

# DuPont™ Vertrel® SMT

Specialty Fluid

## Defluxing Precision Metal Cleaning Removes Rosin, Oils, Ionic Contaminants

### Introduction

Vertrel® SMT is a proprietary azeotrope of Vertrel® XF hydrofluorocarbon (2,3-dihydrodecafluoropentane) with trans-1,2-dichloroethylene 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. It can also be used for precision and general industrial cleaning where this enhanced solvency is required.

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

Physical properties of Vertrel® SMT are shown in **Tables 1** and **2**.

### 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® SMT gave lower ionics and residual rosin levels when compared to the CFC-113/methanol azeotrope under identical cleaning cycles of 2 minutes boil sump and 1 minute rinse sump. Vertrel® SMT is also effective in removing heavy industrial soils (e.g., mineral oil, vacuum oil, wax, heavy grease) from parts in a short vapor degreasing cycle.

**Table 1**  
Physical Properties

Property <sup>a</sup>	Vertrel® SMT	Freon® TMS	HCFC-141b with MeOH
Molecular Weight	128	146	106
Boiling Point, °C (°F)	37 (99)	39.7 (103.5)	29 (85)
Liquid Density, g/cc (lb/gal)	1.37 (11.4)	1.48 (12.3)	1.22 (10.1)
Vapor Pressure, mm Hg (psia)	471 (9.1)	429 (8.3)	527 (10.2)
Surface Tension, dyn/cm	15.5	17.4	18.5
Freezing Point, °C (°F)	<–50 (<–58)	–55 (–66)	<–103 (<–154)
Solubility of Water, wt%	0.34	0.27	—
Heat of Vaporization at Boiling Point, cal/g (Btu/lb)	53 (95.4)	50.4 (90.7)	62 (111)
Heat Capacity, cal/g°C (Btu/lb°F)	0.28 (0.28)	0.24 (0.24)	0.26 (0.26)
Viscosity, cPs	0.47	0.70	0.45
Flashpoint			
Closed Cup	None <sup>b</sup>	None	None <sup>c</sup>
Open Cup	None <sup>d</sup>	None	None <sup>d</sup>
Vapor Flammability in Air, vol%			
Lower Limit	7	None	6
Upper Limit	15	None	20

<sup>a</sup> At 25°C (77°F), except where indicated.

<sup>b</sup> Pensky-Martens Closed Cup Tester (ASTM D 93)

<sup>c</sup> Tag Closed Cup Tester (ASTM D 56)

<sup>d</sup> Tag Open Cup Tester (ASTM D 1310)



**Table 2**  
Density and Vapor Pressure  
Change with Temperature

Temperature, °C (°F)	Density, g/cc (lb/gal)	Vapor Pressure, mmHg (psia)
0 (32)	1.42 (11.7)	165 (3.2)
10 (50)	1.40 (11.6)	257 (5.0)
20 (68)	1.38 (11.5)	388 (7.5)
25 (77)	1.37 (11.4)	471 (9.1)
30 (86)	1.36 (11.4)	569 (11.0)
40 (104)	1.33 (11.2)	815 (15.8)
50 (122)	1.31 (11.0)	1,142 (22.1)
60 (140)	1.29 (10.8)	1,568 (30.3)

## Plastic and Elastomer Compatibility

Most plastics commonly used for components mounted on printed wiring board assemblies can be safely cleaned in Vertrel® SMT. 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 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	Acetal
Polypropylene	Epoxy
Polyester, PET, PBT	Liquid Crystal Polymer
Polyimide, PI, PEI, PAI	Phenolic
Polyetherketone, PEK	PTFE, ETFE
Polyaryletherketone, PEEK	Polyvinylchloride
Polyarylsulfone, PAS	Ionomer
Polyphenylene Sulfide, PPS	Chlorinated PVC
Polysulfone, PSO	
Incompatible <sup>a</sup>	
Polystyrene	ABS
Cellulosic	Acrylic
Polyphenylene Oxide, PPO	

<sup>a</sup> 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
Urethane	Viton® B
	Silicone
Incompatible <sup>a</sup>	
None Tested	

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

## Metals and Other Compatibility

Vertrel® SMT was found compatible with aluminum, copper, and iron, with and without rosin flux present, after exposure for two weeks at 120°C (248°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 acute toxicity studies has demonstrated that Vertrel® SMT has low toxicity. Vertrel® SMT is a slight skin and eye irritant and has low acute inhalation toxicity. Table 5 shows the applicable exposure limits for the component materials of Vertrel® SMT.

## Safety/Flammability

Vertrel® SMT exhibits no closed cup or open cup flash point and is not classified as a flammable liquid by NFPA or DOT. However, the product does exhibit vapor flammability limits in air. 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.

**Table 5  
Exposure Limits**

Component	Limit, ppm	Type
Vertrel® XF	AEL <sup>a</sup> 200 400	8- and 12-hr TWA Ceiling <sup>b</sup>
Trans-1,2-dichloroethylene	TLV <sup>c</sup> 200	8-hr TWA
Methanol	AEL 200 TLV 200 STEL <sup>d</sup> 250	8- and 12-hr TWA 8-hr TWA
Stabilizer	AEL 10 TLV 20	8- and 12-hr TWA 8-hr TWA
Vertrel® SMT	AEL <sup>a, b</sup> 192	Calculated <sup>e</sup>

<sup>a</sup> 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.

<sup>b</sup> 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.

<sup>c</sup> 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.

<sup>d</sup> STEL is short-term exposure limit established by ACGIH.

<sup>e</sup> Calculated in accordance with ACGIH formula for TLVs for mixtures.

## Recovery

Vertrel® SMT is readily recoverable. During some recovery operations, however, especially with flammable soils, or where the composition of the Vertrel® SMT 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.

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 boiling 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® SMT to ensure proper classification for waste disposal.

## Storage/Handling

Vertrel® SMT 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® SMT.

Although Vertrel® SMT is not classified as a flammable liquid by DOT/NFPA, it does have flammable limits in air. A drum pump is recommended to dispense the product 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® SMT 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® SMT 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® SMT 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 6  
Environmental Properties**

Property	Vertrel® SMT
Ozone-Depletion Potential (ODP)	0
Global Warming Potential (GWP/100 yr ITH)	688
Volatile Organic Compounds (VOC, g/L)	645

## Packaging and Availability

Vertrel® SMT is available commercially in 55-gal (208-L) drums with a net weight of 550 lb (249 kg) and in 5-gal (19-L) pails with a net weight of 50 lb (23 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® SMT Specifications**

Vertrel® XF, wt%	52.9 ± 1.0
Trans-1,2-dichloroethylene, wt%	43.0 ± 1.0
Methanol, wt%	4.0 ± 0.3
Stabilizer, wt%	0.10 ± 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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