

# Fomblin PFPE: Vacuum Pump Oils

## Product Data Sheet

Fomblin Y grades are perfluorinated polyether inert fluids for use as lubricants in vacuum pumps. Fomblin fluids are a mixture of fluorinated polymers obtained by a photochemical process that begins with hexafluoropropylene. Since the Fomblin chemical chain contains only carbon, fluorine and oxygen atoms, these fluids have exceptional properties such as:

- Low vapor pressure
- Chemical inertness
- High thermal stability
- Good lubricant properties
- No flash or fire point
- Low toxicity
- Excellent compatibility with metals, plastics, elastomers
- Good aqueous and non-aqueous solvent resistance
- High dielectric properties
- Low surface tension
- Good radiation stability
- Environmentally acceptable

Application	Y LVAC Grade				HVAC Grade			
	06/6	14/6	16/6	25/6	18/8	25/9	40/11	140/13
Rotary pumps – sealing & lubricant fluid	•	•		•				
Turbomolecular pumps – lubrication	•							
Roots pumps – lubrication			•	•				
Diffusion pumps – working fluid					•	•	•	•

FOMBLIN®

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### Fomblin Y LVAC Grades

#### Typical Physical Properties

Typical Property	Units	Fomblin Y LVAC Grades			
		06/6	14/6	16/6	25/6
Average molecular weight	a.m.u.	1800	2500	2700	3300
Specific gravity (20°C) (68°F)	g/cm <sup>3</sup>	1.88	1.89	1.89	1.90
Kinematic Viscosity	cSt	64	148	168	276
Viscosity Index		71	97	110	113
Vapor Pressure @ 25°C (68°F) @ 100°C (212°F)	torr torr	8x10 <sup>-7</sup> 3x10 <sup>-3</sup>	1x10 <sup>-7</sup> 2x10 <sup>-4</sup>	2x10 <sup>-6</sup> 2x10 <sup>-4</sup>	6x10 <sup>-8</sup> 6x10 <sup>-5</sup>
Pour Point	°C °F	-50 -58	-45 -49	-45 -49	-35 -31
Heat of vaporization (200°C) (392°F)	cal/g	11	8	8	7
Surface Tension	dyne/cm	21	22	22	22
Evaporation loss (22hrs; 149°C for 14/6, 16/6, and 25/6, 120°C for 06/6)	% by wt.	2.8	2.6	3.9	0.6
Ultimate total pressure	torr	1.7x10 <sup>-3</sup>	1.4 x <sup>-3</sup>	2.4x <sup>-3</sup>	1.2x10 <sup>-3</sup>
Specific oil consumption	cm <sup>3</sup> /hr	0.4	0.6	0.5	0.7

#### Fomblin Y HVAC Fluids

#### Perfluoropolyether Fluids for Diffusion Pumps

There are several advantages to using Fomblin Y HVAC fluids 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 UF<sub>6</sub>, F<sub>2</sub>, PCI<sub>3</sub>, BF<sub>3</sub>, without harm to the fluid.

Fomblin Y HVAC fluids have been specially developed in order to combine narrow molecular weight range and controlled viscosity with an extremely low vapor pressure. Thus, they provide superior performance in high vacuum applications, especially systems exposed to aggressive gases.

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Typical Property	Units	Fomblin Y HVAC Grades			
		18/8	25/9	40/11	140/13
Average molecular weight	a.m.u.	2800	3400	4100	6600
Specific gravity (20°C) (68°F)	g/cm <sup>3</sup>	1.89	1.90	1.91	1.92
Flash Point	—	None	None	None	None
Kinematic Viscosity @20°C (68°F) @100°C (212°F) @200°C (392°F) cSt	cSt	190 9 2	285 12 2.6	474	1508
Pour Point	°C	-42	-35	-32	-23
Refractive Index, n <sup>20</sup> <sub>D</sub> @20°C (68°F)	°C	1.300	1.300	1.301	1.304
Specific Heat (cal/g) @38°C (100°F)	cal/g	0.24	0.24	0.24	0.24
Surface Tension @25°C (77°F)	dyne/cm	20	20	20	20
Heat of vaporization (200°C) (392°F)	cal/g	9	7	7	5

### Usage

In most cases the Fomblin fluid can be used in the diffusion pumps without any modification to the pump. The major advantage in changing to Fomblin fluid is the reduction in contamination of the vacuum apparatus due to their very low backstreaming characteristics and elimination of solid deposit formation.

Fomblin Y HVAC fluids need adequate heating power in order to obtain optimum pumping speed and vacuum stability. Working in the appropriate temperature range, the use of a cooling baffle is not critical with regard to ultimate pressure value, but best stability performances have been obtained with a single water cooled baffle. Low ultimate pressure is a typical benefit.

It is recommended that fluid temperature be kept below 280°C for long fluid life. Under recommended operating procedures, Fomblin fluids will not decompose. However, gross pump misuse above 290°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.

### Total Fomblin Vacuum Technology

*The roughing pump.* To obtain maximum benefit from the use of Fomblin in the diffusion pump, it is desirable to minimize backstreaming of hydrocarbon vapors from the mechanical roughing pump. This can only be assured by changing the fluid in the roughing pump to the appropriate Fomblin Y HVAC fluid, such as Y HVAC 06/6, 14/6, or 25/6. If hydrocarbon oil is used in the mechanical pump, it is desirable to insert an efficient trap (cryogenic, copper wool, alumina, zeolite) in the inlet line to the roughing pump.

*Vacuum greases and sealing components.* Fomblin Y-VAC 3 is the recommended compatible lubricating grease that is based on Fomblin fluids with extremely low vapor pressure. They eliminate contamination in the system, which can result from evaporation, and decomposition of hydrocarbon or silicon based vacuum greases.

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*Vacuum system cleaning.* Fomblin Perfluorosolv PFS-1 is an excellent non-CFC cleaner solvent for pumping systems using PFPE-based fluids and greases.

### Applications

Fomblin Y HVAC fluids are suggested for applications requiring the highest quality vacuum such as in scanning electron and transmission microscopes, mass spectrometers, particle accelerators, ion implantation, plasma and vapor deposition processes. In addition, it is suggested for pumps handling reactive gases such as UF<sub>6</sub>, F<sub>2</sub>, oxygen, ozone and tritium, as the fluid can be used in direct contact with these gases without reaction and fluid degradation.

Fomblin Y HVAC 18/8 can be used as an alternative to Santovac 5. The heat of vaporization of Fomblin Y HVAC 18/8 at 200°C is 9 Kcal/kg while that of Santovac 5, at the same temperature, is 53 Kcal/kg. The lower value of Fomblin means that the pump can be operated at only 85% of the power used for Santovac, resulting in a 15% energy saving.

The higher molecular weight of Fomblin may give a relatively lower pumping speed depending on the gas being pumped. Pumping speed depends on several factors including jet design, physio-chemical properties of the fluid, and molecular weight of the

gas being pumped. Pumping speed is greater for light gases (H<sub>2</sub> and He) than for heavy gases.

### Miscibility

Fomblin Y HVAC 18/8 and Santovac 5 are not miscible. In order to switch to Fomblin, the diffusion pump must be cleaned using the recommended procedure for Santovac. 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 PFPE fluids is as follows:

1. Dismantle pump and extract inner bell.
2. Drain existing oil
3. Wash three times with Fomblin Perfluorosolv PFS-1 solvent. 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.

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