DuPont™ Vertrel® XP

SPECIALTY FLUID

Technical Information

Removes Particulate and Ionic Soils

Introduction

DuPont™ Vertrel® XP is a proprietary azeotrope of DuPont™ 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 DuPont™ Vertrel® XF, while maintaining excellent compatibility 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.

DuPont™ 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. DuPont™ 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 DuPont™ 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

DuPont™ 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 DuPont™ 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 DuPont™ Vertrel® XP allows it to be used in other industries with other precision cleaning applications.

Table 1
Physical Properties

Property[a]	DuPont™ Vertrel® XP
Molecular Weight	228
Boiling Point, °C (°F)	52 (126)
Liquid Density, kg/l	1.53
Vapor Pressure, atm	0.334
Surface Tension, N/m	0.0151
Freezing Point, °C (°F)	<–80 (<–112)
Heat of Vaporization (at boiling point), kJ/kg	TBD
Heat Capacity, kJ/kg•°C	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, kg/l	Vapor Pressure, atm
0 (32)	1.591	0.094
10 (50)	1.564	0.161
20 (68)	1.537	0.267
25 (77)	1.530	0.334
30 (86)	1.510	0.421
40 (104)	1.483	0.638
50 (122)	1.456	0.933
60 (140)	1.429	1.324

Plastic and Elastomer Compatibility

Most plastics and elastomers can be safely cleaned in DuPont™ 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

DuPont™ 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 DuPont™ 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 DuPont™ Vertrel® XP.

Table 5
Exposure Limits

Component	Limit, ppm		Type
DuPont™ Vertrel® XF	AEL[a]	200 400	8- and 12-hr TWA Ceiling[b]
Isopropanol	AEL TLV[c] STEL[d]	200 200 400	8- and 12-hr TWA 8-hr TWA
DuPont™ Vertrel® XP	AEL[a, b]	200	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

DuPont™ 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 DuPont™ 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 DuPont™ Vertrel® XP to ensure proper classification for waste disposal.

Storage/Handling

DuPont™ 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 DuPont™ Vertrel® XP.

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

Environmental Properties

DuPont™ Vertrel® specialty fluids have zero ozone-deple-tion 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.

DuPont™ 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.

Table 6
Environmental Properties

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

*IPCC Second Assessment Report (1995)

Packaging and Availability

DuPont™ 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
DuPont™ Vertrel® XP Specifications

DuPont™ Vertrel® XF, wt%	96.75% ± 0.2
Isopropanol, wt%	3.25% ± 0.2
Nonvolatile Residue, ppm wt	2.0 max
Moisture, ppm wt	200 max
Appearance	Clear, colorless

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CAUTION: Do not use in medical applications involving permanent implantation in the human body or contact with internal body fluids or tissues. For other medical applications, see "DuPont Medical Caution Statement," H-50102.

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