by agreement between the purchaser and the supplier, the total pressure in the HFC-236fa container, partial pressure of the nitrogen, the fill density of the HFC-236fa within the container, and the maximum safe storage temperature shall be part of the material analysis (certification). The pressure shall be reported in bar (preferred) or pound-force per square inch gage (psig). The fill density shall be reported in kilograms per cubic metre at 21°C (preferred) or pounds per cubic foot at 70°F . The maximum safe storage temperature of the HFC-236fa shall be reported in degrees Celsius (preferred) or in degrees Fahrenheit and shall conform to the applicable regulations for the HFC-236fa container design and use.

4.2 *Type II*—HFC-236fa shall conform to the requirements of Type I, as listed in **4.1.1**, and shall contain no more than ~~1.5%~~ **1.5%** by volume fixed gases in the vapor phase, expressed as air when tested by the appropriate test method(s) listed in Section **6**.

4.3 By agreement between the purchaser and the supplier, analysis may be required and limits established for elements or compounds not specified in **Table 1**. (**Warning**—Exposure to concentrations of HFC-236fa in excess of ~~15%~~ **15%** by volume in air during periods of elevated adrenaline could produce cardiac arrhythmia in some personnel.)

4.4 Unless otherwise specified, Type I is assumed.

5. Sampling

5.1 Samples of HFC-236fa shall be taken from the liquid phase, ~~shall be taken from filled containers in accordance with the method specified in ISO 3427.~~ phase in a closed system as described in 2008 Appendix C to AHRI Standard 700-2014, Part 7. The sampling bottle shall be capable of safely resisting the vapor pressure of the sample at the highest temperature that could be encountered.

5.2 The HFC-236fa selected in accordance with **5.1** shall be tested for quality conformance in accordance with Section **6**. The presence of one or more defects shall be cause for rejection.

6. Test Methods

6.1 *Purity*—~~Determine purity using the method specified in~~ Conduct the analysis in accordance with Practice **D6806**, or in accordance with 2008 Appendix C to AHRI Standard 700-2014, Part 7.

6.2 *Acidity*—Determine acidity using the method specified in 2008 Appendix C to AHRI Standard 700-200, part 1.

6.2 ~~*Water Content*—Acidity—Determine water content using the~~ Conduct the analysis in accordance with the method specified in 2008 Appendix C to AHRI Standard 700-2006, part 2-700-2014, Part 1.

6.3 ~~*Nonvolatile Residue*—Water Content—Determine nonvolatile residue using the~~ Conduct the analysis in accordance with the method specified in 2008 Appendix C to AHRI Standard 700-2006, part 3-700-2014, Part 2.

6.4 ~~*Non-condensable Gases*—Nonvolatile Residue—Determine non-condensable gases using the~~ Conduct the analysis in accordance with the method specified in 2008 Appendix C to AHRI Standard 700-2006, part 5-700-2014, Part 3.

6.5 *Suspended Matter or Sediment*—While performing the nonvolatile residue analysis, examine visually for any suspended matter or sediment. Observation of any suspended matter or sediment shall constitute failure by this test method.

TABLE 1 Requirements

Property	Requirement
HFC-236fa purity, %, mol/mol, min	99 (exclusive of any N ₂ present)
Acidity, ppm by mass, as HCl, max	1.0
Water content, ppm by mass, max	10
Nonvolatile residue, % by weight, max	0.03
Suspended matter or sediment	none visible