



1150 

Foam Blowing Agent

Properties, Uses, Storage, and Handling



Table of Contents

Introduction	3
Background.....	3
Uses	3
Regulatory.....	3
Properties	3
Chemical Properties.....	3
Physical Properties.....	3
Chemical/Thermal Stability and Compatibility	6
Chemical Stability	6
Thermal Decomposition.....	6
Compatibility with Metals	6
Compatibility with Elastomers.....	6
Compatibility with Plastics.....	6
Safe Use	7
Inhalation Toxicity	7
Skin and Eye Contact	7
Spills or Leaks.....	7
Enclosed and Confined Spaces.....	7
Air Monitors and Leak Detection.....	7
Storage and Handling	8
Shipping.....	8
Storage.....	8
Bulk Storage Systems.....	8
Converting Bulk Storage Systems to Opteon™ 1150..	8
Handling.....	9
Recycle and Disposal.....	9
Leaks and Spills.....	9
Disposal	9
References.....	9

Introduction

Background

With the establishment and continued evolution of the Montreal Protocol, the foam blowing agents (FBAs) used for closed-cell polymeric foam products have changed dramatically over the last two decades. Beginning in 1989, both thermoset and thermoplastic foam industries worldwide have moved away from chlorofluorocarbons (CFCs) in favor of hydrochlorofluorocarbons (HCFCs), such as HCFC-141b and HCFC-142b. These alternatives were chosen as they provided a greatly decreased ozone depletion potential (ODP). Today, countries have either eliminated the use of, or are in the process of phasing out, HCFCs in foam applications in order to meet the amended Montreal Protocol's regulated goal of zero ODP foam blowing agents.

This has led to the widespread use of third-generation zero ODP hydrofluorocarbon (HFC) foam blowing agents, such as HFC-245fa, HFC-365mfc, and HFC-134a. However, maturing environmental awareness has put such HFCs under regulation and, per the Kigali Agreement, are being phased out (based on application and country) due to their moderate global warming potential (GWP). As a result, many countries and polymeric foam manufacturers find themselves in need of a zero ODP and low GWP foam expansion agent.

Uses

Opteon™ 1150 is a zero ODP, low GWP foam expansion agent. With a GWP of 7, Opteon™ 1150 readily meets regulations established by the Montreal Protocol. The product is nonflammable and has a favorable toxicity profile.

Opteon™ 1150 is used as a physical foam blowing agent for thermoset polymer foams, including polyurethane, polyisocyanurate, and phenolic resins, as well as thermoplastic foams, such as polystyrene or polyolefin. Opteon™ 1150 provides excellent formulation stability as well as low vapor thermal conductivity. It may be used as a co-blowing agent in polyurethane foam resins or froth foams. Due to its boiling point of 7.5 °C (46 °F), it can easily be handled in cylinders.

Regulatory

The United States Environmental Protection Agency (EPA) has listed Opteon™ 1150 as an acceptable substitute in foam blowing agents for the end uses listed below under the Significant New Alternatives Policy (SNAP) program.

- Rigid Polyurethane Spray Foam (High Pressure Two-Component)
- Integral Skin Polyurethane
- Rigid Polyurethane and Polyisocyanurate
- Laminated Boardstock
- Rigid Polyurethane Appliance

- Rigid Polyurethane Commercial Refrigeration
- Rigid Polyurethane Sandwich Panels
- Rigid Polyurethane Slabstock and other

Opteon™ 1150 is subject to a Significant New Use Rule (SNUR) under the U.S. EPA Toxic Substance Control Act (TSCA) – 40 CFR § 721.10907. Export notification requirements according to TSCA §12(b) are referenced in the Opteon™ 1150 safety data sheet (SDS) regulatory section. Export notification requirements from the United States are referenced in the Opteon™ 1150 safety data sheet (SDS) regulatory section.

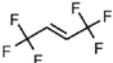
This technical bulletin is intended for general informational purposes only. As we are always discovering new and unique applications for Opteon™ 1150, one should consult the Chemours technical staff to best serve your application's needs. The Opteon™ 1150 SDS should always be consulted prior to use for additional information.

Properties

Chemical Properties

Opteon™ 1150, a hydrofluorinated compound containing a double bond, is otherwise known as a hydrofluoroolefin (HFO). The molecule does not contain chlorine or bromine; therefore, it has zero ODP. The double bond of the molecule allows Opteon™ 1150 to maintain its thermal stability in closed systems, such as polymeric foams; but, when accidentally released to the atmosphere, it has a very short atmospheric lifetime. This short atmospheric lifetime leads to Opteon™ 1150 having a 100-year ITH GWP of 7 (AR5). Chemical information for Opteon™ 1150 is shown in Table 1.

Table 1. Opteon™ 1150 Chemical Information

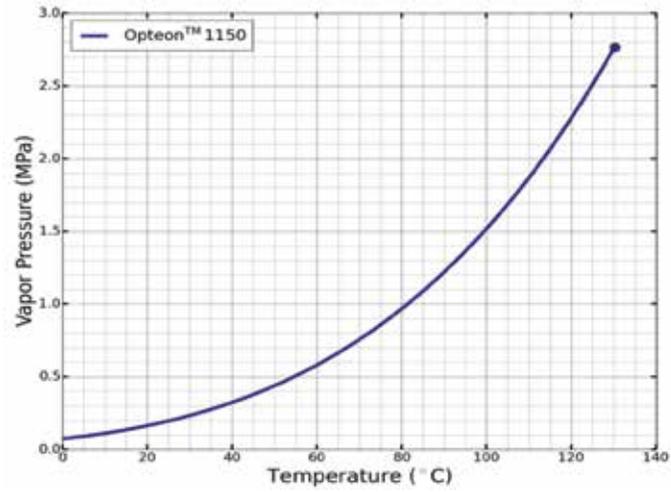
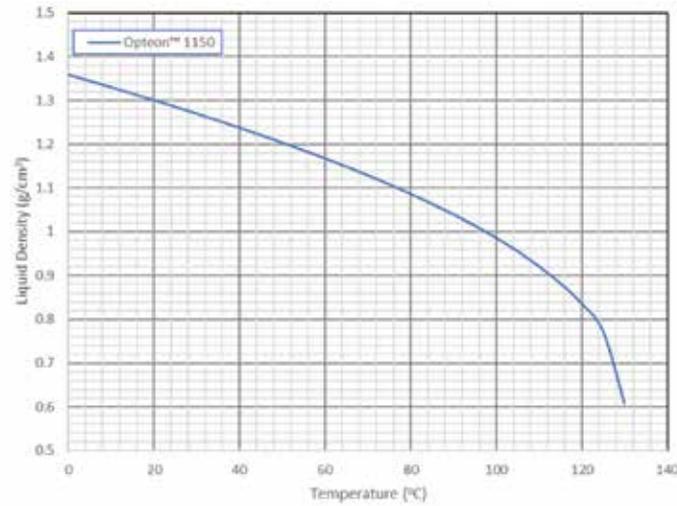
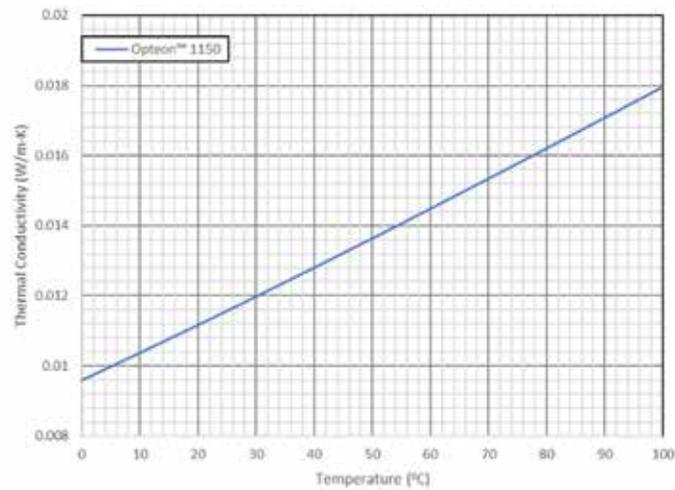
Chemical Name	Trans-1,1,1,4,4,4-Hexafluoro-2-Butene
Synonyms	Opteon™ 1150 HFO-1336mzz-E
Molecular Formula	CF ₃ CHCHCF ₃
CAS Registry Number	66711-86-2
Molecular Weight	164.05
Chemical Structure	

Physical Properties

Physical properties of Opteon™ 1150 are shown in Table 2. Saturated vapor pressure vs. temperature is shown in Figure 1. Liquid density vs. temperature is shown in Figure 2. Vapor thermal conductivity vs. temperature is shown in Figure 3.

Table 2. Opteon™ 1150 General Physical Properties

Physical Property	Unit	Opteon™ 1150
Vapor Pressure at 25 °C (77 °F)	kPa psia	194.55 24.6
Boiling Point (1 atm)	°C °F	7.5 45.5
Critical Temperature	°C °F	137.7 279.9
Critical Pressure	kPa abs psia	3148.9 456.72
Critical Density	kg/m ³ lb/ft ³	538.5 33.62
Liquid Density at 25 °C (77 °F)	kg/m ³ lb/ft ³	1294.7 81.6
Vapor Density at 25 °C (77 °F)	kg/m ³ lb/ft ³	14.3 0.89
Specific Heat, Liquid at 20 °C (68 °F)	kJ/kg-K Btu/lb-F	1.15 0.274
Specific Heat, Vapor at 20 °C (68 °F)	kJ/kg-K Btu/lb-F	0.81 0.193
Heat of Vaporization at Normal Boiling Point	kJ/kg Btu/lb	154 66.3
Thermal Conductivity, Liquid at 25 °C (77 °F)	W/m-K Btu/hr-ft-F	0.0804 0.0465
Thermal Conductivity, Vapor at 25 °C (77 °F)	W/m-K Btu/hr-ft-F	0.0115 0.00665
Viscosity, Liquid at 25 °C (77 °F)	MPa-s	240.9
Viscosity, Vapor at 25 °C (77 °F)	MPa-s	11.15
Flammability Rating at 60 °C (140 °F)	ASTM E-681	None
Solubility of H ₂ O in HFO-1336mzz-E at 25 °C (77 °F), % wt	g/L lb/gal	0.5779 0.00456
Solubility of HFO-1336mzz-E in H ₂ O at 25 °C (77 °F), % wt	g/L lb/gal	0.7789 0.00702
Ozone Depletion Potential (ODP)	CFC-11 = 1.0	0
Global Warming Potential (GWP) 100-yr ITH (AR5)	CO ₂ = 1	7
TSCA Inventory Status	Included	Included
WEEL Exposure Limit	ppm (8- and 12-hr TWA)	400

Figure 1. Opteon™ 1150 Saturated Vapor Pressure vs. Temperature (SI Units)**Figure 2.** Opteon™ 1150 Liquid Density vs. Temperature (SI Units)**Figure 3.** Opteon™ 1150 Vapor Thermal Conductivity vs. Temperature (SI Units)

Chemical/Thermal Stability and Compatibility

Due to the wide range of applications in which Opteon™ 1150 can be used, it is important to always review the system's chemicals, as well as the materials of construction for compatibility, before using Opteon™ 1150 in a new application. The following are general test results. To determine the compatibility of the specific system and materials being considered for use, additional tests should be considered at the conditions of the system.

Chemical Stability

Opteon™ 1150 is expected to be stable when used in combination with many typical polyurethane foam components, including polyols, surfactants, catalysts, and flame retardants. Consult your Chemours technical representative for details.

Thermal Decomposition

Although Opteon™ 1150 contains a carbon-carbon double bond, the molecule shows remarkable stability at temperatures up to 250 °C (482 °F) for at least 2 weeks in the presence of air, moisture, and metals (ASHRAE Standard 97 Sealed Tube Method).

Opteon™ 1150 will decompose when exposed to temperatures in excess of several hundred degrees Celsius (such as prolonged exposure to flame sources). Decomposition may produce toxic and/or irritating compounds, such as hydrogen fluoride. The decomposition products released will irritate the nose and throat.

Therefore, it is important to prevent exposure to decomposition products by following the Chemours SDS's recommendations for handling.

Compatibility with Metals

Compatibility tests were conducted in heavy walled glass tubes in accordance with ASHRAE 97. The tests were conducted with metal coupons (copper, brass, carbon steel, stainless steel, and aluminum) in the presence of Opteon™ 1150 and aged for 14 days at 175 °C (347 °F). Changes in weight and appearance of the metal coupons were recorded. The liquid solutions were also evaluated for appearance and decomposition products, such as fluoride. There were no changes in the color of the liquid or the condition of the metals at the conclusion of this test.

Compatibility with Elastomers

Compatibility tests with elastomers were performed similarly to the metal stability test, except the aging was done at room temperature (23 °C [74 °F]). This test indicates that Opteon™ 1150 is compatible with most common elastomers that exhibit negligible swelling, weight gain, or hardness change after exposure (shown in Table 3).

Compatibility with Plastics

Plastics compatibility tests were similarly performed by exposing plastic materials to Opteon™ 1150 at room temperature for two weeks. Weight, volume, and hardness before and after the exposure were measured. Observations of changes are summarized in Table 4, which indicates that Opteon™ 1150 is compatible with commonly employed plastics.

As always, verifying compatibility using fabricated parts under end user conditions is advised, as the performance of plastics is affected by polymer variations, compounding agents, fillers, and molding processes.

Table 3. Elastomer Compatibility – 2 Weeks Exposure to Opteon™ 1150 at Room Temperature

Elastomer Material	% Weight Change	% Volume Change	% ASTM Hardness Change
Neoprene C1276-70	-1.0	1.9	0.0
Epichlorohydrin YB 146-75	0.0	1.6	0.0
Butyl B0612-70	0.6	8.3	0.0
EPDM E0893-80	1.7	-1.7	0.0
Fluorosilicone	50.7	40.6	-22.5
HNBR Nitrile N1173-70	2.6	8.4	-5.0
NBR Nitrile NA151-70	0.9	-2.4	-2.5
Fluorocarbon FKM V0747-75	32.9	16.8	-12.5
Neoprene C0873-70	0.3	1.4	0.0
Viton™ A-401C	30.1	28.7	-12.5
Viton™ GF-600S	54.4	76.2	-19.5

Table 4. Plastic Compatibility – 2 Weeks Exposure to Opteon™ 1150 at Room Temperature

Plastic Material	% Weight Change	% Volume Change	% ASTM Hardness Change
Polyester (Thermoplastic) Bexloy V-978	2.4	1.9	2.2
Nylon Resin -Zytel 330	-0.1	1.7	6.7
Torlon Polymer (Polyamideimide Plastic)	-0.1	-0.6	8.0
Ryton Polymer (Polyphenylene Sulfide)	0.1	-2.5	-7.6
PEEK (Ketaspire 820 NT)	0.0	1.1	-2.2
Nylon 6.6 Polymer Plastic (Zytel 101)	-0.2	1.4	-2.2
PTFE	4.7	6.4	-2.2

Safe Use

Users of Opteon™ 1150 should read and understand the Chemours SDS that can be obtained from Chemours Customer Service or any authorized distributor.

Inhalation Toxicity

When handled in accordance with Chemours recommendations and exposure is maintained below the WEEL of 400 ppm (8-hr TWA), no acute or chronic adverse health effects are expected from exposure to Opteon™ 1150. Opteon™ 1150 should only be used with adequate ventilation; and, when inhalation of high concentrations is a possibility, use of NIOSH-approved respiratory protection should be considered.

Inhaling high concentrations of Opteon™ 1150 vapor may cause temporary central nervous system effects, such as convulsions, dizziness, headache, confusion, and loss of coordination and even consciousness. Higher exposure to vapors may cause temporary alteration of the heart's electrical activity with irregular pulse, palpitations, or inadequate circulation. Similar effects are observed with many hydrocarbons and halocarbons at high concentrations. The likelihood of these cardiac problems increases if the person is under physical or emotional stress. Intentional misuse or deliberate inhalation may cause death without warning.

If a person is experiencing any of these initial symptoms, they should be moved to fresh air and kept calm. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Seek medical attention immediately.

Because of possible disturbances of cardiac rhythm, catecholamine drugs, such as epinephrine, should be considered only as a last resort in life-threatening emergencies.

Skin and Eye Contact

At room temperature, Opteon™ 1150 vapors have little or no effect on the skin or eyes.

Always wear protective clothing (e.g., eye protection and face shield) when there is a risk of exposure to liquid Opteon™ 1150. **If skin or eye contact occurs**, flush the exposed area in lukewarm water, not hot or cold, for at least 15 minutes. Seek medical attention as soon as possible.

Spills or Leaks

If a large release of vapors occurs, such as from a leak or spill, the vapors may concentrate near the floor or in low elevation areas and displace the oxygen available for breathing, causing suffocation.

Evacuate everyone until the area has been well ventilated. Use blowers or fans to circulate the air at floor level. Do not re-enter the affected area without self-contained breathing apparatus (SCBA) or unless the area has been monitored to indicate that the concentration of Opteon™ 1150 vapors in the area is below the WEEL and oxygen levels have returned to normal.

Enclosed and Confined Spaces

To ensure safety when working with halocarbons in enclosed areas:

1. Route relief and purge vent piping outdoors, away from air intakes.
2. Make certain the area is well ventilated, using auxiliary ventilation if necessary, to move vapors.
3. Make sure the area is clear of vapors prior to beginning work. Be conscientious of low lying areas where vapors may gather.
4. Utilize constant air monitoring and/or spot check detection equipment to detect leaks.

Always use SCBA or a supplied air mask when entering tanks or other confined spaces where vapors might exist. Use the buddy system, a lifeline, and regular air monitoring. Refer to the Opteon™ 1150 SDS for more information.

Air Monitors and Leak Detection

Opteon™ 1150 vapors have virtually no odor. Therefore, frequent leak checks or the installation of area monitors are necessary in areas where leaks can occur. Whenever a system is assembled or serviced, it should be checked for leaks. This is not only for the protection of employees, but also to reduce fugitive emissions to the atmosphere, protect valuable equipment, and conserve material.

Leak detectors exist not only for pinpointing specific leaks, but also for monitoring an entire room on a continual basis for the absence of oxygen or presence of a fluorochemical. Prior to the purchase of a detector or monitor, make sure to consider your requirements or criteria, such as sensitivity, detection limits, selectivity, and flammability.

There are many commercially available leak detectors. These devices are readily available through a refrigeration contractor or service store. For more information on recommended types and technologies of air monitors and leak detectors, please contact Chemours Customer Service or any authorized technical service representative.

Storage and Handling

Shipping

Opteon™ 1150 is a nonflammable gas (ASTM E-681). The appropriate DOT designations are as follows:

Proper Shipping Name:

(E)1,1,1,4,4,4-Hexafluoro-2-Butene

Hazard Class:

2.2 (Nonflammable Gas) UN No.: 3159

DOT/IMO Label:

Nonflammable Gas

Details of our current Opteon™ 1150 packaging options are found in **Table 5**.

Storage

Cylinders of Opteon™ 1150 should be stored tightly closed and in an upright position. Cylinders should be in a clean, dry, and, if possible, temperature-regulated area. Cylinders should be kept away from direct sunlight. Cylinders should be stored at temperatures less than 46 °C (115 °F). Never expose cylinders to temperatures at or above 52 °C (125°F). If 52 °C (125 °F) or greater temperatures are possible, relocating to a temperature-controlled area or usage of refrigerated storage/transportation is recommended.

Storage areas should also be equipped with adequate ventilation. Quantities stored should be limited to that needed for reasonable process requirements. No storage of Opteon™ 1150 should be permitted in areas containing alkali or alkaline earth metals, such as powdered aluminum, zinc, or beryllium.

Table 5. Opteon™ 1150 Packaging Options

Water Capacity	123 lb (55 kg)	1000 lb (453 kg)
Dimensions	55 in (140 cm) H x 10 in (25.4 cm) OD	50 in (127 cm) H x 30 in (76 cm) OD
Spec	4BA300	4BW260
Net Weight	145 lb (65 kg)	1200 lb (544 kg)

Bulk Storage Systems

Chemours can supply storage systems to its Opteon™ customers. The type of systems can vary from region to region and customer site to customer site. Some systems are prefabricated, tested, and ready to install on-site. These units are designed to optimize economy, efficiency, and safety in the storage and dispensing of fluorochemicals.

These delivered systems include all components, such as storage tanks, pumps, piping, valves, motors, and gauges, as an integrated unit. All such systems are equipped with the Chemours Fluorochemical Emission Elimination Delivery (FEED) or alternative system to prevent emissions during deliveries and dual pumps to provide an installed spare. When possible, units are skid-mounted and require only placement on a concrete pad and connection to electrical and process systems.

Your Chemours marketing representative can arrange for guidance on site selection, purchase, installation, startup, and maintenance.

Converting Bulk Storage Systems to Opteon™ 1150

Before switching from previous foam expansion agents to Opteon™ 1150, the existing storage equipment must be checked to verify that it is adequate and can be converted for use with Opteon™ 1150. Your Chemours marketing or technical service representative can arrange for guidance on storage system conversion.

Handling

- A minimum of gloves, safety glasses with side shields, and safety shoes are recommended at all times when handling Opteon™ 1150. Always assess the job for the proper choice of glove. Splash goggles or face shield and chemical-resistant clothing/aprons to avoid skin contact are recommended when handling open drums.
- Opteon™ 1150 should only be handled in areas with adequate ventilation. If exposure to Opteon™ 1150 vapors is possible, a NIOSH-approved respirator is recommended.
- Never apply direct flame or live steam to a container.
- Never use a lifting magnet or sling (rope or chain) when handling containers. A crane may be used when a safe cradle or platform is used to hold the container.
- Use of cylinder handling equipment, such as hand carts, dollies, and forklifts, are recommended per the equipment manufacturer's restrictions.
- Never use container for any purpose other than to store Opteon™ 1150.
- Never attempt to repair or alter containers.
- Never force connections that do not fit.
- Protect containers from any object that will result in cuts or other abrasion to the surface of the metal.
- Use a vapor recovery system when possible to collect vapors from lines after unloading a container.
- Pumps can be utilized for transfer of material. Selection will be based on individual setup and flow requirements and should be reviewed to minimize emissions and loss of product, as well as for safety and efficiency.
- Methods of movement, such as nitrogen pressure pumping or blow casing, are not recommended due to the inert gas's ability to solubilize in the product and potentially lead to pressurized containers.
- When working near other drums and equipment, be careful of pinch points.
- Opteon™ 1150 cylinders should always be tightly secured when stored.

Recycle and Disposal

Opteon™ 1150 that is not used for foam production should be recovered for reuse or disposal. Chemours will accept the return of unused or empty Opteon™ 1150 packages. If you need to return an empty or partial cylinder of Opteon™ 1150, please contact your Chemours representative for details.

Leaks and Spills

Major leaks or spills may not evaporate readily due to the high boiling point of Opteon™ 1150, forcing recovery as a liquid. Until levels, as verified by the proper monitor, are reduced sufficiently to permit other or no respiratory protection, SCBAs are required. Spill control measures should be preplanned, and all washes should be disposed of in accordance with applicable government regulations. If splash potential exists, wear protective equipment fabricated from an impervious material, such as butyl rubber.

Disposal

Disposal refers to the destruction of used Opteon™ 1150. Although Chemours does not presently accept severely contaminated foam blowing agents for disposal, licensed waste disposal firms are available. Be sure to check the qualifications of any firm before sending them contaminated Opteon™ 1150.

References

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For more information on Opteon™ foam blowing agents, visit opteon.com or call (800) 235-7882.

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