HP 152a

Aerosol Propellant

Technical Information

Introduction

Hydrofluorocarbon 152a (HFC-152a) is an aerosol propellant containing no chlorine atoms, and, as such, falls completely outside concerns about stratospheric ozone destruction by chlorofluorocarbons or other chlorinated hydrocarbons. It has zero ozone depletion potential (ODP), and the U.S. Environmental Protection Agency has found it is not a volatile organic compound (VOC), i.e., it has negligible photochemical reactivity (55 FR 11418). The registered trademark of Chemours for HFC- 152a is HP 152a.

HP 152a can be used alone or mixed with other common aerosol propellants in a wide range of personal or industrial product categories where the product is dispensed as a spray, e.g., hair spray, cologne, deodorant, etc. HP 152a also produces excellent foams or mousses and is used in a number of commercial aerosol foam products, e.g., hair styling and skin conditioning mousses.

There has been recent renewed interest in HP 152a as a result of state regulations to limit VOC emissions from a wide range of consumer products, including aerosol products. HP 152a propellant may offer options to meet these regulations in paints, adhesives, and other aerosol products, including personal products, e.g., hair spray.

The vapor pressure of HP 152a is 63 psig at 70 °F (4.16 bar at 20 °C), which is close to that of CFC-12 or dimethyl ether; furthermore, its low molecular weight (66.1) means that a low weight percent of propellant is generally required to produce an acceptable degree of atomization. A similar argument has been used to describe the advantages of hydrocarbon propellants; however, HP 152a has several physical properties that make it superior to the hydrocarbon propellants for certain applications.

HP 152a has an lower explosive limit (LEL) of 3.9 volume percent in air, and it does not give a flame extension or flashback in the standard test used to measure the flammability of aerosol products. Isobutane, on the other hand, has an LEL of 1.8 volume percent in air and gives a flame extension of greater than 22 inches when sprayed through a typical antiperspirant valve. As a result, HP 152a and HP 152a/hydrocarbon blends can be used to produce aerosol formulations possessing a lower degree of flammability than their hydrocarbon-propelled counterparts. This may be an advantage in products with high propellant levels, e.g., antiperspirants.

HP 152a forms azeotropes with each of the three most common hydrocarbon propellants and with HP DME (dimethyl ether). The use of a HP 152a/hydrocarbon or HP 152a/HP DME propellant blend whose composition will not change during use of the aerosol product represents still another attractive alternative.

The liquid density of HP 152a is 0.91 g/cc at 70 °F (21.1 °C) compared to 0.56 g/cc for isobutane. This difference makes it possible to obtain reduced settling rates in products containing suspended solids, improvements in emulsion stability with aqueous-based products, and greater product net weights for equivalent container sizes compared with hydrocarbon-based formulations. It is completely miscible with most organic liquids and other active ingredients used in aerosol formulations, and has a very low taste and odor level. Furthermore, the solubility

of HP 152a in water and its strong resistance to hydrolysis allow its use in a variety of water-based products as well. Several unique formulation possibilities (e.g., quick-breaking foams, hair styling mousses) have already been demonstrated.

Toxicological evaluations have demonstrated that HP 152a has a very low order of acute and chronic inhalation toxicity. The compound is not a mutagen, teratogen or carcinogen. Chemours' work-place exposure limit (AEL) for it is 1000 ppm.

Table 1. Physical Properties of HP 152a

Formula	CH_3CHF_2
Molecular Weight	66.1
Boiling Point, °F (°C)	–13 (-25)
Vapor Pressure, psig 70 °F 130°F	 63 177
Vapor Pressure, bar 20 °C 50 °C	 4.16 10.86
Liquid Density, g/cc 70 °F 130 °F 20 °C 50 °C	 0.908 0.816 0.911 0.830
Solubility in Water at 1 atm and 77 °F (25 °C), wt%	0.28
Kauri-Butanol Value	11
Solubility Parameter	7
Liquid Viscosity at 70°F (21.1°C), cP	0.243
Flammability Limits in Air, vol%	3.9–16.9
Tag. Open Cup Flash Point	⩽58 °F (⩽50 °C)
Ozone Depletion Potential	0
Global Warming Potential (100 yr. Integrated Time Horizon)	140
Volatile Organic Compound	No

Toxicity Summary of Hydrofluorocarbon 152a

Hydrofluorocarbon 152a has a low order of toxicity on both an acute and chronic basis. Although a TLV® has not been established for HFC-152a, a value of 1,000 ppm (v/v; 8-hour TWA) seems appropriate based on its low toxicity and analogy to other fluorocarbons.

The main physiological action of HFC-152a is that of "weak anesthesia" at high inhaled levels. Its 4-hr approximate lethal concentration (ALC) in rats is 383,000 ppm[1]. Like other halocarbons and hydrocarbons, under gross misuse or abuse conditions, HFC-152a is capable of sensitizing the heart to the body's own adrenalin. However, even in experimental screening studies using dogs and simulating stress with a large intravenous dose of adrenalin, cardiac sensitization was not observed at exposure levels below 150,000 ppm[2].

In a subchronic inhalation study[3], rats were exposed to HFC-152a at 100,000 ppm for 16 hr daily for 2 months with no adverse effects, except for microscopic evidence of slight respiratory irritation. In a more recent study[1], when rats were exposed at 100,000 ppm for 6 hr/day, 5 days/week for 2 weeks, there were no significant effects relative to clinical, hematological, blood chemistry, urine analytical, or histopathological indices.

A lifetime inhalation toxicity study[4] has also been conducted on HFC-152a. Rats (120 #/sex/exposure level) were exposed for 6 hr/day, 5 days/week for 24 months to 0, 2,000 10,000, or 25,000 ppm. Under the conditions of this experimental study, HFC-152a was not carcinogenic and produced no life-shortening toxic effects in rats exposed by inhalation for 24 months at concentrations ⩽ 25,000 ppm (v/v).

In a study[5] designed to determine reproductive toxicity potential, groups of 27 pregnant rats were exposed by inhalation to 5,000 or 20,000 ppm HFC-152a for 6 hr/day on days 6–15 of gestation. There was no evidence of maternal toxicity, embryotoxicity, or teratogenicity under these experimental conditions. In another study[6] (Ames Test) designed to screen for mutagenic potential, HFC-152a was not mutagenic in *Salmonella typhimurium* bacteria, with or without metabolic activation.

In conclusion, based on acute and chronic animal toxicity studies and many years of human experience, HFC-152a at or below an occupational limit (8-hr TWA) of 1,000 ppm should pose no hazard relative to general toxicity, carcinogenicity, mutagenicity, or teratogenicity. This fluorocarbon exhibits a very low degree of reactivity in biological system.

References

1. Unpublished DuPont Haskell Laboratory Data, 1975.
2. Reinhardt, C. F., et al. Arch. Environ. Hlth. 22: 265–269, 1971.
3. Lester, D., and L. A. Greenberg. Arch. Ind. Hyg. Occup. Med. 2: 335-344, 1950.
4. Unpublished DuPont Haskell Laboratory Data, 1982.
5. Unpublished DuPont Haskell Laboratory Data, 1979.
6. Logstaff, E., et al. Toxicol. Appl. Pharmacol. 72: 15–31, 1984.

Figure 1. Saturated Vapor Pressure of HP 152a

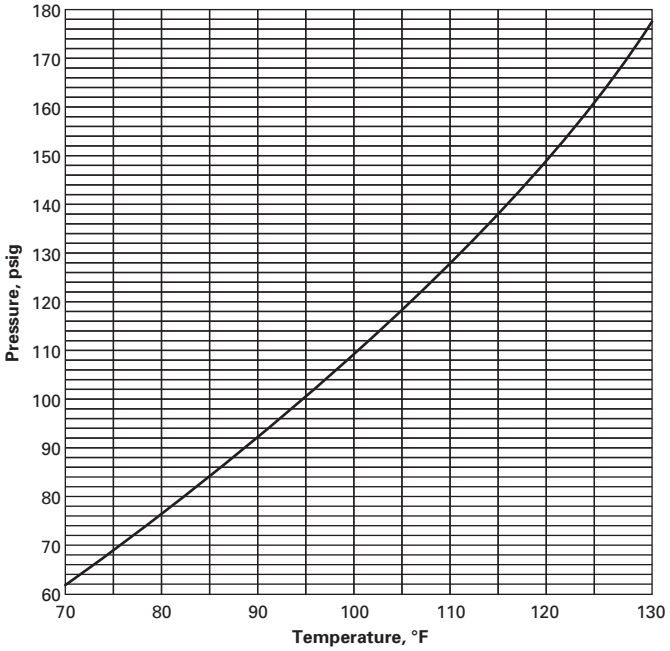
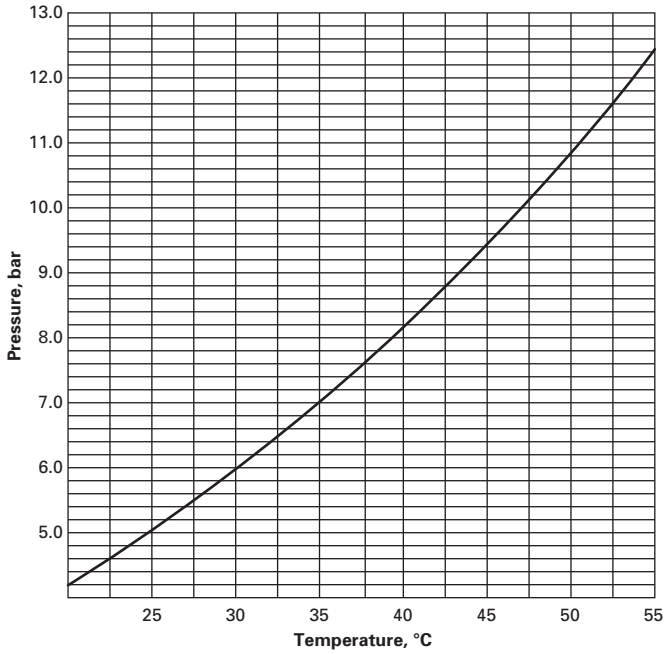


Figure 2. Saturated Vapor Pressure of HP 152a



Triangular-Coordinate Charts

The following triangular-coordinate charts are available from the Fluorochemicals Laboratory. They provide vapor pressure data at 70°F (21.1°C) for each of the ternary mixtures listed below:

Components

- HP 152a/Propane/Isobutane
- HP 152a/n-Butane/Ethanol
- HP 152a/Isobutane/Ethanol
- HP 152a/Ethanol/Water
- HP 152a/Ethanol/HP DME
- HP 152a/Ethanol/Freon™ 134a

Stability/Compatibility of HP 152a

HP 152a is a relatively inert chemical. It does not undergo reaction with the solvents commonly used in aerosol formulations, e.g., ethanol, chlorocarbons, hydrocarbon solvents, etc. It is also very stable to hydrolysis, especially under alkaline conditions. It is a propellant in several water-based commercial hair styling mousse formulations packaged in aluminum containers. Although no stability problems resulting from the use of HP 152a as a propellant are anticipated, formulations should be thoroughly tested prior to marketing them to ensure this is the case.

HP 152a is compatible with a wide range of elastomers and plastics. As an example, Buna N, butyl, or Neoprene gasketing materials can be used with it. However, like many other fluorochemicals, HP 152a is not compatible with Viton™. It does not craze or attack the plastics commonly used in the aerosol industry. Compatibility tests have been run with several plastics that are prone to attack by solvents and propellants. The results are presented below.

Table 2. Compatibility of Selected Plastics with HP 152a

Plastic	4 hr at 75 °F (23.9°C)
ABS Polymer	0
Polycarbonate	0
Polymethyl methracrylate	0
Polystyrene	0

Codes

0 = Suitable for use in contact with HP 152a

1 = Probably suitable for use

2 = Probably not suitable for use

3 = Not suitable for use

4 = Plastic disintegrated or dissolved in liquid

Binary Azeotropes of HP 152a

Table 3. Binary Azeotropes of HP 152a with Hydrocarbon and Dimethyl Ether Propellants

		Vapor Pressure			
		psig		bar	
Azeotrope	Composition	70° F*	130 °F	21.1 °C	54.4 °C
HP 152a/Propane	45/55	130	295	8.96	20.34
HP 152a/Isobutane	75/25	72	190	4.96	13.10
HP 152a/n-Butane	85/15	68	180	4.69	12.41
HP 152a/HP DME	55/45	61	169	4.21	11.65

*Handbook of Aerosol Technology, 2nd Ed., P. A. Sanders.

Note 1: The composition of an azeotrope varies with temperature. The values given are average values over the temperature range 70–130 °F (21.1–54.4 °C).

Note 2: "The Aerosol Handbook," 2nd Ed., M. A. Johnsen gives the composition of the HFC-152aa/propane azeotrope as 79/21, respectively.

Table 4. Spray Characteristics of Blends of HP 152a with Ethanol and Water

Composition, wt%			Vapor Pressure		
HP 152a	Water	EtOH	psig at 70 °F	bar at 21.1 °C	Spray Characteristic*
72	—	28	50	3.45	Fine
45	—	55	40	2.76	Fine
45	9	46	50	3.45	Fine
30	—	70	30	2.07	Medium
30	10	60	40	2.76	Medium
30	20	50	50	3.15	Medium
21.5	—	78.5	20	1.38	Coarse
21.5	11.5	67	30	2.07	Coarse
21.5	19.5	59	40	2.76	Coarse
21.5	29	48.5	50	3.45	Coarse/Streamy
10	25	65	20	1.38	Streamy
10	34	56	30	2.07	Streamy
10	40	50	40	2.76	Streamy
5	38.5	56.5	20	1.38	Stream
5	47	48	30	2.07	Stream
5	52	43	40	2.76	Stream

*Precision #0.80" × 0.018" valve and 0.018" standard actuator.

Classification of Spray Characteristics

Very Fine
The spray disappears at a distance of about 2–3 ft after it leaves the actuator. The spray causes no wetting of paper when sprayed from a distance of about 1 ft.

Fine
The spray travels for a distance of at least 5–6 ft before disappearing. Slight wetting of paper occurs at a distance of about 1 ft.

Medium
The spray tends to travel in a horizontal path, and the particle size is noticeably larger than that in a fine spray. Definite wetting of paper occurs at a distance of about 1 ft.

Coarse
Fallout of large droplets from the spray is evident. Heavy wetting of paper occurs at a distance of 2 ft.

Streamy
A broken stream consisting of mixture of spray and stream.

Stream
A stream with little or no spray.

Sprays with properties intermediate between any of the groups shown above are classified as medium-fine, medium-coarse, etc.

Flame Projection Test Results

Table 5. Prototype Products Using HP 152a Propellant

Product	Valve	Prop. Conc.	Solvent	Flame Proj., in	Flash Back, in	VP (70 °F) [20 °C], psig
Hair Spray	(1)	25/75	EtOH	17	6	37
Personal Deodorant	(2)	30/70	EtOH	15	0	49
Cologne	(3)	18/82	EtOH	7	3	27
Topical Antiseptic	(4)	75/25	EtOH	0	0	60
Pan Sprays	(5)	25/75	Corn oil	19	0	62
Space Insecticide	(6)	32/68	Kerosene and Trichloroethane	17	0	34
Hornet/Wasp Spray	(7)	17/83	IPA and Trichloroethane	16	0	30
Residual Insecticide	(8)	15/85	Kerosene	22+	4	47
Spray Lubricant	(6)	95/05*	Trichloroethane	2	0	34
Mold Release Spray	(9)	90/05**	Trichloroethane	2	0	28
Electronic Cleaner	(10)	10/90	Freon™ TF	0	0	22
Penetrating Oil	(6)	25/75	—	22	0	37

(1) Precision .013/.018 valve, .016 MBRT actuator.
(2) Precision .018/.025, .013 vapor tap valve, .016 MBRT actuator.
(3) Risdon .016/.040 valve, .016 MB actuator.
(4) Precision .025/.018, .013 vapor tap valve, .016 MBRT actuator.
(5) Precision .013/.010 valve, .013 MB actuator.
(6) Precision .080/.018 valve, .018 standard actuator.
(7) Precision .080/3x.040, .020 total release actuator.
(8) Precision .080/.018 valve, .025 total release actuator.
(9) Newman-Green B-14-10 valve, model 150-16-16 actuator.
(10) Newman-Green B-14-10 valve, model 110-20-32 actuator or Model 102-20-18 actuator with #805 extension tube.
*"Propellant" was HP 152a/1,1,1-trichloroethane (30/70)
***"Propellant" was HP 152a/1,1,1-trichloroethane (20/80)

Flame Projection Test Results (Metric Units)

Table 6. Prototype Products Using HP 152a Propellant

Product	Valve	Prop. Conc.	Solvent	Flame Proj., in	Flash Back, in	VP (70° F) [20 °C], psig
Hair Spray	(1)	25/75	EtOH	43.2	15.2	2.55
Personal Deodorant	(2)	30/70	EtOH	38.1	0	3.38
Cologne	(3)	18/82	EtOH	17.8	7.6	1.86
Topical Antiseptic	(4)	75/25	EtOH	0	0	4.14
Pan Sprays	(5)	25/75	Corn oil	48.3	0	4.27
Space Insecticide	(6)	32/68	Kerosene and Trichloroethane	43.2	0	2.34
Hornet/Wasp Spray	(7)	17/83	IPA and Trichloroethane	40.6	0	2.07
Residual Insecticide	(8)	15/85	Kerosene	55.9+	10.2	3.24
Spray Lubricant	(6)	95/05	Trichloroethane	5.1	0	2.34
Mold Release Spray	(9)	90/05	Trichloroethane	5.1	0	1.93
Electronic Cleaner	(10)	10/90	Freon™ TF	0	0	1.52
Penetrating Oil	(6)	25/75	—	55.9	0	2.55

(1) Precision .330/.457 valve, .406 MBRT actuator.
(2) Precision .457/.635, .330 vapor tap valve, .406 MBRT actuator.
(3) Risdon .406/1.016 valve, .406 MB actuator.
(4) Precision .635/.457, .330 vapor tap valve, .406 MBRT actuator.
(5) Precision .330/.254 valve, .330 MB actuator.
(6) Precision 2.032/.457 valve, .457 standard actuator.
(7) Precision 2.032/3x1.016, .508 total release actuator.
(8) Precision 2.032/.457 valve, .635 total release actuator.
(9) Newman-Green B-14-10 valve, model 150-16-16 actuator.
(10) Newman-Green B-14-10 valve, model 110-20-32 actuator or Model 102-20-18 actuator with #805 extension tube.
*"Propellant" was HP 152a/1,1,1-trichloroethane (30/70).
***"Propellant" was HP 152a/1,1,1-trichloroethane (20/80).

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Replaces: H-64411
C-10777 (3/16)