FM-200™

Fire Extinguishing Agent

Technical Information

Description

FM-200™ is the world's most widely selected clean agent for use in new applications and as a Halon 1301 replacement. It is suitable for use in a wide range of fire extinguishing applications, including total flooding, streaming, and inerting applications. FM-200™ (HFC-227ea, CF_3CHFCF_3) is a safe, clean, and electrically non-conductive agent that protects people, high value assets, and the continuity of business operations.

FM-200™ has been validated by independent agencies and received component approval from Underwriters Laboratories (UL) and Factory Mutual Research Corporation (FM). It is listed as an acceptable agent for the replacement of Halon 1301 and new applications in the United States Environmental Protection Agency's (EPA's) Significant New Alternative Policy (SNAP) program in both total flooding and streaming systems. FM-200™ has a zero ozone depletion potential (ODP) and is the environmentally preferred alternative to Halon 1301. FM-200™ is included in the National Fire Protection Association (NFPA) 2001 Clean Agent Standard and the International Standards Organization (ISO) 14520 Clean Agent Standard.

Applications

Total Flooding of Class A Hazards

FM-200™ is an ideal choice for new applications and the replacement of Halon 1301 in total flooding applications involving Class A (plastic, cellulosic, solid) hazards. FM-200™ is suitable for use in Class A applications where people are normally present (normally occupied spaces). Class A fire hazards represent greater than 90% of all commercial protection scenarios. Examples of applications where FM-200™ is an excellent choice for a total flood fire suppression system where people are present include: computer rooms, telecommunication switch stations and facilities, semiconductor manufacturing facilities, data processing centers, clean rooms, industrial process control rooms, museums, libraries, and historical sites.

Total Flooding of Class B Hazards

FM-200™ is suitable for the protection of Class B (liquid and gas) fire hazards. Examples of these applications include: engine compartments, petrochemical facilities, chemical storage rooms, paint lockers, and other areas where hydrocarbon-based materials are stored or handled.

Total Flooding of Class C Hazards

In certain instances, equipment remains electrically energized during and after fire extinguishing system activation. FM-200™ is also suitable for the protection of these Class C (electrically energized) fire hazards.

Explosion Suppression

FM-200™ is also suitable for use in explosion suppression applications. Such systems typically employ extremely rapid detection and suppression system activation.

Streaming Applications

FM-200™ is suitable for the replacement of Halon 1301 or Halon 1211 in certain streaming applications, such as portable fire extinguishers, for the protection of Class A, B, and C hazards.

A selection of physical properties of FM-200™ are given in **Table 1**; vapor pressure and density of FM-200™ are given in **Tables 2** and **3**. For more detailed information on the properties and applications of FM-200™, see "FM-200™ Fire Extinguishing Agent, Properties, Uses, Storage, and Handling."

Chemours™

Table 1.. Properties of FM-200™

Chemical Formula	CF_3CHFCF_3
Ozone Depletion Potential	0
Molecular Weight	170.03
Boiling Point, °C (°F)	–16.34 (2.59)
Critical Temperature, °C (°F)	101.75 (215.1)
Liquid Density at 25 °C (77 °F), kg/m³ (lb/ft³)	1,387.7 (86.63)
Vapor Pressure at 25 °C (77 °F), kPa (psia)	454.73 (65.9)
LC50 (4 hr, rat), ppm	>800,000
Heat of Vaporization at Boiling Point, kJ/kg (Btu/lb)	131.77 (56.7)
Minimum Design Concentration Class A and C Hazards Heptane	 6.25–7 8.7

Table 2. Vapor Pressure and Density of FM-200™ (SI Units)

Temperature (°C)	Vapor Pressure (kPa)	Liquid Density (kg/m³)	Saturated Vapor Density (kg/m³)	Vapor Density at 1 atm (kg/m³)
–15	107.33	1539.7	8.961	8.4325
–10	132.23	1522.1	10.921	8.2412
–5	161.41	1504.2	13.205	8.0603
0	195.36	1486.0	15.853	7.8889
5	234.58	1467.3	18.905	7.7260
10	279.57	1448.2	22.411	7.5709
15	330.89	1428.6	26.421	7.4229
20	389.08	1408.4	30.996	7.2815
25	454.73	1387.7	36.202	7.1461
30	528.42	1366.2	42.118	7.0163
35	610.79	1344.0	48.833	6.8918
40	702.45	1320.9	56.454	6.7720
45	804.09	1296.7	65.109	6.6568
50	916.39	1271.4	74.956	6.5459
55	1040.10	1244.8	86.189	6.4389
60	1175.90	1216.5	99.062	6.3356
65	1324.70	1186.2	113.900	6.2359
70	1487.40	1153.6	131.170	6.1395
75	1664.90	1117.9	151.500	6.0462
80	1858.30	1078.2	175.870	5.9559
85	2068.80	1032.8	205.840	5.8684
90	2298.10	978.6	244.310	5.7836
95	2547.90	907.8	298.000	5.7013
100	2821.60	786.8	397.240	5.6215

Table 3. Vapor Pressure and Density of FM-200™ (English Units)

Temperature (°F)	Vapor Pressure (psia)	Liquid Density (lb/ft³)	Saturated Vapor Density (lb/ft³)	Vapor Density at 1 atm (lb/ft³)
10	17.50	95.51	0.63	0.5197
20	21.93	94.28	0.77	0.5069
30	27.18	93.02	0.95	0.4948
40	33.35	91.73	1.16	0.4834
50	40.55	90.41	1.40	0.4726
60	48.88	89.05	1.68	0.4624
70	58.45	87.64	2.00	0.4527
80	69.38	86.19	2.38	0.4434
90	81.79	84.68	2.81	0.4345
100	95.80	83.11	3.31	0.4261
110	111.54	81.46	3.88	0.4179
120	129.15	79.73	4.54	0.4102
130	148.77	77.90	5.30	0.4027
140	170.55	75.94	6.18	0.3955
150	194.65	73.84	7.22	0.3886
160	221.26	71.54	8.45	0.3820
170	250.55	69.00	9.93	0.3756
180	282.77	66.10	11.76	0.3694
190	318.18	62.68	14.10	0.3634
200	357.11	58.32	17.33	0.3576

Toxicology

FM-200™ is characterized by very low acute toxicity. The 4 hour (rat) LC50 of FM-200™ is greater than 800,000 percent (>80% v/v). The threshold cardiac sensitization, lowest observed adverse effect level (LOAEL) for FM-200™ is 105,000 ppm (10.5%) and the no observed adverse effect level (NOAEL) is 90,000 ppm (9.0%) as determined in epinephrine-challenged dogs. The physiologically-based pharmokinetic (PBPK) methodology has demonstrated that human exposure to FM-200™ for up to 5 minutes at concentrations of up to 10.5% v/v does not produce a blood level of FM-200™ associated with cardiac sensitization in epinephrine-challenged dogs.

Materials Compatibility

Because FM-200™ can be used in a variety of applications, it is important to review the materials of construction for compatibility when designing new equipment, retrofitting existing equipment, or preparing storage and handling facilities. The following are general test results. To determine the compatibility of the specific materials being considered for use in a particular system, additional tests should be conducted with these materials at the conditions of that system.

Stability with Metals

Most of the commonly encountered metals, such as steel, cast iron, brass, copper, tin, lead, and aluminum, can be employed with FM-200™ under normal conditions of use. Testing to ASTM G31 at 54 °C (130 °F) for 18 days indicates that the following metals are suitable for use with FM-200™:

Aluminum 1100
Aluminum 2024
Inconel 600
Stainless Steel 316
Stainless Steel 304
Yellow Brass
Nickel 200
Copper CDA 110
Cast Iron, Grey
Lead
Carbon Steel 1020
Silver 999+ Fine

Compatibility with Elastomers

Compatibility tests were performed with several commonly used elastomers. Elastomer coupons were 50% immersed in liquid FM-200™ for two weeks at room temperature. Additional tests were conducted per ASTM D471 at 100 °C (212 °F). All of the elastomers tested exhibited minimal swell with the exception of urethane and Viton™ A.

Table 4.. Elastomer Compatibility

Elastomer	Linear Swell (%)	Weight Gain (%)	Hardness Change (units)
Exposure at Room Temperature, 23 °C (72 °F) for 14 days			
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
Exposure per ASTM D471 at 100 °C (212 °F)			
Buna N	–3.1		
Butyl	3.6		
EPDM	1.0		
Hypalon™	–2.0		
NR Rubber	1.7		
Neoprene G	0.8		
Neoprene W	–3.6		
SBR	–1.2		
Silicone	2.8		
Urethane	>10		
Viton™ A	8.4		

Compatibility with Plastics

Compatibility tests were also performed with several commonly used plastics. Results are summarized in **Table 5**.

Table 5. Plastic Compatibility

Elastomer	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
Nylon 6/6	-0.17	No Change
Polytetrafluoroethylene (PTFE)	5.23	No Change
Polyimide (PI)	-0.11	No Change
Polyethylene Terephthalate (PET)	-0.04	No Change
Polybutylene Terephthalate (PBT)	-0.06	No Change
Acetyl	-0.04	No Change
Polyvinyl Chloride (PVC)	-0.06	No Change
Polyphenylene Oxide (PPO)	-0.05	No Change
Polyphenylene Sulfide (PPS)	-0.38	No Change

Containers

FM-200™ is available from Chemours in 1,200-lb (544-kg) containers and 37,000-lb (16,784-kg) tank trailers and ISO containers. Regional stocks of FM-200™ are maintained globally in accordance with local demand.

Specification

FM-200™ is of high purity and residue-free, meeting the following minimum 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

For more information on FM-200™, please visit cleanagents.chemours.com or call (800) 473-7790

Replaces: K-23455
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