Freon™ 134a

Aerosol Propellant

Technical Information

Introduction

Freon™ 134a (HFC-134a; 1,1,1,2-tetrafluoroethane) is a nonflammable vapor at room temperature and atmospheric pressure. Certain physical properties, e.g., vapor pressure, are very close to those of CFC-12, suggesting that Freon™ 134a may be useful as a propellant in various aerosol applications. This bulletin presents selected physical properties of Freon™ 134a, focusing on its use as an aerosol propellant, and preliminary information on its chemical stability, solvency, materials compatibility, as well as results of toxicity testing.

Physical Properties

Table 1 lists selected physical properties of Freon™ 134a. Charts showing its saturated vapor pressures in psia, pressure units, and liquid densities of Freon™ 134a over temperature ranges of interest to the aerosol industry are included in this bulletin.

Flammability

The vapors of Freon™ 134a are nonflammable at all concentrations in air. As such, it can be mixed with flammable propellants to produce a limited range of nonflammable blends or reduce the flammable content of aerosol formulations. However, Freon™ 134a is not as efficient an inerting agent as were CFC-12 or HCFC-22. Accordingly, nonflammable binary propellant blends of Freon™ 134a contain lower concentrations of the flammable component than those of the more efficient inerting agents.

Although nonflammable at ambient temperatures and atmospheric pressure, Freon™ 134a is combustible at pressures above atmospheric and air concentrations greater than 60% by volume. This property of Freon™ 134a should not pose an explosion hazard from aerosol containers using it as propellant or during normal aerosol filling operations. However, as is common industry practice, air should be removed from aerosol containers before they are filled with Freon™ 134a.

Chemical Stability

Freon™ 134a is stable enough for use in most aerosol formulations. This conclusion is based mainly on studies carried out with it to assess its stability in refrigeration applications. In most environments, HFC-134a is as stable as HFC-152a, which can be used in a wide range of aerosol formulations. Because this assessment is based on the results of testing for applications other than aerosols, thorough storage testing is necessary before marketing any aerosol formulation containing Freon™ 134a. Information on its stability in an aluminum container is sparse; but, again, testing directed toward refrigeration applications suggests that Freon™ 134a and aluminum metal are compatible.

The stability of Freon™ 134a in water-based products has not been investigated extensively. However, based on limited testing, Freon™ 134a is believed to be stable in aqueous media, including conditions of high pH.

Table 1. Selected Physical Properties of Freon™ 134a

Chemical Formula		CF_3CH_2F
Molecular Weight		102.0
Boiling Point at 1 atm	°F (°C)	–15.0 (–26.1)
Freezing Point	°F (°C)	–149.8 (–101)
Vapor Pressure at 70°F 130°F 20°C 50°C	psig psig Bar, Gauge Bar, Gauge	70 199 4.72 12.18
Liquid Density at 70°F 130°F 20°C 50°C	g/cc g/cc g/cc g/cc	1.221 1.083 1.224 1.103
Liquid Specific Heat	cal/g	0.340 at 77 °F (25 °C)
Heat of Vaporization at Boiling Point	cal/g Btu/lb	51.9* 93.4*
Solubility of Propellant in Water at 77 °F (25 °C) and 1 atm	wt%	0.15
Solubility of Water in Propellant at 77 °F (25 °C) and 1 atm	wt%	0.11
Solubility of Propellant in Water at 70 °F (20 °C), Autogenous Pressure	wt%	0.95
Solubility of Water in Propellant at 70 °F (20 °C), Autogenous Pressure	wt%	0.095
Liquid Viscosity at 70 °F (20 °C)	mPa · s (cP)	0.205
Kauri-Butanol Number		8.0
Solubility Parameter		6.6
Flammability Limits in Air, vol%	vol%	Nonflammable
Ozone Depletion Potential		Zero
Volatile Organic Compound (U.S. EPA Listing)		No

*Denotes calculated values

Solvency

Freon™ 134a is not a good solvent, especially for higher molecular weight solutes, e.g., polymers. As an example, it is essentially immiscible with many lubricating oils. It is miscible with lower alcohols, ketones, chlorinated solvents, etc., and its vapor pressure is depressed by them. Aerosol formulations using Freon™ 134a as all or part of the propellant should be stored in glass pressure vessels as part of stability testing to verify that active ingredients do not come out of solution.

Compatibility with Plastics and Elastomers

Based on available information, there should be no problems associated with Freon™ 134a in contact with plastic and elastomers, e.g., Buna N, Neoprene W, or butyl commonly used in aerosol components. Chemours does not recommend Viton™ fluoroelastomer for use in contact with Freon™ 134a. Nonetheless, storage stability testing should be carried out to verify that incompatibility between Freon™ 134a, the aerosol concentrate, and materials of construction does not develop.

Toxicity

Freon™ 134a has undergone extensive short-term, i.e., 90-day toxicity testing under the sponsorship of the worldwide fluorocarbon producers consortium, PAFT I. A large number of specific toxicity tests, i.e., reproductive toxicity, mutagenic toxicity, etc., have also been completed. At the end of a 2-yr inhalation study, no effects were observed in body weights, in-life measurements, clinical observations or chemistry, or haematology.

The International Pharmaceutical Aerosol Consortium for Toxicology Testing (IPACT-I) has conducted an extensive series of tests to qualify HFC-134a as an aerosol propellant for pharmaceutical applications.

Based on all the completed PAFT I studies, Freon™ 134a appears to be a chemical having an extremely low order of toxicity. No adverse effects were noted in animals after repeated inhalation exposures at 50,000 ppm concentration; it is not a mutagen in tests designed to detect this property; it produced no developmental (teratogenic) effects in animals. Chemours has assigned a provisional acceptable exposure limit (AEL) of 1,000 ppm (8-hr and 12-hr TWA) to Freon™ 134a. This is a workplace exposure limit derived in much the same way as the ACGIH TLV®. It must be adhered to in Chemours facilities, and we recommend its use to customers (especially in cases where no other workplace exposure limit exists).

Regardless, as with all chemicals, unnecessary exposure of people to Freon™ 134a should be minimized.

Packaging

Although the vapor pressure of Freon™ 134a is almost the same as that of CFC-12 at 70 °F (20 °C), its vapor pressure at 130 °F (54 °C) exceeds the pressure limit of a U.S. Department of Transportation (DOT) 2Q aerosol container by about 1 atmosphere, i.e., 19 psi. It is not certain whether the DOT will permit pure Freon™ 134a to be packaged in a 2Q aerosol container or whether they will require a DOT E-10232 container or equivalent. Aerosol formulations using Freon™ 134a as propellant must be packaged in accordance with the usual DOT regulations for aerosol products.

Outside the United States, international and/or national regulatory authorities should be consulted who have jurisdiction over packaging of compressed gases for guidance on suitable containers for packaging pure Freon™ 134a and its aerosol formulations.

Uses

Chemours does not support the use of Freon™ 134a as a propellant in high-volume aerosol personal products.

We sell Freon™ 134a into limited commercial applications. Long-term, we view it being used in aerosol products that recently used CFCs or HCFCs, because of legitimate concerns about the flammability of the product.

Figure 1. Staturated Vapor Pressure of Freon™ 134a

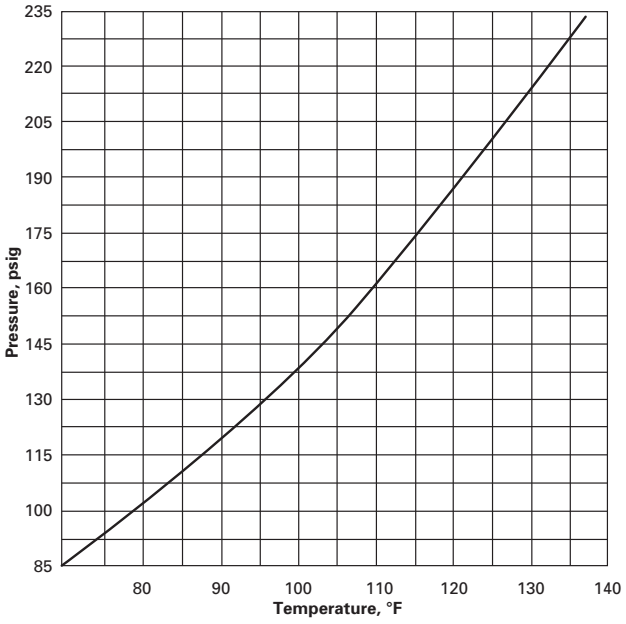


Figure 2. Staturated Vapor Pressure of Freon™ 134a

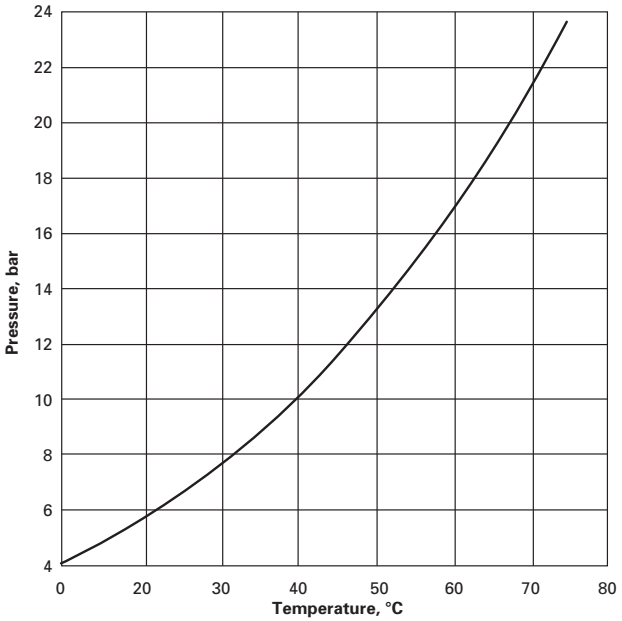
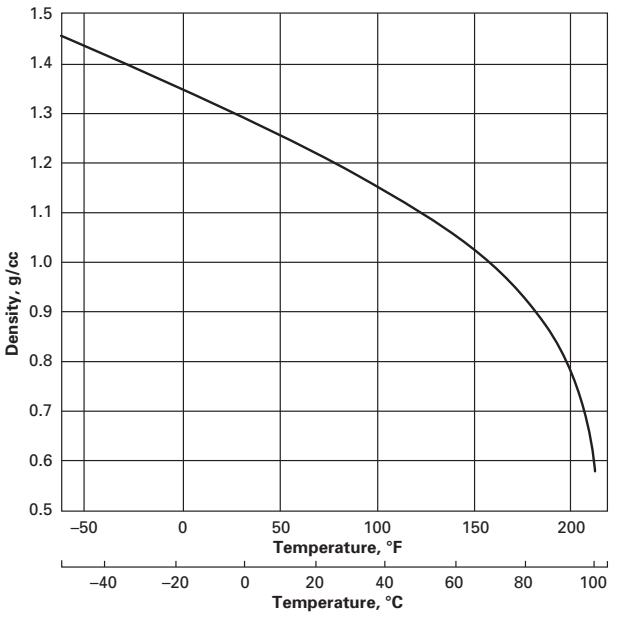


Figure 3. Liquid Density of HFC-134a



For more information about propellants from Chemours, visit Chemours.com/Propellants

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