DuPont™ Vertrel® XMS Plus

Specialty Fluid

Defluxing
Removes Rosin
Removes Ionic Contaminants

Introduction

Vertrel® XMS Plus is a proprietary blend of Vertrel® XF hydrofluorocarbon (2,3-dihydrodecafluoropentane) with trans-1,2-dichloroethylene, cyclopentane, and methanol. It is ideally suited for use in vapor degreasing equipment with solvency power for cleaning ionic soils and flux residues from electronic assemblies.

Physical properties of Vertrel® XMS Plus are shown in **Table 1**.

Table 1
Physical Properties

Property[a]	Unit	Vertrel® XMS Plus	Freon® TMS	HCFC-141b with MeOH
Molecular Weight	—	125	146	106
Boiling Point	°C	38	40	29
	°F	100	104	85
Liquid Density	g/cc	1.34	1.48	1.22
	lb/gal	11.2	12.3	10.1
Vapor Pressure	mm Hg	470	429	527
	psia	9.1	8.3	10.2
Surface Tension	dyne/cm	14.9	17.4	18.5
Freezing Point	°C	<–50	–55	<–103
	°F	<–58	–67	<–154
Heat of Vaporization at boiling point	cal/g	54	50	62
	Btu/lb	97	91	111
Heat Capacity	cal/g °C	0.29	0.24	0.26
	Btu/lb °F	0.29	0.24	0.26
Viscosity	cPs	0.46	0.7	0.45
Flash Point				
Closed Cup	°C	None[b]	None	None
Open Cup	°C	20[c]	None	None
Vapor Flammability In Air				
Lower Limit	vol%	6	—	6
Upper Limit	vol%	15	—	20

[a] At 25°C (77°F) except where indicated.

[b] Pensky-Martens Closed Cup Tester (ASTM D 93)

[c] Tag Open Cup Tester (ASTM D 1310)—no fire point was observed with Vertrel® XMS Plus

Vertrel® XMS Plus has similar performance characteristics to Vertrel® SMT, in addition to having a wider range of solvency for some types of soils and flux residues.

Vertrel® XMS Plus has "zero" ozone-depletion potential, and low global warming potential. It can replace CFC-113, methyl chloroform (1,1,1-TCA), hydrochlorofluorocarbons (HCFCs), and perfluorocarbons (PFCs) in many applications. Vertrel® XMS Plus 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.

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 reduce vapor loss.

In a test with RMA and RA flux soldered assemblies, Vertrel® XMS Plus gave lower ionics and residual rosin levels when compared to the CFC-113/methanol azeotrope under actual production cleaning operations.

Plastic and Elastomer Compatibility

Vertrel® XMS Plus is compatible with most polymeric materials commonly used for components mounted on printed wiring board assemblies. Acrylic, ABS, and polycarbonate parts, particularly if under stress, may show slight cracking or crazing damage and should be tested. EPDM, butyl rubber, Buna-S, and neoprene are recommended for elastomeric parts.

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.

Tables 2 and **3** 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 2
Plastic Compatibility
Immersion: 15 Minutes at Room Temperature

Compatible	
Polyethylene	Acetal
Polypropylene	Epoxy
Polyester, PET, PBT	Liquid Crystal Polymer
Polyimide, PI, PEI, PAI	Phenolic
Polyetherketone, PEK	PTFE, ETFE
Polyaryletherketone, PEEK	Polyvinylchloride
Polyarylsulfone, PAS	Chlorinated PVC
Polyphenylene Sulfide, PPS	Ionomer
Polysulfone, PSO	

Incompatible[a]	
Polystyrene	ABS
Polyphenylene Oxide, PPO	Acrylic
	Cellulosic

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

Table 3
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
Urethane	Viton® B
	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.

Metals and Other Compatibility

Vertrel® XMS Plus was found compatible with zinc, stainless steel, carbon steel, aluminum, and copper.

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 acute toxicity studies has demonstrated that Vertrel® XMS Plus has low toxicity. **Table 4** shows the applicable exposure limits for the component materials of Vertrel® XMS Plus.

Table 4
Exposure Limits

Component	Limit, ppm		Type
Vertrel® XF	AEL[a]	200	8- and 12-hr TWA
		400	Ceiling[b]
Trans-1,2-dichloroethylene	TLV[c]	200	8-hr TWA
Cyclopentane	AEL	600	8- and 12-hr TWA
	TLV	600	8-hr TWA
Methanol	AEL	200	8- and 12-hr TWA
	TLV	200	8-hr TWA
	STEL[d]	250	
Stabilizer	AEL	10	8- and 12-hr TWA
	TLV	20	8-hr TWA
Vertrel® XMS Plus	AEL[a, b]	197	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® XMS Plus exhibits no closed cup flash point per the Pensky-Martens Closed Cup Tester (ASTM D93) and is not classified as a flammable liquid by NFPA or DOT. The product does exhibit vapor flammability limits in air, and has the potential to ignite in an open vessel or in case of a spill, if an ignition source is present. However, laboratory tests with virgin solvent in an open vessel show the solvent will not sustain combustion, and quickly self extinguishes. Users should clear equipment of all vapors and liquids before performing any maintenance operations that could result in an ignition source.

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

Vertrel® XMS Plus is readily recoverable. During some recovery operations, however, especially with flammable soils, or where the composition of the Vertrel® XMS Plus in the liquid or vapor state may change (e.g., during distillation), it is possible for the mixture to exhibit either a flash point or wider UEL and LEL.

Because the product is not a true azeotrope, the concentration of Vertrel® XF may decrease in the boiling liquid during recovery operations. This may change the flammable characteristics of the remaining mixture, especially during the last 25 percent of the recovery operation or with heavy soil loading. Unless recovery equipment is rated for flammables, it is recommended that no more than 75 percent of the liquid be recovered (i.e., stop the recovery process when 75 percent of the liquid has been boiled over and recovered). This should ensure an adequate concentration of Vertrel® XF to suppress the flammability characteristics of the remaining liquid. However, the customer should check carefully for flammability in their particular application.

Recovery operations should be monitored closely to ensure operating levels are maintained. Users should test the spent Vertrel® XMS Plus to ensure proper classification for waste disposal.

Storage/Handling

Vertrel® XMS Plus 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® XMS Plus.

Although Vertrel® XMS Plus is not classified as a flammable liquid by DOT/NFPA, it does have flammable limits in air, and has the potential to ignite in an open vessel or in case of a spill, if an ignition source is present. A drum pump is recommended to dispense the product from its container. If an electric drum pump is used, avoid operation near open equipment or when solvent vapors are present. In these cases, consideration should be given to the use of a flammable-rated drum pump.

Environmental Legislation

Vertrel® specialty fluids have "zero" ozone depletion potential and low global warming potential (**Table 5)**. 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® XMS Plus 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 components of Vertrel® XMS Plus 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.

The methanol component of Vertrel® XMS Plus is considered a hazardous air pollutant (HAP), and therefore is subject to NESHAP regulation. Methanol is included in the SARA Title III Section 313 list of toxic chemicals, and is subject to SARA Title III (EPCRA) reporting requirements.

Table 5
Environmental Properties

Property	Vertrel® XMS Plus
Ozone-Depletion Potential (ODP)	0
Global Warming Potential (GWP/100 yr ITH)	662
Volatile Organic Compounds (VOC, g/L)	658

Packaging and Availability

Vertrel® XMS Plus is available commercially in 55-gal (208-L) drums with a net weight of 500 lb (227 kg) and in 5-gal (19-L) pails with a net weight of 45 lb (20 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 6**. All components are listed in the TSCA Inventory.

Table 6
Vertrel® XMS Plus Specifications

Vertrel® XF, wt%	50.9 ± 1.0
Trans-1,2-dichloroethylene, wt%	43.0 ± 1.0
Cyclopentane, wt%	2.0 ± 0.2
Methanol, wt%	4.0 ± 0.3
Stabilizer, wt%	0.1 ± 0.05
Nonvolatile Residue, ppm wt	10 max.*
Moisture, ppm wt	200 max.
Appearance	Clear, colorless

*50 ppm max. in 5-gal pails.

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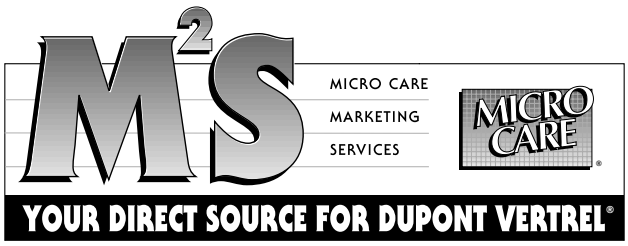

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