

DuPont™ Vertrel® XP

Specialty Fluid

Removes Particulate and Ionic Soils

Introduction

Vertrel® XP is a proprietary azeotrope of Vertrel® XF hydrofluorocarbon (2,3-dihydrodecafluoropentane) and isopropanol. It is ideally suited for use in vapor degreasing equipment. It offers improved solvency for polar soils, compared to Vertrel® XF, while maintaining excellent com-patibility with most plastic, ceramic, and metal components. Typical applications include precision and specialty cleaning and rinsing for removal of particulate, light soils, and fingerprints from plastic, glass and metal parts.

Vertrel® XP has “zero” ozone-depleting potential and low global warming potential. It can replace CFC-113, 1,1,1-trichloroethane (1,1,1-TCA), hydrochlorofluorocarbons (HCFCs), and perfluorocarbons (PFCs) in many applications. Vertrel® XP is accepted by the U.S. Environmental Protection Agency under the Significant New Alternatives Policy (SNAP) program as a substitute for ozone-depleting substances.

The unique properties of Vertrel® XP (Tables 1 and 2) include a high density, low viscosity, and low surface tension for effective particle and soil removal.

Cleaning Process

Vapor degreasing should be used for optimum cleaning effectiveness and economy. Modern vapor containment technology is recommended for both batch and in-line equipment. These systems have higher freeboard and a secondary set of low temperature (–29°C [–20°F]) condenser coils to greatly reduce vapor losses.

Cleaning Applications

Vertrel® XP is ideally suited for cleaning fine particulate matter (submicron range) from metal and nonmetal parts. Contaminants such as dust particles, skin flakes, fibers, and other process

contaminants tend to bond with the surface of the part by some physical force such as electrostatic forces or a mechanical entrapment due to the surface geometry. Removal of these contaminants requires a solvent that can reduce the laminar boundary layer thickness to allow particles to be washed away by the liquid solvent flow-through.

A thin boundary layer and higher liquid flow-through momentum can be accomplished with a solvent such as Vertrel® XP which has a high density, low viscosity, and low surface tension so that fine particles can be debonded efficiently. Typical applications include pre-sputter cleaning of disk media, head stack assemblies, and lenses for optical devices. The versatility of Vertrel® XP allows it to be used in other industries with other precision cleaning applications.

Table 1
Physical Properties

Property ^a	Vertrel® XP
Molecular Weight	228
Boiling Point, °C (°F)	52 (126)
Liquid Density, g/cc (lb/gal)	1.53 (12.8)
Vapor Pressure, mm Hg (psia)	253 (4.9)
Surface Tension, dyn/cm	15.1
Freezing Point, °C (°F)	<–80 (<–112)
Heat of Vaporization (at boiling point), cal/g (Btu/lb)	TBD
Heat Capacity, cal/g°C (Btu/lb°F)	TBD
Viscosity, cPs	0.68
Flash Point	
Closed Cup ^b	None
Open Cup ^c	None
Vapor Flammability in Air, vol%	
Lower Limit	None
Upper Limit	None

^a At 25°C (77°F), except where indicated.

^b Tag Closed Cup Tester (ASTM D 56-93)

^c Tag Open Cup Tester (ASTM D 1310-86)



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Table 2
Density and Vapor Pressure Change
with Temperature

Temperature, °C (°F)	Density, g/cc (lb/gal)	Vapor Pressure, mmHg (psia)
0 (32)	1.591 (13.3)	70 (1.4)
10 (50)	1.564 (13.0)	122 (2.4)
20 (68)	1.537 (12.8)	202 (3.9)
25 (77)	1.530 (12.8)	253 (4.9)
30 (86)	1.510 (12.6)	319 (6.2)
40 (104)	1.483 (12.4)	483 (9.3)
50 (122)	1.456 (12.2)	707 (13.7)
60 (140)	1.429 (11.9)	1003 (19.4)

Plastic and Elastomer Compatibility

Most plastics and elastomers can be safely cleaned in Vertrel® XP. **Tables 3 and 4** summarize test results on short-term exposures of unstressed plastics and elastomers simulating a typical cleaning cycle.

Long-term compatibility data simulating exposure of vapor degreaser construction materials is available from DuPont upon request.

Table 3
Plastic Compatibility
Immersion: 15 Minutes at Room Temperature

Compatible	
Polyethylene	ABS
Polypropylene	Acetal
Polystyrene	Acrylic
Polyester, PET, PBT	Epoxy
Polyphenylene Oxide, PPO	Ionomer
Polyimide, PI, PEI, PAI	Liquid Crystal Polymer
Polyetherketone, PEK	Phenolic
Polyaryletherketone, PEEK	PVC, CPVC
Polysulfone	PTFE, ETFE
Polyarylsulfone	Cellulosic
Polyphenylene Sulfide, PPS	
Incompatible ^a	
None tested	

^a Material composition varies depending upon compounding agents, plasticizers, processing, etc. Specific materials should be tested for compatibility with solvent.

Table 4
Elastomer Compatibility
Immersion: 15 Minutes at Room Temperature

Compatible	
Buna N, NBR, Nitrile	Buna S, SBR, GRS
Butyl Rubber, IIR	Chlorosulfonated PE
EPM, EPDM, Nordel®	Polysulfide
Natural Rubber, Isoprene	Neoprene
Viton® B	Urethane
Silicone	
Incompatible ^a	
None Tested	

^a Material composition varies depending upon compounding agents, plasticizers, processing, etc. Specific materials should be tested for compatibility with solvent.

Elastomer swelling and shrinking will, in most cases, revert to within a few percent of original size after air drying. Swell, shrinkage, and extractables are strongly affected by the compounding agents, plasticizers, and curing used in the manufacture of plastics and elastomers. Therefore, prior in-use testing is particularly important.

Metals and Other Compatibility

Vertrel® XP was found compatible with stainless steel, aluminum, copper, and brass after exposure for two weeks at 100°C (212°F) in sealed tubes.

Large amounts of water may extract alcohol and affect cleaning performance. Therefore, to reduce alcohol loss, use desiccant dryers rather than water separators in the condensate return line.

Contact with highly basic process materials, pH 10 or above, is not recommended.

Exposure Limits

Data from toxicity studies has demonstrated that Vertrel® XP has low toxicity. It is a slight skin and eye irritant and has low inhalation toxicity. **Table 5** shows the applicable exposure limits for the component materials of Vertrel® XP.

**Table 5
Exposure Limits**

Component	Limit, ppm	Type
Vertrel® XF	AEL ^a 200	8- and 12-hr TWA Ceiling ^b
	400	
Isopropanol	AEL 400	8- and 12-hr TWA 8-hr TWA
	TLV ^c 400	
	STEL ^d 500	
Vertrel® XP	AEL ^{a,b} 213	Calculated ^e

^a AEL (Acceptable Exposure Limit) is an airborne inhalation exposure limit established by DuPont that specifies time-weighted average concentrations to which nearly all workers may be repeatedly exposed without adverse effects.

^b A ceiling limit is the concentration that should not be exceeded during any part of the working day. The ceiling limit for individual components applies to the blend product as well.

^c TLV (Threshold Limit Value) is an air-borne inhalation exposure limit established by the American Conference of Government and Industrial Hygienists (ACGIH) that specifies time-weighted average concentrations to which nearly all workers may be repeatedly exposed without adverse effects.

^d STEL is short-term exposure limit established by ACGIH.

^e Calculated in accordance with ACGIH formula for TLVs for mixtures.

Safety/Flammability

Vertrel® XP exhibits no closed cup or open cup flash point, and is not classified as a flammable liquid by NFPA or DOT. In addition, the product has no vapor flammability limits in air.

Flash point data and limits of flammability in air provide the user with additional information that should be used as elements of a fire risk assessment and to determine guidelines for the safe handling of volatile chemicals. Users should assure compliance with NFPA standards and local fire codes.

Recovery

Due to the azeotropic nature of Vertrel® XP, the product is easily recoverable by off-line or in-line distillation equipment such as a vapor degreaser or still. The presence of soil, however, may alter the characteristics of the material during the recovery operation. Recovery should be closely monitored to ensure operating levels are maintained. Users should test the spent Vertrel® XP to ensure proper classification for waste disposal.

Storage/Handling

Vertrel® XP is thermally stable and does not oxidize or degrade during storage. Store in a clean, dry area. Protect from freezing temperatures. If solvent is stored below -10°C (14°F), mix prior to use. Do not allow stored product to exceed 52°C (125°F) to prevent leakage or potential rupture of container from pressure and expansion.

Consideration should be given to retrofit of existing, or purchase of new, vapor degreasing equipment to provide vapor containment technology that enables safe and economical use of Vertrel® XP.

Drum pumps are recommended to dispense Vertrel® XP from its container. Refer to the Material Safety Data Sheet for specific handling precautions and instructions.

Environmental Legislation

Vertrel® specialty fluids have “zero” ozone depletion potential and low global warming potential (**Table 6**). They are used as alternatives to CFC-113, methylchloroform, hydrochlorofluorocarbons (HCFCs), and perfluorocarbons (PFCs) in many critical cleaning, drying, carrier fluid, and other high-value specialty uses where reliability is paramount.

Vertrel® XP is accepted by the U.S. Environmental Protection Agency (EPA) under the Significant New Alternatives Policy (SNAP) program, as a substitute for ozone-depleting substances. The product is VOC compliant under the California South Coast Air Quality Management District (SCAQMD) regulations which require VOC content less than 50 g/L of solvent.

The components of Vertrel® XP are listed in most country chemical inventories, such as TSCA in the U.S., ELINICS in Europe, Chemical Substances Control Law (MITI/MHW) in Japan, DSL (notified) in Canada, NICNAS in Australia, and TCCL in Korea.

Vertrel® XP is not a hazardous air pollutant (HAP), and therefore not subject to NESHAP regulation. Spent Vertrel® XP is not a RCRA characteristic or listed waste. However, addition of contaminants could change that status. Vertrel® XP is not included in the SARA Title III Section 313 list of toxic chemicals, and is not subject to SARA Title III (EPCRA) reporting requirements.

**Table 6
Environmental Properties**

Property	Vertrel® XP
Ozone-Depletion Potential (ODP)	0
Global Warming Potential (GWP/100 yr ITH)	1258
Volatile Organic Compounds (VOC, g/L)	49.7

Packaging and Availability

Vertrel® XP is commercially available in 55-gal (208-L) drums with a net weight of 600 lb (272 kg) and in 5-gal (19-L) pails with a net weight of 55 lb (25 kg). One-gallon and smaller samples in glass containers are available on request. Customers are encouraged to secure samples now for compatibility and performance testing.

Specifications

Composition and specifications are shown in **Table 7**. All components are listed in the TSCA Inventory.

Table 7
Vertrel® XP Specifications

Vertrel® XF, wt%	96.75% ± 0.2
Isopropanol, wt%	3.25% ± 0.2
Nonvolatile Residue, ppm wt	1.0 max
Moisture, ppm wt	200 max
Appearance	Clear, colorless

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