DuPont™ FE-13™

FIRE EXTINGUISHING AGENT

Technical Information

DuPont™ FE-13™ for Total Flooding Agent Applications

Description

In response to the production phaseout of Halon fire extin - guishants, DuPont has developed FE-13™ (trifiuoromethane) as a replacement for Halon 1301 in applications requiring a clean, environmentally acceptable, and humanly compatible fire extinguishing agent. It can be used in the same appli- cations as Halon 1301 but not as a “drop-in” replacement because of differences in pressure and volumetric efficiency. Because DuPont™ FE-13™ contains no chlorine or bromine, its ozone depletion potential is zero.

Performance

FE-13™ extinguishes fires by both physical and chemi- cal means. Primarily, it raises the total heat capacity of the environment to the point that the atmosphere will not support combustion. In practice, however, extinguishment occurs at concentrations less than the theoretical heat capacity value. This is explained by assuming that the agent also removes the free radicals that serve to maintain the combustion process.

The extinguishing concentration of FE-13™ for heptane (cup burner method) is 12% by volume. Although it is customary to recommend a design concentration of cup burner plus 20%, DuPont recommends a minimum value of 16%. Under these conditions, when compared to Halon 1301 at a 5% design concentration, it requires 1.7 times as many pounds of FE-13™ to give the same protection. FE-13™ is also effective on Class A fires.

The inerting concentration for methane fuel is 20.5% by volume.

Comparison of CO_2 and FE-13™

The higher vapor pressure of FE-13™ suggests its similarity to carbon dioxide, but its greater liquid density along with the much lower toxicity and extinguishing concentration merit its consideration for use in place of CO_2.

Cylinders rated for CO_2 storage would be similar to those required for FE-13™.

Toxicity

Short-term and extended inhalation studies on animals, including histologic examination, indicate that FE-13™ is chemically and biologically unreactive. Although it has not been evaluated as extensively as Halon 1301, where there are comparable studies, FE-13™ exhibits lesser effects. In 1992, DuPont sponsored a study to evaluate the cardiac sensitization potential of FE-13™ in dogs. No serious arrhyth- mias were evoked after a 5-min exposure to 30% FE-13™ (and 70% air), followed by an epinephrine challenge. It is not likely that higher concentrations of FE-13™ would be used for fire protection in normally occupied spaces because of excessive oxygen depletion. Nevertheless, one additional test was performed with added oxygen at 50% FE-13™. Again, no serious arrhythmias were elicited. Other research - ers report that 80% by volume of FE-13™ did not produce cardiac sensitization in animals.

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FE-13™ is not a mutagen in the Ames test.

When exposed to open fiames, FE-13™ will decompose and produce hydrofiuoric acid (HF). The amount of HF will depend upon the size of the fire and the speed of extinguishment. Even at low levels, these decomposition products have a very acrid odor and are easily detected by the human senses. The natural tendency to escape exposure should be heeded.

Compatibility

In storage, FE-13™ is a very stable compound and in the absence of excessive moisture is not expected to react with common materials of construction such as steel, aluminum, and brass. Likewise, many elastomers and plastics are compatible with FE-13™.

Table 1
Properties of DuPont Alternative Fire Extinguishant

	Total Flooding Agents	
	Halon 1301	FE-13™
Chemical Formula	CF3Br	CHF3
Ozone Depletion Potential	16	0
Molecular Weight	148.9	70.01
Boiling Point (°F/°C)	–72.0/–57.8	–115.7/–82.0
Critical Temperature (°F/°C)	152.6/67.0	78.6/25.9
Liquid Density at 77°F (lb/ft3)	96.01	41.82
25°C (g/cm3)	1.54	0.67
Vapor Pressure at 77°F (psia)	234.8	686
25°C (kPa absolute)	1620	4729
Heat of Vaporization at 70°F (Btu/lb)	35.5	31.4
21.1°C (cal/g)	19.7	17.5
Extinguishing Concentration, Heptane, Cup Burner (vol%)	3.5	12
Acute Toxicity (ALC or LC50 Rats; 4 hr–ppm)	400,000 800,000*	>650,000

* Estimated values

Comparison of CO_2 and FE-13™

	CO_2	FE-13™
Boiling Point (°F/°C)	–109.1/–78.4 (sublimes)	–115.7/–82.0
Vapor Pressure at 70°F (psia)	845	624
21.1°C (kPa absolute)	5826	4299
Liquid Density at 68°F (lb/ft^3)	48.4	50.3
20°C (g/cm^3)	0.75	0.806
Specific Volume at 70°F (ft^3/lb)	8.76	5.486
20°C (m^3/kg)	0.547	0.3425
Critical Temperature (°F/°C)	87.8/31	78.6/25.9
Extinguishing Concentration (vol %)	28*	12**
Safety at Extinguishing Concentrations	Life Threatening	Not Life Threatening

* Theoretical minimum for gasoline

** Cup burner for heptane

When released under fire conditions, some FE-13™ will decompose, producing hydrofiuoric acid, which can react with glass and metallic surfaces. The effects may be neg - ligible where rapid detection and extinguishment minimize decomposition products.

Availability and Approvals

DuPont is now producing FE-13™ in commercial quantities and has the capacity to meet all anticipated fire protection needs.

FE-13™ is listed as acceptable for use by the U.S. Environmental Protection Agency “wherever technical or market conditions warrant.” FE-13™ is included in National Fire Protection Standard 2001, where it is identified as HFC-23.

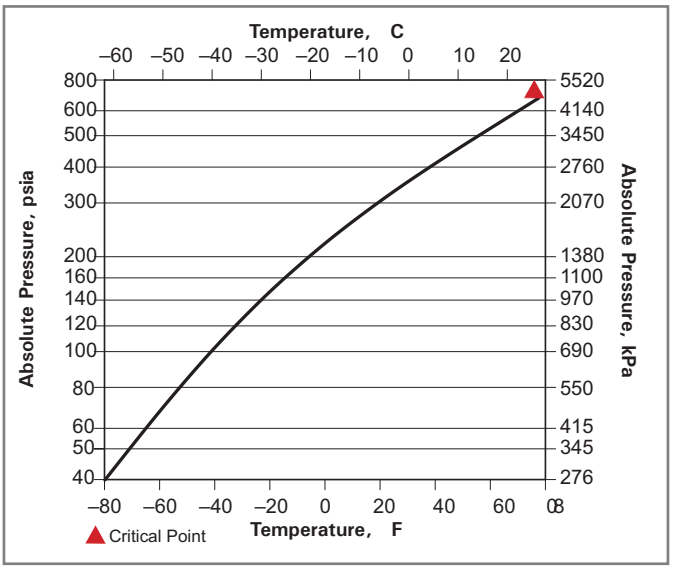
At least one hardware manufacturer has received a listing from Underwriters Laboratories. Also, FE-13™ is approved for use in Factory Mutual approved fire extinguishing systems.

Applications

FE-13™ has the potential to replace Halon 1301 in a broad range of fire extinguishing and inerting applications. Its very low boiling point permits use in temperature extremes ranging from –40°F (–40°C) to 130°F (54.4°C). Therefore, systems containers need not be stored in protected spaces at room temperature. The low boiling point also leads to high volatility and the ability to evenly fiood large enclosures, particularly those with high ceilings (25 ft [7.6 m]).

The low toxicity of FE-13™ allows for consideration of higher design concentrations such as might be required for inertion, difficult fuels, variable volumes (cargo holds), or increased margins of safety. Although 24% FE-13™ in air does not de - crease oxygen levels below the no impairment level of 16%, or lead to cardiac sensitization, it is always best to plan an evacuation prior to discharge whenever practical.

Figure 1. Saturated Vapor Pressure of FE-13™



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