



Novec™ 1230

Fire Protection Fluid

Introduction

3M™ Novec™ 1230 Fire Protection Fluid, dodecafluoro-2-methylpentan-3-one, (CF₃CF₂C(O)CF(CF₃)₂), is a clear, colorless and low odor fluid, one of a long line of 3M products designed as a replacement technology for ozone depleting substances (ODSs).

Novec 1230 fluid is an effective fire extinguishing agent in standard fire scenarios where halons historically have been used and where halon alternatives are now being used.

Typical Applications

Novec 1230 fluid can effectively be applied in streaming, localized flooding, total flooding, inerting and explosion suppression applications in the following areas:

- Data Processing Centers
- Telecommunications
 - Cellular Sites
 - Switching Centers
- Commercial Aviation
 - Aboard Aircraft
 - Airport Crash Rescue Vehicles
- Military Aviation
 - Flightlines
 - Crash Rescue Vehicles
- Military Systems
 - Combat Vehicles
 - Marine Engine Rooms
- Oil & Gas Exploration
 - Platform Helipads
 - Storage Tank Rim Seals
- Transportation
 - Merchant Marine Vessels
 - Mass Transit Vehicles
- Recreation
 - Pleasure Craft
 - Race Cars

Material Specifications

Properties	Novec 1230 Fluid
Dodecafluoro-2-methylpentan-3-one	99.0 mole %, minimum
Nonvolatile residues	0.05 g/100 ml, maximum
Acidity and water content	Specifications are under development.

Fire Extinguishing Performance

The extinguishing performance of Novec 1230 fluid has been shown in small- and large-scale tests. The initial effectiveness has been demonstrated in military applications such as on flightlines and in standard fire scenarios as part of an Underwriters Laboratories and Factory Mutual listing.

3M™ Novec™ 1230 Fire Protection Fluid Features

Novec 1230 fluid's environmental profile, toxicity characteristics, and fire performance make it a sustainable solution as a halon replacement alternative to Halons, HFCs and PFCs.

An advantage of a liquid agent is that it can be shipped in drums and totes rather than pressurized cylinders. That means that you can air freight Novec 1230 fluid in bulk quantities if needed for refills instead of the very limited quantities of gases that can be air shipped.

If a leak occurs in the extinguisher or system after superpressurization, the N₂ can easily be vented and the agent retained while repairing the cylinder seal or gasket. With gases, the agent would be lost.

The liquid is pourable, low in viscosity and easy to handle. It can easily be pumped with hand or electric pumps.

Novec 1230 fluid can be used both as a streaming agent (e.g., hand-held extinguishers) or as a total flooding agent in fixed systems.

Novec 1230 fluid is compatible with a wide range of materials of construction. It is stable in storage.

Properties Description

Not for specification purposes

All values determined at 25°C (77°F) unless otherwise specified

Typical Physical Properties	Novec 1230 Fluid
Chemical Formula	CF ₃ CF ₂ C(O)CF(CF ₃) ₂
Molecular Weight	316.04
Boiling Point @ 1 atm	49.0°C (120.2°F)
Freezing Point	-108°C (-162.4°F)
Critical Temperature	168.66°C (335.6°F)
Critical Pressure	18.65 bar (270.44 psi)
Critical Volume	494.5 cc/mole (0.0251 ft ³ /lbm)
Critical Density	639.1 kg/m ³ (39.91 lbm/ft ³)
Density, Sat. Liquid	1.60 g/ml (99.9 lbm/ft ³)
Density, Gas 1 ATM	0.0136 g/ml (0.851 lbm/ft ³)
Specific Volume, Gas 1 ATM	0.07333 m ³ /kg (1.175 ft ³ /lb)
Specific Heat, Liquid	1.1030 kJ/kg°C (0.2634 BTU/lb°F)
Specific Heat, Vapor @1 ATM	0.891 kJ/kg°C (0.2127 BTU/lb°F)
Heat of Vaporization @ boiling point	88.1 kJ/kg (37.9 BTU/lb)
Liquid Viscosity @ 0°C/25°C	0.56/0.39 centistokes
Solubility of Water in Novec 1230 Fluid	<0.001 % by wt.
Vapor Pressure	0.40 bar (5.85 psig)
Dielectric Strength	~60 kV

Novec 1230 Safety and Use Concentration Comparison

All data other than those for Novec 1230 fluid were compiled from published sources.

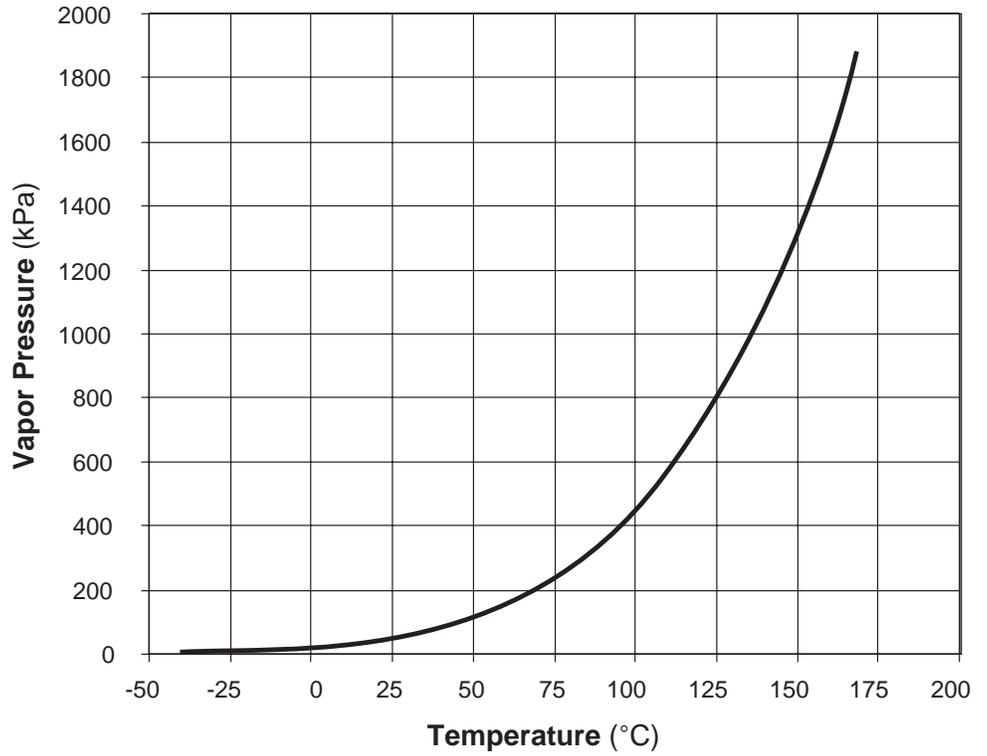
Properties	Halon 1301	HFC-227ea	Novec 1230	Inert Gas	CO ₂
Boiling point °C (°F)	-57.8 (-72.04)	-16.4 (2.48)	49.0 (120.2)	-196.0 (-320.8)	Sublimes at low temps
Use Concentration	5%	7.5-8.7%	5-6%	38-40%	30-75%
NOAEL*	5%	9%	10%	43%	<5%
Safety Margin	nil	3-20%	67-100%	7-13%	Lethal at Design Concentrations

* No Observed Adverse Effect Level for cardiac sensitization (halocarbons) and oxygen depletion (inert gas).

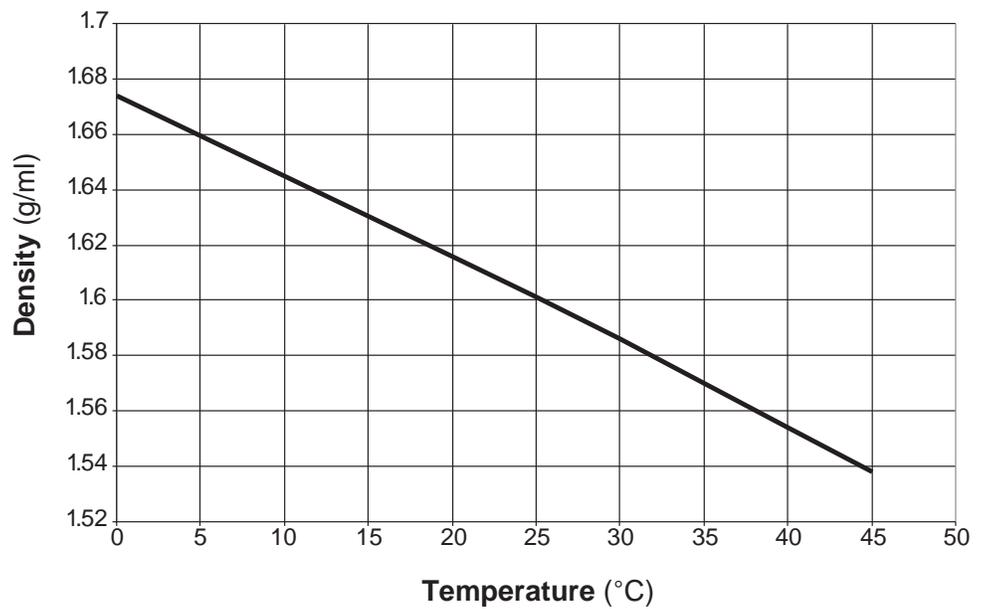
Novec 1230 fluid offers outstanding margins of human safety when compared to halon and to all viable alternatives.

Not for specification purposes

**Novec 1230 Fluid
Vapor Pressure vs. Temperature**



**Novec 1230 Fluid
Liquid Density vs. Temperature**

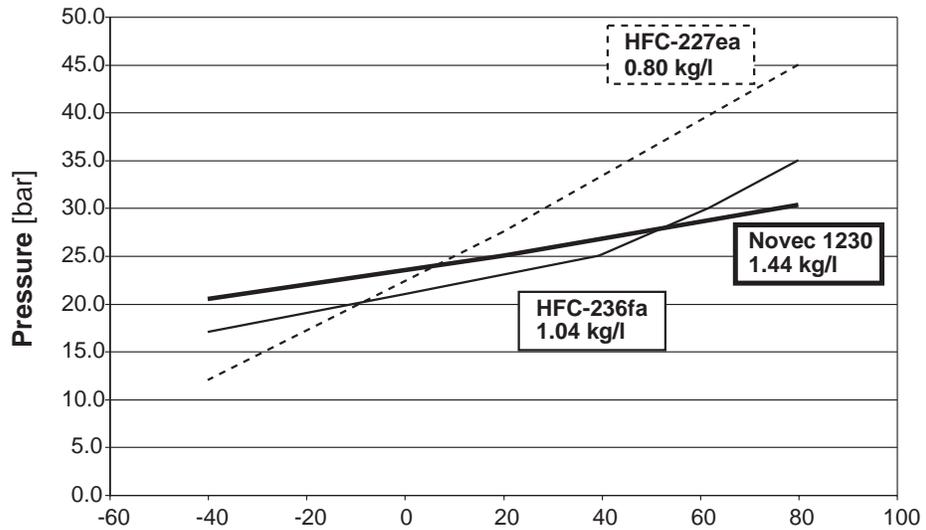


3M™ Novec™ 1230 Fire Protection Fluid Advantages of a Liquid Instead of Gas

Not for specification purposes

The following graph displays the unique properties that differentiate Novec 1230 fluid from other agents. Over a wide range of temperatures, a high boiling material like Novec 1230 fluid, when superpressurized with nitrogen in a cylinder, does not vary significantly in storage pressure like the lower boiling gasses. Note the pressure delta of only 10 bar for Novec 1230 fluid, whereas with some low boiling gasses, there can be as much as a 33 bar delta over the same temperature range. The maximum fill density for Novec 1230 fluid is 1.8 times greater than lower boiling gasses over the -40°C to 80°C range. This is important in applications where there is an expected wide range of temperatures, such as military vehicles, aircraft, or aboard ships that may enter tropical or arctic waters.

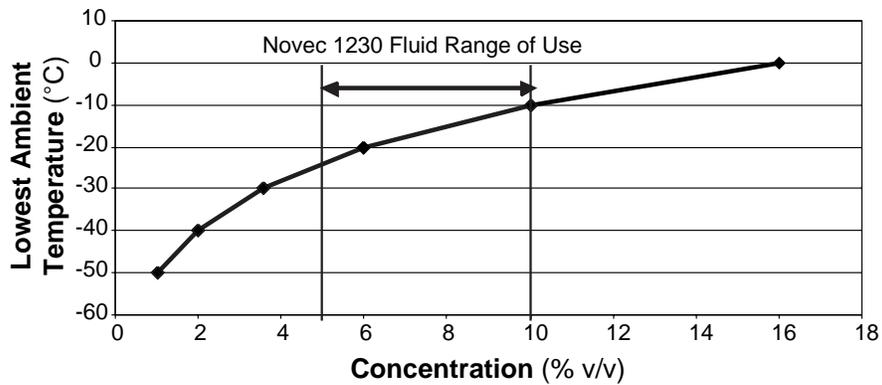
Pressure vs. Temperature Comparison
Super Pressurization @ 25 Bar



Source: NFPA 2001 and 3M Labs

Although most applications will not be in this temperature range, the following chart illustrates that Novec 1230 fluid is able to effectively vaporize over the expected range of design concentrations at very low ambient temperatures, even though it is a high boiling fluid.

Expected Range of Use Concentration



Source: Tropodegradeable Halocarbons and Main Group Element Compounds
April 1999, Halon Options Technical Working Conference - NMERI

Source: NMERI and 3M Labs

**Compatibility of “O” Rings with Novec 1230 Fluid
Exposure Time: 1 Week @ 25°C, 100°C**

Elastomer Type	Exposure Temp.	Change in Shore A Hardness	% Change in Weight	% Change in Volume
Neoprene	25°C	-1.8	-0.6	-1.2
	100°C	-2.2	+2.3	+0.8
Butyl rubber	25°C	-2.7	+0.2	+0.1
	100°C	-4.0	+4.3	+4.2
Fluoroelastomer	25°C	-6.2	+0.7	+0.6
	100°C	-12.6	+9.5	+10.6
EPDM	25°C	-4.7	+0.6	+0.3
	100°C	-5.7	+3.3	+2.4
Silicone	25°C	N/A	+3.1	+2.8
	100°C	-5.4	+6.0	+5.1
Nitrile	25°C	-0.7	-0.3	-0.5
	100°C	+2.5	+4.6	+0.7

Effects of Boiling Novec 1230 Fluid on Various Metals

Metals	Effect
Aluminum Alloy 6262 T6511	A
Brass Alloy UNS C36000	A
AISI Type 304L stainless steel	A
AISI Type 316L stainless steel	A
Copper UNS C12200	A
ASTM A 516, Grade 70 carbon steel	A

A. No discoloration or destruction of fluid or metal at temperature indicated, 10 days minimum exposure, 49°C.

A study conducted by MIT examined the atmospheric loss mechanisms for Novec 1230 fluid. The authors of this study determined that this compound does not react with hydroxyl radical (OH) but that substantial decay occurs when exposed to UV radiation. The authors measured the UV cross-section for Novec 1230 fluid, finding a maximum wavelength of absorbance at 306 nm.

Since this compound shows significant absorbance at wavelengths above 300 nm, photolysis in the lower atmosphere will be a significant sink for this compound. The authors conclude that, “In fact, the absorption spectrum is similar to that of acetaldehyde, a species whose lifetime against solar photolysis is about 5 days. The absorption cross sections of Novec 1230 fluid are somewhat larger; hence, we expect the atmospheric lifetime of Novec 1230 fluid against solar radiation to be of the order of 3-5 days.”

Recent laboratory measurements of the photodissociation rate of Novec 1230 fluid found it to be equivalent to that for acetaldehyde, within experimental error. Hence, an atmospheric lifetime of 5 days is appropriate for Novec 1230 fluid.

The potential for Novec 1230 fluid to impact the radiative balance in the atmosphere (i.e., climate change) is limited by its very short atmospheric lifetime and low global warming potential (GWP). Using a measured IR cross-section and the method of Pinnock et. al., the instantaneous radiative forcing for Novec 1230 fluid is calculated to be $0.50 \text{ Wm}^{-2}\text{ppbv}^{-1}$. This radiative forcing and a 5-day atmospheric lifetime results in a GWP value of 1 using the WMO 1999 method and a 100-year integration time horizon. Compounds with such short atmospheric lifetimes do not pose a risk with respect to potential climate change.

Novec 1230 fluid is expected to rapidly degrade to fluorinated alkyl radicals similar to those produced by other fluorochemicals. Studies of the atmospheric chemistry of these radical species and their degradation products have concluded that they have no impact on stratospheric ozone. This, combined with its very short atmospheric lifetime, leads to the conclusion that Novec 1230 fluid has an ozone depletion of zero.

Before using this product, please read the current product Material Safety Data Sheet (available through your 3M sales or technical service representative) and the precautionary statement on the product package. Follow all applicable precautions and directions.

3M™ Novec™ 1230 Fire Protection Fluid Environmental Properties Comparison

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All data other than those for Novec 1230 fluid were compiled from published sources

Properties	Novec 1230	Halon 1211	Halon 1301	HFC-227ea	HFC-236fa	HCFC Blend B
Ozone Depleting Potential (ODP)	0.0	4.0	12.0	0.0	0.0	0.014
Global Warming Potential–IPCC 2001 ¹	1	1300 ²	6900 ²	3500	9400	120 ³
Atmospheric Lifetime (years)	0.014	11.0	65	33	220.0	1.4
SNAP (Yes/No)	Yes ⁴	No	No	Yes	Yes	Yes/ Phase-out

¹ IPCC Intergovernmental Panel on Climate Change Method 100 Year (ITH)

² Global Warming Potential 1998 WMO Method 100 Year (ITH)

³ Data based on HCFC-123 only—also contains CF₄

⁴ U.S. EPA has expressed its intent to approve. Commercial sale of Novec 1230 fluid is permitted.

Toxicity Profile

Novec 1230 fluid is a fluorinated ketone. It is safe for its intended use when used as directed. Acute toxicity testing completed shows that Novec 1230 fluid is low in toxicity. The effective toxicity exposure limit is greater than 100,000 ppm (>10% v/v) for both the acute 4-hour inhalation exposure and the acute cardiac sensitization No Observed Adverse Effect Level, or NOAEL. The acute cardiac sensitization Lowest Observed Adverse Effect Level, or LOAEL, is greater than 100,000 ppm (>10% v/v). See the Toxicity Properties Comparison table below.

Toxicity Properties Comparison

Not for specification purposes

Properties	Novec 1230	Halon 1211	Halon 1301	HFC-227ea	HFC-236fa	HCFC Blend B
Physical State @ 25°C	Liquid	Gas	Gas	Gas	Gas	Liquid
LC-50 4-hour acute inhalation (UNO) (% v/v)	> 10 ¹	20 (15 min)	>80	> 80	> 80	3.2
NOAEL / LOAEL Cardiac sensitization (% v/v)	10.0/ >10.0 ^{1,3}	1.0/ 2.0 ²	5.0/ 7.5	9.0/ 10.5	10.0/ 15.0	1.0/ 2.0

¹Huntingdon, UK results, 2000

²NOAEL–Dupont data, EC-50 (LOAEL)–Beck, Clark and Tinston data, 1973 & 82

³Although a test conducted at a high cardiac sensitization dose of 15% was not fully completed, no cardiac sensitization or deaths were observed.

Packaging and Availability

Novec 1230 fluid is currently available in 2645 lb. (1200 kg) intermediate bulk containers (IBCs), 353 lb. (160 kg) drums and 11 lb. (5 kg) glass sample jugs.

A cylinder containing Novec 1230 fluid superpressurized with nitrogen varies only 150 psi over a temperature range of 220°F (105°C). Also, because it is packaged in IBCs and drums, it can be air freighted without the restrictions on gaseous alternatives.

3M™ Novec™ 1230 Fire Protection Fluid Resources & Distribution

3M™ Novec™ 1230 Fire Protection Fluid is supported by global sales, technical and customer service resources, with technical service laboratories in the U.S., Europe, Japan, Latin America and Southeast Asia. Users benefit from 3M's broad technology base and continuing attention to product development, performance, safety and environmental issues.

Extensive O.E.M. policies and equipment design guidelines have been prepared for system retrofit, installers and equipment manufacturers in support of Novec 1230 fluid.

For additional technical information on Novec 1230 fluid in the United States, or for the name of a local distributor, call 3M Performance Materials Division, **800 810 8513**.

For other 3M global offices, and information on additional 3M products, visit our web site at **www.3m.com/specialtymaterials**

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