Krytox® Performance Lubricants

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Statement of Krytox® VPF as Diffusion Pump Fluid

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DuPont™ Krytox® VPF oils are clear, colorless, fluorinated synthetic oils that are nonreactive, nonflammable, safe in chemical and oxygen service, and are long-lasting. Krytox® VPF oils can be used as diffusion pump fluid with the following exceptional properties such as:

- Absolutely safe, as they has no flash or fire point;
- Chemical inertness with almost all chemicals and gases;
- High thermal stability and oxygen resistance;
- Excellent compatibility with metals, plastics, Elastomers
- High dielectric properties
- Good radiation stability
- Environmentally acceptable

Comparison table between Krytox® and Dow Corning fluids:

Items	**Dow Corning 704**	**Krytox® VPF1506**	**Krytox® VPF1514**
Base Oil	siloxane	PFPE	PFPE
Average molecular weight	484	2160	2840
Ultimate Vacuum, torr, untrapped trapped	 10^{-7}~10^{-8} ~10^{-11}	 10^{-7}~10^{-8} ~10^{-12}	 10^{-7}~10^{-8} ~10^{-12}
Specific Gravity at 25°C	1.07	1.88	1.89
Viscosity, cSt 20°C 25°C 50°C	 39 	 60 45.7 15.5	 140 104.1 32
Flash Point, open cup, °C	221	no	no
Boiling Point, at 0.5 torr, °C	215	--	--
Typical Boiler Temperature, °C	220	--	--
Surface Tension, dynes/cm	37.3	20	20
Heat of Vaporization,200C, cal/g	52.7	10	9

Oxygen compatibility

Compared with silicone or polyphenyl ether type diffusion pump fluids such as Santovac 5 or Dow Corning 704/705, Krytox® shows excellent thermal and Oxidation stability, which is shown in the data below.

Oxygen compatibility of Krytox® Lubricants

Test Type	Temperature, °C (°F)	O2 Pressure, Mpa	Impact Energy, Joules (ft-lb)	Test Result
Ignition in gaseous oxygen (a)	400 (752)	13 (1,886)		No ignition
Pressure drop in gaseous oxygen bomb (b)	99 (210)	0.7 (100)		No pressure drop after 600 hr
Mechanical impact in liquid oxygen	Ambient		98 (72)	No reaction in 20 trials (c,d,e)
Ignition in gaseous oxygen (a)	Ambient		122 (90)	No reaction in 10 trials (a)
Ignition in gaseous oxygen (a)	Ambient		736 (543)	No reaction in multiple trials (f)

a British Specification 3100
b American Society for Testing and Materials, D-942
c Marshall Space Flight Center Specification 106B
d National Aeronautics and Space Administration Handbook, 8060.1B, Test 13, Part 1
e American Society for Testing and Materials, D-2512
f West German Federal Institute for Materials Testing (BAM), 8104-411

Metal compatibility:

Although Lewis Acids such as aluminum trichloride can decompose Krytox® fluids at relative low temperatures, Krytox® oils are inert to most metals at temperatures up to approximately 288℃ for longer time.

Advantages of using Krytox® oils in diffusion pumps:

- Will not polymerize when exposed to oxygen, ionizing radiation or accelerated subatomic particles. The system stays free of varnish and deposits from fluid decomposition.
- Non–flammable
- Resistant to oxidation of explosion and hot fluid can be exposed repeatedly to air without harm to the fluid while running the pumps.
- Inert to most reactive chemicals, the fluid can be used in direct contact with materials such as UF6, F2, PCI3, BF3, without harm to the fluid.

Miscellaneous items of use Krytox® as diffusion pump fluids:

- It is recommended that fluid temperature be kept below 300°C for long fluid life. Under recommended operating procedures, Krytox® fluids will not decompose. However, gross pump misuse above 350°C could result in partial decomposition and release of toxic gases. Improved safety can be obtained by absorbing the gases in a glass tube filled with granular calcium oxide at the end of the vacuum system.

- The higher molecular weight of Krytox® fluids may give a relatively lower pumping speed depending on the gas being pumped. Pumping speed depends on several factors including jet design, physic–chemical properties of the fluid, and molecular weight of the gas being pumped.
- In order to switch to Krytox®, the diffusion pump must be cleaned. The pump should be cleaned as thoroughly as possible before filling to ensure that no traces of solvent are present which may affect vacuum performance. The procedure for cleaning diffusion pumps working with hydrocarbon fluids is as follows:
    1. Dismantle pump and extract inner bell.
    2. Drain existing oil
    3. Wash three times with IPA/Acetone or other suitable solvents. All solvent to remain in pump for several minutes each time before draining.
    4. Dry all metal parts in an oven to remove traces of solvent.

If you have any questions, please contact me on (8621) 2892-1382, or E-mail：eva.he@chn.dupont.com..

Respectfully Submitted,

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