

DuPont™ Vertrel®

SPECIALTY FLUID

Safe Handling of Vertrel® specialty fluids

What is Vertrel®?

In response to customer needs for safe, environmentally acceptable alternatives to CFCs, HCFCs, and PFCs used in many critical precision cleaning and specialty applications, DuPont has developed a family of products based on HFC 43-10mee (2,3-dihydrodecafluoropentane). These products are marketed under the DuPont™ Vertrel® registered trademark.

Commercialized in mid-1995, the Vertrel® products were the first fluorinated fluid alternatives with zero ozone-depletion potential and low global-warming potential. In addition to these desirable environmental properties, their unique physical properties, including low surface tension and low viscosity and other properties very similar to CFC-113, make Vertrel® products ideally suited for many critical applications, such as precision cleaning, high-performance electronics defluxing, drying, carrier fluids, process media, test fluids, heat transfer, and other high-value uses where reliability is paramount.

As with any chemical, it is important for all users to be well educated regarding the product's properties and safe handling and use. This bulletin is provided by DuPont to assist with that education, in a handy "Question and Answer" format that addresses several frequently asked questions. Customers are advised to communicate this information to all workers involved with the handling and use of Vertrel® products. Please contact DuPont if you have additional questions or would like to arrange an educational safety seminar for your employees.

Flammability/Decomposition

None of the Vertrel® blends listed in **Table 1** exhibit a closed cup flash point and, therefore, are not classified as flammable liquids by the National Fire Protection Association (NFPA) or the Department of Transportation (DOT). However, some of the blends have vapor flammability limits in air. These limits of flammability provide the user with additional information that may be used as elements of a fire risk assessment and to determine guidelines for the safe handling of volatile chemicals. In the event of a spill or leak situation, the vapors above the liquid may fall within the lower explosive limit/upper explosive limit (LEL/UEL) and, therefore, become flammable. Precautions to take include evacuating the area,

providing maximum ventilation (especially low places where heavy vapors might collect), and ensuring there are no ignition sources present.

Q. Can the Vertrel® products decompose during normal use in cleaning applications?

A. Although Vertrel® specialty fluids are stable during storage and normal use conditions, they can decompose in contact with very high temperatures such as open flames or hot surfaces like those found in space heaters. Decomposition products produce irritating and toxic compounds such as hydrogen fluoride, hydrogen chloride, and possibly carbonyl halides.

Q. Are the products of decomposition hazardous?

A. Yes, the acidic vapors produced by the decomposition of Vertrel® vapors are hazardous, and the area should be evacuated and ventilated to prevent personnel exposure. In fact, the irritating nature of the fumes will generally require people to leave the area before hazardous effects can occur. Anyone exposed to the decomposition products should be taken to fresh air and given medical attention immediately.

Q. What should I do to prevent decomposition?

A. To prevent decomposition of Vertrel® specialty fluids, operating conditions should be held within the recommended guidelines, and any contact with high heat source, such as open flames or hot surfaces, should be avoided. Vapor degreasers typically have low level interlocks that prevent the heating coils from becoming uncovered; if the coils become uncovered, the surface temperature can increase dramatically and result in solvent decomposition. If there is evidence that decomposition is taking place, shut down the system, provide ventilation to clear the area of decomposition products, and leave the area to get fresh air.



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Human Health

The Vertrel® specialty fluids have low inhalation toxicity and pose little risk of adverse health effects when airborne exposures are maintained below established exposure limits. Vertrel® vapors are transparent, with only a slight odor. The vapors are four to eight times heavier than air and, therefore, can collect and concentrate near the floor or in low lying areas. High vapor concentrations can result in suffocation due to an oxygen deficiency. It is, therefore, not safe to enter a tank, vapor degreaser, or other confined space without observing safe entry procedures.

Q. What are the exposure limits for Vertrel® specialty fluids?

A. For Vertrel® XF, DuPont has established an Acceptable Exposure Limit (AEL) of 200 ppm, 8- and 12-hr time-weighted average (TWA). An AEL is the airborne concentration to which nearly all workers may be repeatedly exposed day after day, without adverse effects. Also, a ceiling limit of 400 ppm has been set by DuPont. A ceiling limit is the airborne concentration that should not be exceeded during any part of the working day. Similarly, the American Conference of Governmental Industrial Hygienists (ACGIH) has set threshold limit values (TLVs) that represent airborne concentrations to which nearly all workers may be repeatedly exposed without adverse effect. The calculated TLV for Vertrel® blends is shown in Table 1. The exposure limits for some other solvents are shown for a comparison in **Table 2**.

Table 1 - Vertrel® Specialty Fluids

Product	Boiling Point °C (°F)	Acceptable Exposure Limit (ppm) ^a	Closed Cup Flash Point	Tag Open Cup Flash Point	Vapor Flammability Limits in Air (vol %)	
					Lower Limit	Upper Limit
Vertrel® XF	55 (130)	200	None ^c	None	None	None
Vertrel® XM	48 (118)	200	None ^e	None	9	11
Vertrel® XE	52 (126)	235	None ^e	None	None	None
Vertrel® XP	52 (126)	200	None ^e	None	None	None
Vertrel® X-P10	54 (129)	200	None ^c	None	5	11
Vertrel® MCA	39 (102)	200	None ^d	None	None	None
Vertrel® MCA Plus	38 (100)	214	None ^d	None	6	11
Vertrel® SMT	37 (99)	169	None ^d	None	8	13
Vertrel® XMS Plus	38 (100)	197	None ^d	20° C (68° F) ^f	4	14
Vertrel® SDG	43 (109)	193	None	None	7	14
Vertrel® SFR	41 (106)	187	None	None	7	15
Vertrel® XH	53 (127)	217	None	None	None	None
Vertrel® X-DF	39 (102)	200	None ^d	None	None	None
Vertrel® X-DA	55 (130)	186	None ^c	None	None	None
Vertrel® XSi	57 (134)	200	< - 18° C	< 0° C	5	^g

^a AEL is the DuPont Acceptable Exposure Limit where governmentally imposed occupational exposure limits that are lower than the AEL are in effect, such limits shall take precedence

^b AEL values are calculated in accordance with ACGIH Formula for TLVs for mixtures

^c Tag Closed Cup Flash Point – ASTM D 56

^d Pensky-Martens Closed Cup Flash Point – ASTM D 93

^e Setflash Closed Cup Flash Point – ASTM D 3278

^f Vertrel® XMS Plus has a Tag Open Cup Flash Point of 20°C (68°F), but no fire point (i.e., <5 sec sustained flame)

^g Unable to determine due to condensation

Q. What are the symptoms of exposure above the exposure limits?

A. Inhaling concentrations well above the established exposure limits of vapor from Vertrel® may affect the central nervous system. Symptoms may include dizziness, a feeling of intoxication, tremors, convulsions, and loss of coordination. These symptoms are reversible upon exposure to fresh air. There are no indications of long-term chronic effects. Prolonged inhalation of high concentrations may also cause suffocation and death due to oxygen deprivation. Breathing high concentrations of Vertrel® vapor may produce cardiac sensitization. Cardiac sensitization is an increased sensitivity of the heart to adrenaline in the presence of an inhaled sensitizing chemical such as fluorocarbons or organic chemicals. Cardiac sensitization leads to heart irregularities which may be fatal. The likelihood of such heart problems increases if a person is under emotional or physical stress. Medical attention should be sought immediately.

Do not treat with epinephrine (adrenaline) or similar heart stimulants, because they will increase the risk of cardiac arrhythmia and cardiac arrest. If there is breathing difficulty, administer oxygen. If breathing has stopped, give artificial respiration.

If any of the initial symptoms are experienced, move to fresh air and seek medical attention immediately. Recovery occurs quickly.

Table 2 - Solvent Comparison

Solvent	TLV-8hr TWA (ppm)	Flammability Limits (% in Air)
Vertrel® XF	200*	None
HCFC-225, blend	50**	7.5 - 15
HCFC-141b	500	7.6 - 17.7
Perchloroethylene	25	None
Trichloroethylene	10	7.8 - 52
Methylene Chloride	25***	13 - 23

* DuPont's Acceptable Exposure Limit

** Calculated exposure limit based on a 25 ppm (8-hr TWA) limit for HCFC-225ca and a 200 ppm (8-hr TWA) limit for HCFC-225cb

*** Permissible Exposure Limit established by OSHA

Q. What can I do to work safely on systems in enclosed areas?

A. Good work practices dictate that solvent degreasers be used in open, well-ventilated areas. However, if you need to enter an enclosed area where unknown concentrations of Vertrel® vapors may exist, open all hatches or vents on the equipment and ventilate the area. The highest concentration of vapors will be near the ground, because the vapors are four to eight times heavier than air. To ventilate, use fans to force air down to the lowest point in the area you will be entering. Monitor the composition of the atmosphere in the area you will be entering. Before you can enter the area safely without an independent air supply, the oxygen content should be at least 19.5%, and the concentration of vapors should be below the AEL.

Table 3 - Potential Hazards of Fluorocarbons

Condition	Potential Hazard	Safeguard
Vapors may decompose in flames or in contact with hot surfaces.	Inhalation of or skin contact with toxic decomposition products.	Adequate ventilation. Avoid contact with open flames or hot surfaces. Toxic decomposition products serve as warning agents.
Vapors are six to eight times heavier than air. High concentrations may accumulate in low places.	Inhalation of concentrated vapors can cause suffocation due to lack of oxygen and can be fatal. Excessive overexposures may cause central nervous effects including tremors or convulsions.	Provide forced air ventilation at the level of vapor concentration. Follow confined space requirements including lifelines when entering tanks or confined areas.
Vapor concentrations of some blends may be within flammable limits.	In the event of a spill or leak, flammable mixtures may form above the liquid.	Remove all possible ignition sources and provide ventilation in the event of a spill.
Deliberate inhalation to produce intoxication.	Can be fatal.	Avoid product misuse.
Some fluorocarbon liquids tend to remove natural oils from skin.	Irritation of dry, sensitive skin.	Impervious gloves and protective clothing.
Liquids may be splashed into eyes.	Liquids may cause temporary irritation.	Wear eye protection. Flush eyes for several minutes with running water.

Q. Can skin or eye contact with Vertrel® be hazardous?

A. At low concentrations, vapors from Vertrel® have little or no effect on the skin or eyes. Contact with higher concentrations should be avoided, for example, inside the vapor zone of a degreaser or with liquid Vertrel®. The fluid can dissolve natural oils, resulting in drying, itching, swelling, and roughening of the skin. Gloves made of neoprene or nitrile should be worn.

If Vertrel® is accidentally splashed into the eyes, it may cause temporary irritation. Flush eyes with water, and seek immediate medical attention.

Q. Is Vertrel® toxic when taken orally?

A. Vertrel® specialty fluids are colorless liquids. Because they look just like water, it is important to avoid storing them in containers where they can be mistaken for water. As with all chemicals, proper labeling is imperative. Vertrel® products have low oral toxicity, but should not be ingested. If Vertrel® is accidentally or intentionally swallowed, do not induce vomiting. Doing so could result in drawing the product into the lungs, potentially leading to chemical pneumonia, pulmonary edema, and hemorrhage. Get medical attention immediately.

An exception to this rule is when dealing with products containing methanol such as Vertrel® XM and Vertrel® SMT. Due to the high risk of systemic toxicity (blindness) from methanol, it is recommended to induce vomiting. Get medical attention immediately.

Potential hazards that may be associated with Vertrel® products and suggestions for avoiding problems that may arise are summarized in **Table 3**.

Monitoring Vertrel® in the Air

Q. How can I monitor vapor from Vertrel®?

A. Several types of fluorocarbon monitors are available, including those based on thermal conductivity, hot wire, pyrolyzer, flame ionization, and infrared technology. Infrared monitors are highly recommended because of their long economical life, accuracy, and portability. Any monitor must be calibrated for the specific fluid being monitored. For more information, contact your DuPont representative.

Pressure

Q. Can pressure cause any hazard during use?

A. Because Vertrel® specialty fluids boil at relatively high temperatures, there are minimal vapor pressure problems to consider when using these products in most applications. However, it is a good practice to always open the bung slowly while standing back from the drum to avoid possible exposure due to a pressure buildup in a drum. As with any expandable fluid, overfilling containers (e.g., drums or pails) can create a potential hazard. If an overfilled, closed container of Vertrel® specialty fluid is exposed to high temperatures—as in a fire or even in hot weather—hydrostatic overpressure can result, causing rupture failure of the container. Do not store drums in direct sunlight; store drums in clean, dry areas where the temperature does not exceed 52°C (125°F).

Q. Can I use air pressure to help dispense a Vertrel® specialty fluid from its container?

A. Shipping and storage drums are not designed as pressure vessels. Forcing air under pressure into these drums could cause a rupture failure of the container and a serious spill of the fluid. Whenever possible, a drum pump or a gravity stand should be used to transfer the solvent from the container to the point of use. Cautions should be taken when transferring product from a drum or pail to the cleaning equipment to avoid high concentrations. Drum pumps are recommended.

Drum Handling

Vertrel® specialty fluids are shipped in drums up to 55-gal capacity, which can weigh in excess of 600 lb. Full drums are best moved by forklift trucks onto racks to provide gravity feed to the point of use. Whenever drums are handled to transfer the fluid, to empty drums, or to move them manually, several cautions should be observed.

- Use of proper drum handling equipment is recommended.
- Wear proper safety equipment, including gloves, splash goggles, aprons (when handling open drums), and safety shoes if the drums are to be moved.
- Before moving drums, make sure the bungs are tightly closed to prevent splashing.
- When working near other drums and equipment, be careful of pinch points.

- Any drum containing solvent should be kept tightly sealed between transfer operations to prevent unnecessary evaporation losses. Drum should be stored with the bung tightened to eliminate the possibility of incurring a major spillage of solvent through a loose or a leaky bung.

Regulations

Q. How do federal regulations affect the use of Vertrel® specialty fluids?

A. Vertrel® specialty fluids are subjected to fewer regulatory restrictions than chlorinated solvents. The base chemical of Vertrel® products, HFC 43-10 has zero ozone-depletion potential. The Vertrel® line of products is accepted by the EPA under the Significant New Alternatives Program (SNAP) rules as a substitute for ozone-depleting substances. HFC 43-10 is not photochemically reactive and is, therefore, exempted from VOC regulation by the U.S. EPA. Some Vertrel® products, however, contain components such as methanol and trans-1,2 dichloroethylene, which are VOC regulated. Vertrel® products are not restricted as hazardous air pollutants (HAP) and, therefore, are not subject to NESHAP regulations, nor are they restricted by the Clean Water Act. They are subject to the least stringent regulations under CERCLA.

Q. What is the classification when shipping spent solvent?

A. DuPont Vertrel® fluorocarbon specialty fluids are not regulated as hazardous materials by the Department of Transportation, unless the user has introduced a RCRA hazardous material during use. Even though some Vertrel® specialty fluids are mixtures that include other solvents such as alcohol, none of the mixtures are classified as flammable, poisonous, or corrosive by Department of Transportation definition.

During some recovery operations, especially with flammable soils or where the composition of the product in the liquid and vapor state may change (e.g., during distillation), it is possible for the mixture to exhibit either a flash point as a liquid or wider LEL/UEL in the vapor state. Users should test the spent product to ensure proper classification for waste disposal.

It is important to remember that all chemical compounds, including Vertrel® fluorocarbons, must be handled in an environmentally responsible manner. DuPont has an arrangement with a solvent reclaim/disposal facility for handling spent solvent. Contact a Vertrel® technical manager for further information on this program.

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