



## Disk Drive Maker Uses Vertrel® to Lubricate Precision Assemblies

### Synopsis

Seeking to minimize cleaning costs while sustain quality, a major disk drive manufacturer selected Vertrel® XF to replace PFC solvents for the deposition of specialized lubricants upon disk drive sub-assemblies. The net result was a 55% reduction in total cleaning costs, as measured on a per-part basis.

### Background

A major U.S.-based maker of high speed hard disk drives was using PFC solvents as a carrying agent. The solvent was used dissolve a specialized lubricant, which then was deposited precisely onto the platter of disk drive sub-assemblies. They were using PFC solvents for this task because PFCs are dense, ozone-safe, fast-drying, plastic-safe, nonflammable and exhibit a low degree of toxicity. They also are extremely expensive.

However, PFC solvents have a significant global warming factor with an atmospheric half-life estimated by the U.S. Environmental Protection Agency to be more than 5,000 years. The disk drive maker decided to seek an alternative which was less expensive to use and more environmentally acceptable, while equal or better at the task of depositing the lubricants.

The disk drive manufacturer decided to switch to Vertrel® XF. This material is an HFC which is totally ozone safe and has a significantly lower global warming potential than PFCs. It is also nonflammable, has high chemical and thermal stability, and low toxicity. The higher solvency of Vertrel® XF ( $K_b = 10.4$ ), compared with that of PFCs ( $K_b \approx 0$ ), makes it ideally suited as a cleaner as well as a carrier fluid for fluorolubricants in disk-lubing applications. It has been successfully tested and is currently being used as an environmentally friendly alternative to PFC fluids (eg., PF-5060).

Some key physical and environmental properties of Vertrel® XF and PF-5060 are shown in Table 1 comparison.

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**Table 1 -- Solvent Physical Properties Compared**

Property	Vertrel®	PFC 5060
Molecular Weight	252	338
Boiling Point (°F)	130	133
Liquid Density (g/mL)	1.58	1.68
Vapor Pressure (mmHg)	226	232
Surface Tension (dyn/cm)	14	12
Liquid Viscosity (cP)	0.67	0.67
Heat of Vaporization (boiling point cal/g)	31	21
Specific Heat (cal/g °C)	0.27	0.25

The product characteristics listed above confirm that the Vertrel® XF would be a “drop-in” replacement for the PF-5060, and would be easily retained in the vapor degreaser. Further testing confirmed the lubricants used in disk-lubing applications are soluble in Vertrel® XF.

**Economic Analysis**

Solvent loss represents a significant cost component in this application. Rates for Vertrel® XF versus PF-5060 were measured using laboratory test equipment in which the freeboard height was adjustable.

As one would expect from a solvent with a higher vapor pressure and lower heat of vaporization, the operating solvent loss rates for PF-5060 are over 39% higher than Vertrel® XF at equivalent freeboard ratios. Both the weight and volume loss rates are lower for Vertrel® XF than for PF-5060. Increasing the freeboard ratio from 1.0 to 2.0 reduced the loss rate of Vertrel® XF by 28%, which is a significant improvement when compared with PF-5060 (lower by 15%). Experimental data thus obtained is presented in Table 2..

The net result of this change was a reduction in disk lubrication costs of 55% on a per-part basis, and a substantial (albeit proprietary) reduction in actual out-of-pocket costs for the manufacturer.

**Table 2 -- Experimental Evaporation Losses (kg/hr/m2) at Boiling Point**

Freeboard	0.75	1.0	2.0
Vertrel®	0.84	0.71	0.51
PFC 5060	0.98	0.84	0.71
% Difference	16.6	18.3	39.2

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