

# DuPont™ FE-25™

## FIRE EXTINGUISHING AGENT

### Technical Bulletin

#### Description

DuPont has developed a Halon 1301 alternative fire extinguishing agent, called FE-25™, for use in a wide range of total flooding and inerting applications. DuPont™ FE-25™, pentafluoroethane or HFC-125, is a safe, clean, and electrically non-conductive agent that is intended to protect people, high value assets and the continuity of business. FE-25™ demonstrates the closest physical property match to Halon 1301 in terms of both flow characteristics and vapor pressure.

FE-25™ has been validated by independent agencies and received component approval from Factory Mutual Research Corporation (FM). It is listed as an acceptable replacement for Halon 1301 in the United States Environmental Protection Agency's Significant New Alternative Policy (SNAP) program for fixed fire extinguishing systems. FE-25™ has zero ozone-depletion potential and is an environmentally preferred alternative to Halon. It is also listed in the National Fire Protection Association (NFPA) 2001 Clean Agent Standard and the International Standards Organization (ISO) 14520 Standard.

#### Performance

The accepted Minimum Extinguishing Concentration (MEC) for FE-25™ for Class-A fires is 6.7% based on the Class-A fire test requirements found in the Underwriters Laboratories' (UL) Standard 2166. For Class-B fires, the MEC is 8.7% based on cup-burner tests with n-heptane fuel. Minimum Design Concentrations (MDC) should be based on the specific hardware manufacturer's MEC plus a safety factor of 20%–30% depending on the requirements of the local Authority Having Jurisdiction (AHJ).

Testing has demonstrated that FE-25™ closely matches the flow characteristics of Halon 1301. This feature may allow FE-25™ to be used in Halon 1301 piping networks when retrofitting existing systems.

Properties of FE-25™ are compared with Halon 1301 in **Table 1**.

**Table 1**  
**Typical Properties of DuPont™ FE-25™**

	Halon 1301	FE-25™
Chemical Formula	CF3Br	CF3CHF2
Ozone Depletion Potential	16	0
Molecular Weight	148.9	120.02
Boiling Point, °C (°F)	–57.7 (–72.0)	–48.3 (–55)
Critical Temperature, °C (°F)	152.6	66.3 (151.3)
Liquid Density at 77°F, lb/ft <sup>3</sup>	96.01	74.27
Vapor Pressure at 77°F, psia	234.8	200.4
Heat of Vaporization at Boiling Point, Btu/lb	51	71
Extinguishing Concentration, Heptane, Cup Burner, vol %	3.5	8.7
Acute Toxicity, ALC or LC50 Rats; 4 hr-ppm	400,000–800,000*	>700,000

\*Estimated values



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The concentration of FE-25™ required to inert an atmosphere containing a flammable concentration of methane has been measured as 14.7%. The inerting concentration is defined as the percentage of agent in air that inhibits the propagation of a flame. It is typically measured using the specific fuel and an ignition spark energy of 68 Joules. The inerting concentration is always greater than an agent's extinguishing concentration.

## **Application**

### ***Total Flooding of Class-A Hazards***

FE-25™ is an ideal replacement for Halon 1301 for the total flooding of enclosures. It can be used in applications where people are normally present (normally occupied spaces) for Class-A fire assets. Class-A fire assets represent greater than 90% of all commercial protection scenarios. Examples of applications where FE-25™ would be an excellent choice for a total flood fire suppression system where people are present are: computer rooms, telecommunication switch stations and facilities, semi-conductor manufacturing facilities, data processing centers, clean rooms, industrial process control rooms, museums, libraries and historical sites.

### ***Total Flooding of Class-B Hazards***

FE-25™ can also be used to suppress Class-B fire hazards. Examples of these applications would include: engine compartments, petrochemical facilities, chemical storage rooms, paint lockers and other areas where hydrocarbon-based materials are stored or handled.

### ***Protection of Aircraft Engine Nacelles***

FE-25™ was selected by the U.S. Department of Defense to undergo full-scale testing for engine nacelle applications as a replacement for Halon 1301 in new aircraft designs. This selection follows a comprehensive 17-month study at Wright-Patterson Air Force Base coordinated by National Institute of Standards and Technology (NIST) involving 12 candidate agents. NIST evaluated performance of the candidate agents over the flight envelope noting agent discharge characteristics, toxicity, and agent compatibility. As a result, the Navy has specified FE-25™ for the engine nacelles of aircraft such as the F/A-18 E/F and V-22.

## ***Flow Simulant***

HFC-125 (FE-25™) demonstrates the closest match to the flow characteristics of Halon 1301. As a result, FE-25™ is used for system flow verification, eliminating the use and discharge of Halon 1301, an ozone-depleting substance, into the atmosphere. The pressure traces, vaporization, and spray patterns for HFC-125 nearly duplicate that of Halon 1301.

## ***Explosion Suppression***

FE-25™ is currently used commercially in the area of explosion suppression. The primary application for FE-25™ in explosion suppression is to stop grain elevator explosions by stopping flame propagations in a fraction of a second.

## ***Toxicity***

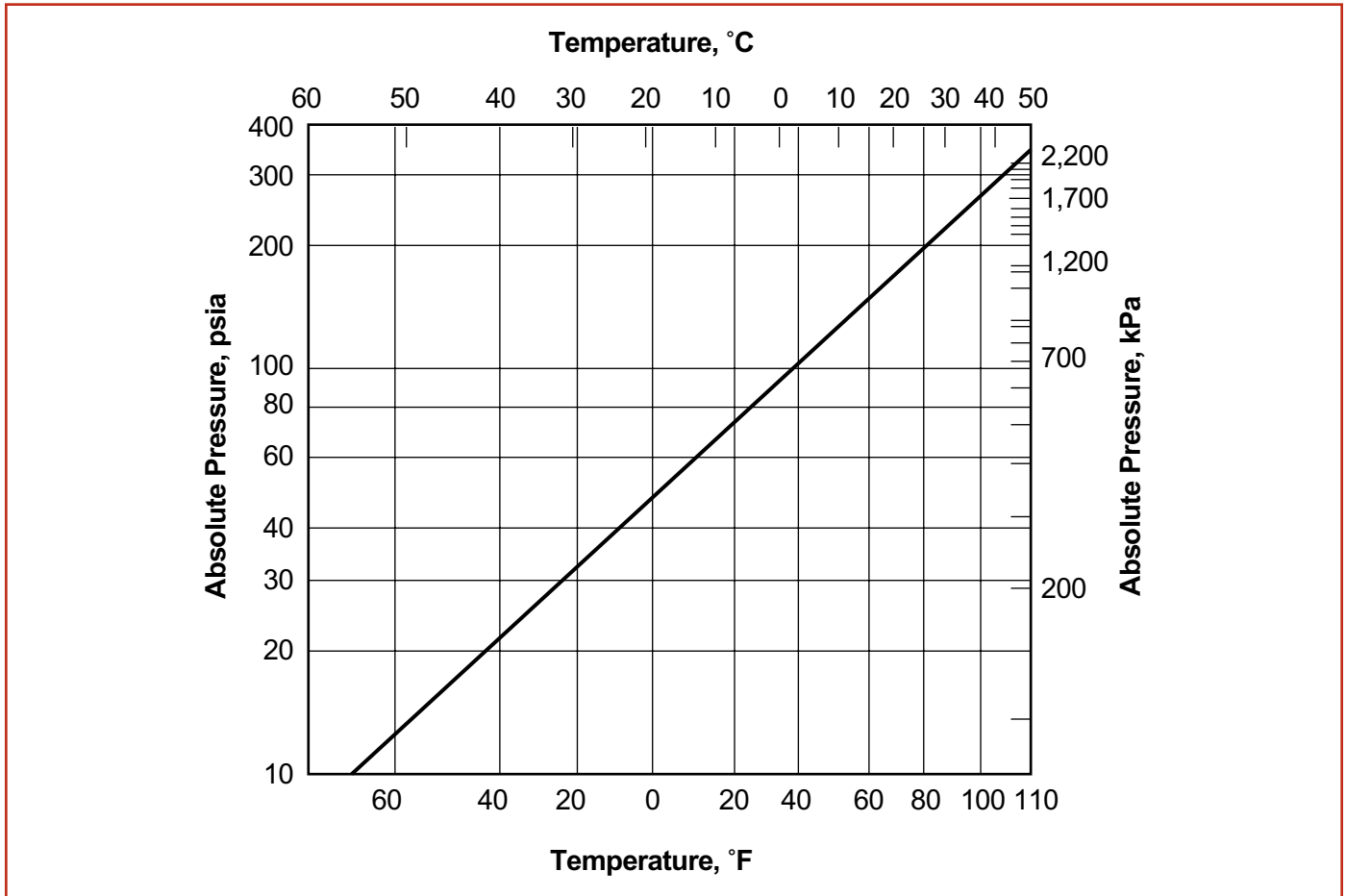
HFC-125 (FE-25™) is one of a series of fluorocarbon alternatives that was tested by the Program for Alternative Fluorocarbon Toxicity Testing (PAFT). It has very low acute toxicity by inhalation. As with most other halocarbons, HFC-125 produces a cardiac sensitization response in experimental screening studies.

NFPA 2001 Standard provides guidance for human exposure limits for various clean agent alternatives. The Standard lists HFC-125 acceptable for use in normally occupied spaces. For design concentrations up to 11.5%, the EPA recommended, Physiologically-Based Pharmacokinetic (PBPK) method allows an exposure time limited to a duration of five minutes. Typical design concentrations used for Class-A hazards are 8.0% (NFPA) or 8.7% (ISO).

It was also determined that HFC-125 does not cause developmental toxicity and is not mutagenic. The DuPont Acceptable Exposure Limit (AEL) for HFC-125 is 1,000 ppm by volume for an 8- to 12-hr time weighted average. This chronic exposure limit of 1,000 ppm in air, corresponds to the highest value conventionally used for an organic material. The AEL provides limits for long-term exposure in manufacturing operations.

During application as a fire suppressant, HFC-125 has the potential to form acid by-products, as is the case with all other halogenated agents. Rapid fire detection combined with short discharge times will minimize the formation of by-products.

**Figure 1. Saturated Vapor Pressure of DuPont™ FE-25™**



### Environmental

FE-25™ is an environmentally preferred alternative to Halon 1301. Unlike Halon, FE-25™ does not contain chlorine or bromine and therefore has zero ozone-depletion potential (ODP). Like many fluorine-based gases, FE-25™ has some global warming potential. The global warming potential for FE-25™ is 2,800, based on a 100-year time horizon relative to CO<sub>2</sub>. This is one of the lowest for the chemical agents commercially available. The overall environmental impact is minimized by improved detection technology to eliminate unwanted emissions into the environment.

### Compatibility

NIST tests concluded that FE-25™ showed no decomposition at 150°C (302°F) in the presence of eight commonly used metals for one-month exposure tests. FE-25™ exhibited good compatibility with a spectrum of cross-linked elastomers. The data in Table 2 are based on DuPont tests of each elastomer subjected to aging at room temperature for two weeks in FE-25™.

### Availability

FE-25™ is in commercial production and ready to serve the fire protection industry. It is available in tank trucks, ton tanks (1,200 lbs net), and cylinders (90-lbs net).

**Table 2  
Elastomer Compatibility**

	Linear Swell, %	Hardness Change
Adiprene® U	2	-2
Nitrile Rubber NBR	**1*	-8
Butyl Rubber	-1	2
Hypalon® CSM	1	-1
Natural Rubber	-1	1
Neoprene CR	3	-5
Nordel® EPDM	-1	-2
Silicone	4	-5
FA® Polysulfide	-1	2
Viton® A	** 9**	-10

\* Sample lost elasticity; did not return to original shape when deformed

\*\* Sample blistered

## Specifications

FE-25™ 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, max.	0.1
Residue, % by volume, maximum	0.01

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