

DuPont™ FE-227™

FIRE EXTINGUISHING AGENT

Technical Information

Description

Ever since Halon 1301 was targeted as a serious ozone-depleting substance, DuPont has been instrumental in developing and manufacturing non-ozone-depleting replacement agents. The most recent addition to DuPont's full line of Halon replacements is FE-227™, or heptafluoropropane (HFC-227ea), which is the world's most widely used in-kind replacement for Halon 1301 in total flooding applications. FE-227™ effectively prevents or extinguishes all major classes of fires and is safe, clean, and electrically nonconductive. Its boiling point is -16.45°C (2.4°F) making it useful for total flooding of enclosures at normal ambient temperatures.

FE-227™ as a fire extinguishing composition is disclosed in U.S. Patent 5,084,190 which is assigned to DuPont. In addition, DuPont has a license to U.S. patent 5,124,053 which covers a method for extinguishing a fire.

Performance

The extinguishing concentration of FE-227™ on heptane fuel is 6.7% by volume as determined by the cup burner test. According to the 2000 edition of National Fire Protection Association (NFPA) standard 2001, the minimum design concentration for Class B fires shall be 1.3 times the cup burner value. For Class A fuels the minimum design concentration is 1.2 times the extinguishing concentration for wood and polymeric materials as tested according to UL 2166, Standard for Halocarbon Clean Agent Extinguishing System Units.

In comparison to Halon 1301, FE-227™ is a less efficient extinguishing agent, but this is not unexpected given the absence of bromine in the molecule. (It is bromine that made the Halon compounds extremely effective fire extinguishants, but also made them potent ozone depleters.) To overcome the lack of bromine, about two times as much FE-227™ must be used to achieve suppression under equivalent conditions. This presents no problem in designing and installing new systems, but makes it unlikely that existing Halon 1301 systems could simply be refilled with an equal quantity of FE-227™ and achieve the same level of performance. Nevertheless, FE-227™ is expected to replace the majority of uses for Halon 1301.

Applications

FE-227™ has its greatest benefit when used as a total flooding agent to protect high-value critical equipment requiring a clean (leaves no residue), electrically nonconductive gaseous agent that is safe for people in the event of exposure. These applications typically exist in telecommunication facilities, computer rooms, process control centers and other electro-mechanical equipment rooms.

A comparison of some properties of FE-227™ to Halon 1301 is in **Table 1**.



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Table 1
Properties Comparison
Halon 1301 to FE-227™

	Halon 1301	FE-227™
Chemical Formula	CF ₃ Br	CF ₃ CHFCF ₃
Ozone-Depletion Potential	10	0
Molecular Weight	148.9	170.03
Boiling Point, °C (°F)	-57.7 (-72.0)	-16.45 (2.3)
Critical Temperature, °C (°F)	67.0 (152.6)	101.7 (215)
Liquid Density at 77°F, lb/ft ³	96.01	86.53
Vapor Pressure at 77°F, psia	234.8	66.0
Heat of Vaporization at Boiling Point, Btu/lb	35.5	56.7
Extinguishing Concentration, Heptane, Cup Burner, vol%	3.5	6.7
Acute Toxicity, ALC or LC ₅₀ Rats; 4 hr-ppm	400,000–800,000*	>788,000

*Estimated values

Toxicity

FE-227™ has very low acute toxicity by inhalation. As with many other halocarbons and hydrocarbons, FE-227™ produces a cardiac sensitization response in experimental screening studies. This cardiac sensitization response is observed in dogs at approximately 105,000 ppm (10.5% LOEL), but not at 90,000 ppm (9.0% NOEL). In 1999, further research using an EPA-approved, physiologically-based pharmacokinetic (PBPK) model demonstrated that human exposure to FE-227™ for up to 5 minutes at concentrations of up to 10.5% v/v would not produce a blood level of FE-227™ associated with cardiac sensitization. As with all HFC agents used as fire suppressants, human exposure to concentrations above the NOEL is limited to 5 minutes in duration.

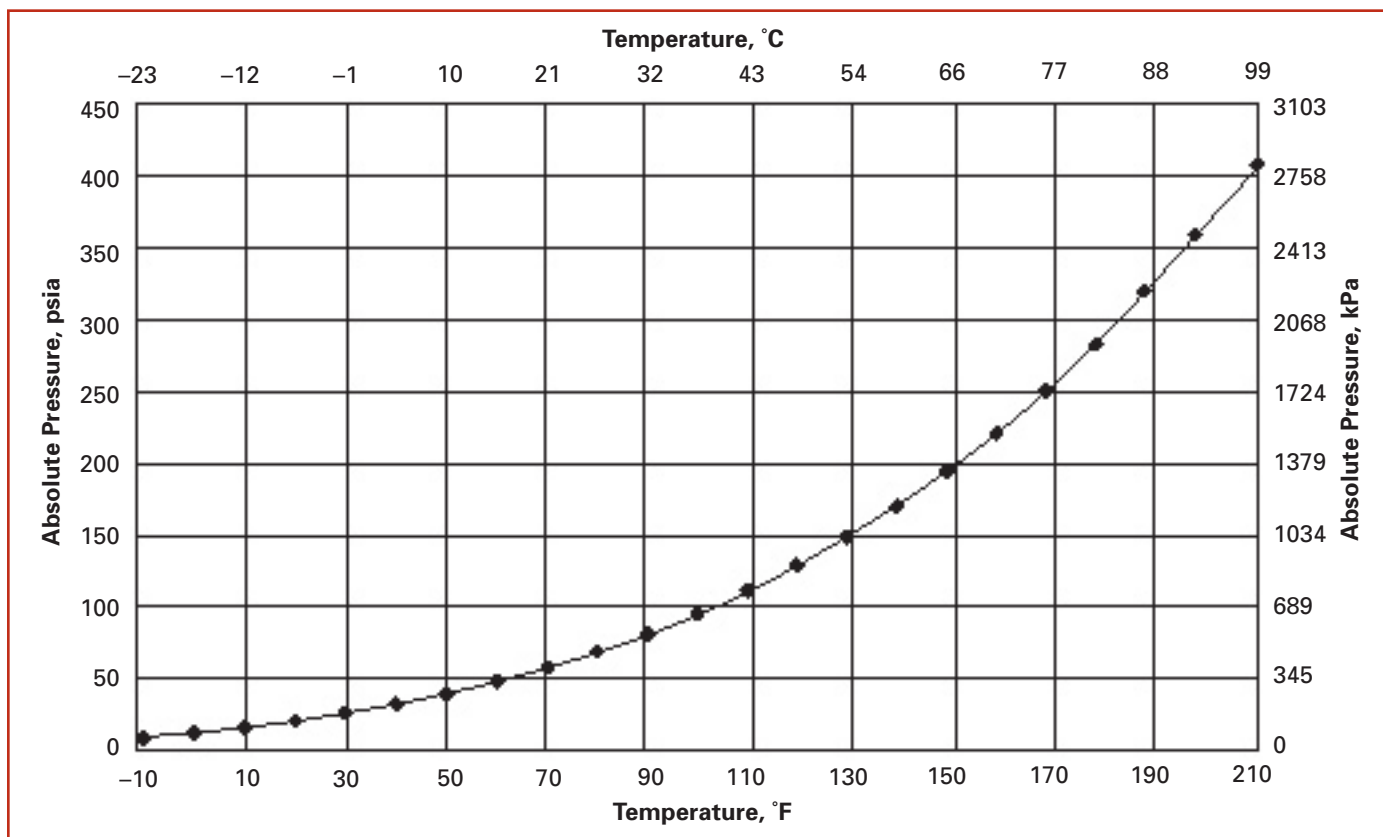
No other adverse effects were observed in rats exposed by inhalation at concentrations of up to 105,000 ppm for up to 90 days.

FE-227™ is not mutagenic.

Environmental

FE-227™ or heptafluoropropane (CF₃CHFCF₃) is environmentally acceptable with an ozone-depletion potential (ODP) of zero, a global warming potential of 2,900, based on a 100-yr horizon relative to CO₂, and an atmospheric lifetime of 36.5 years.

Figure 1. Saturated Vapor Pressure of DuPont™ FE-227™



In 1994 the EPA rated HFC-227ea as acceptable for use as a total flooding agent in occupied spaces under their Significant New Alternatives Policy (SNAP) program.

Materials Compatibility

Selected elastomers were immersed in a liquid/vapor mixture of FE-227™ for two weeks at room temperature (23°C [74°F]). Eight of the nine common elastomers exhibited negligible swelling, weight gain, or hardness change after exposure. This is shown in **Table 2**.

Plastics were evaluated in the same manner as the elastomers. Six of the plastics showed negligible effect (weight gain and surface condition). Results are summarized in **Table 3**.

Most of the common metals such as steel, cast iron, brass, copper, tin, lead, and aluminum can be used in contact with FE-227™ under normal conditions. Vessels storing FE-227™ should be free of moisture.

Availability

FE-227™ is available from DuPont in 150-pound cylinders, 1,200-pound containers and either 37,000-pound tank trailers or ISO containers depending upon location. Regional stocks of FE-227™ are maintained globally in accordance with local demand.

Specifications

FE-227™ is of high organic purity and essentially residue-free, meeting the following quality specifications:

Purity, % by weight, minimum	99.0
Moisture, ppm by weight, maximum	10
Acidity, ppm by weight, expressed as HCl, maximum	0.5
Residue, % by volume, maximum	0.03

Table 2
Elastomer Compatibility

Elastomer	Linear swell, %	Weight Gain, %	Hardness Change, units
Butyl	0	0.37	0
Nordel® EPDM	0.20	1.44	1.6
Neoprene W	0.05	0.66	0
NBR	0	1.86	4.0
Hypalon® CSM	0.19	1.41	2.4
Viton® A	9.49	26.83	-44.0
Epichlorohydrin homopolymer	0.15	0.08	5.5
FA polysulfide	0.05	0.06	6.9
Hytrel® TPE	1.33	5.71	4.6

Table 3
Plastic Compatibility

Plastic	Weight Gain, %	Surface Condition
High-density polyethylene (HDPE)	0.11	No Change
Polystyrene (PS)	-0.03	No Change
Polypropylene (PP)	0.06	No Change
Acrylonitrile-butadiene-styrene (ABS)	-0.03	No Change
Polycarbonate (PC)	-0.10	No Change
Polymethyl methacrylate (PMMA)	*	*
Nylon	-0.17	No Change
Teflon® PTFE	5.23	No Change

* Partly dissolved, deformed, and destroyed

For further information regarding DuPont Fire Extinguishing Agents, contact:

Americas

DuPont Fluoroproducts
Chestnut Run Plaza 702-1274E
P.O. Box 80702
Wilmington, DE 19880
Tel: (800) 473-7790

Asia

DuPont Taiwan, Limited
13F, Hung Kuo Building
167 Tun Hwa North Road
Taipei, Taiwan 105
ROC
Tel: 886-2-25144488

Europe

DuPont de Nemours International S.A.
2, Chemin du Pavillon
CH-1218 Le Grand-Saconnex
Geneva, Switzerland
Tel: 41-22-717-5376

cleanagents.dupont.com

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