

Kurt J. Lesker[®]
Company

GALDEN[®] PFPE & FOMBLIN[®] PFPE

HT FLUIDS & VAC LUBRICANTS



**EXCLUSIVE
NORTH AMERICAN
DISTRIBUTOR**

Galden® PFPE Perfluorinated Inert Heat Transfer Fluids

Galden® PFPE fluids are ideal for applications with component immersion, wafer etching, ion implantation, radar equipment, transformers, power supplies, chillers, cooling towers, and freeze dryers.

- Nine distilled fractions are offered with boiling points that range from 55° C to 270° C
- Perfluorinated, inert polyethers have a high resistance to oxidation and thermal degradation
- Compatible with metals, ceramics, plastics, and elastomers
- Fluids have low viscosity, no hydrogen in the molecular structure, and low water absorption
- Excellent for use in direct immersion cooling and indirect cooling applications
- Non-flammable, low-toxic, and safe for the environment

Application Chart

Industry	Key Features	Industry	Key Features
Electronics		Electrical	
Component Immersion	<ul style="list-style-type: none"> • Compatible with most materials over a wide temperature range • Thermally stable 	Transformers	<ul style="list-style-type: none"> • Non-flammable • Non-toxic
Wafer Etching	<ul style="list-style-type: none"> • Excellent dielectric properties • Low viscosity 	Power Supplies	<ul style="list-style-type: none"> • Excellent dielectric properties
Ion Implantation	<ul style="list-style-type: none"> • High electrical resistivity • Compatible with most metals and plastics 	Chemical	
Radar Equipment	<ul style="list-style-type: none"> • Good electromagnetic radiation resistance 	Chillers	<ul style="list-style-type: none"> • Low viscosity • Choice of boiling points • High chemical stability • High thermal stability
		Cooling Towers	
		Pharmaceutical	
		Freeze Dryers	<ul style="list-style-type: none"> • Non-flammable • Non-toxic • Wide temperature range

Typical Properties

	HT55	HT70	HT90	HT110	HT135	HT170	HT200	HT230	HT270
Operating Range (°C)	-90 to 45	-80 to 60	-70 to 80	-60 to 100	-50 to 125	-30 to 160	-20 to 190	0 to 230	25 to 260
Boiling Point (°C)	55	70	90	110	135	170	200	230	270
Pour Point (°C)	-110	-115	-110	-100	-100	-97	-85	-77	-66
Density (g/cm³)	1.65	1.68	1.69	1.72	1.73	1.77	1.79	1.82	1.85
Kinematic Viscosity (cSt)	0.45	0.50	0.75	0.77	1.00	1.80	2.40	4.4	11.7
Vapor Pressure (Torr)	225	141	48	17	5.8	0.8	0.2	0.025	0.01
Specific Heat (cal/g°C)	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232	0.232
Heat of Vap @ BP (cal/g)	22	17	17	17	16	16	15	15	15
Thermal Conduct (W/cm°C)	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065
Surface Tension (dynes/cm)	16	14	16	16	17	18	19	19	20
Dielectric Strength*	40	40	40	40	40	40	40	40	40
Dielectric Constant (1 kHz)	1.86	1.88	1.9	1.92	1.92	1.94	1.94	1.94	1.94
Volume Resistivity (ohm-cm)	1 x 10 ¹²	1 x 10 ¹⁵	1.5 x 10 ¹⁵	1 x 10 ¹⁵	1 x 10 ¹⁵	1 x 10 ¹⁵	1 x 10 ¹⁵	6 x 10 ¹⁵	6 x 10 ¹⁵
Solubility of Water (ppm by wt)	14	14	14	14	14	14	14	14	14
Solubility of Air**	26	26	26	26	26	26	26	26	26
Avg Molecular Wt.	340	410	460	580	610	760	870	1020	1550

Measurements taken at 25°C.

* Units = kV (2.54 mm gap)

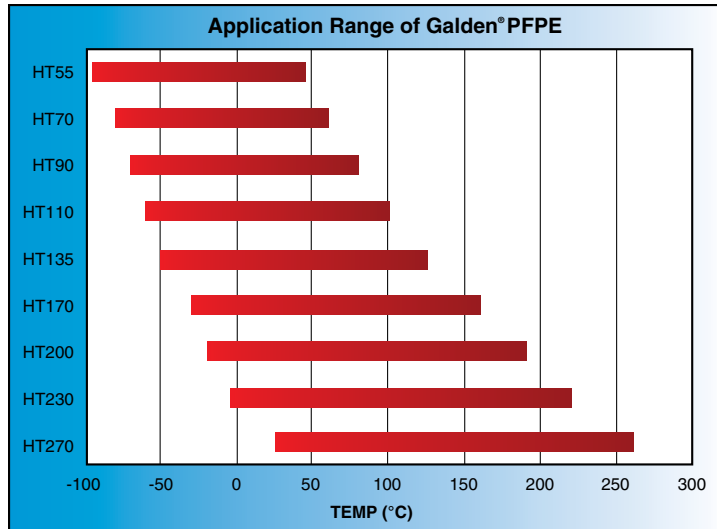
** Units = cm³ gas/100 cm³ liquid)

Package Weights

Grade	Lbs.	KJLC Part No.
HT55	15.4	HT55-7KG
	33.0	HT55-15KG
HT70	15.4	HT70-7KG
	33.0	HT70-15KG
HT90	15.4	HT90-7KG
	33.0	HT90-15KG
HT110	15.4	HT110-7KG
	33.0	HT110-15KG
HT135	15.4	HT135-7KG
	33.0	HT135-15KG
HT170	15.4	HT170-7KG
	33.0	HT170-15KG

Grade	Lbs.	KJLC Part No.
HT200	15.4	HT200-7KG
	33.0	HT200-15KG
HT230	15.4	HT230-7KG
	33.0	HT230-15KG
HT270	15.4	HT270-7KG
	33.0	HT270-15KG
PFS1	15.4	MFYPFS1-7KG
	33.0	MFYPFS1-15KG
PFS2	15.4	MFYPFS2-7KG
	33.0	MFYPFS2-15KG

Selection Chart



Galden® PFPE's chemical inertness, low viscosity, and wide operating temperature range stimulate its use as a heat transfer fluid in extreme conditions.



FM 6930 Approval Standard for Flammability Classification of Industrial Fluids

This standard states the flammability classification rating for industrial fluids intended for, but not limited to, lubricants, hydraulic power transmission, turbine governor control, transfer insulation, and cooling.

For pharmaceutical and semiconductor heat transfer and lubrication applications, Galden® PFPE and Fomblin® PFPE fluids deliver better performance than silicone and flammable fluids where safety, cleanliness, and non-flammability are required:

- FM 6930 listed
- No flash or fire point; no explosion hazards
- Odorless and colorless
- High dielectrical properties
- Good compatibility with metals, plastics, rubber
- No formation of decomposition residues
- No change in chemical properties with use
- Available as fluids, lubricants, or greases

Solvay Solexis is an international fluorospecialties producer, supplying high performance materials to demanding markets such as Pharmaceutical, Bioscience and Semiconductor industries.

For more information, visit www.lesker.com

Fomblin® PFPE vacuum Pump Oils

Fomblin® Y grades are perfluorinated polyether inert fluids for use as lubricants in vacuum pumps. Fomblin® PFPE fluids are a mixture of fluorinated polymers obtained by a photochemical process that begins with hexafluoropropylene. Since the Fomblin® PFPE 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



Applications	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® Y LVAC Fluids - Total Fomblin® PFPE Vacuum Technology

To obtain maximum benefit from the use of Fomblin® PFPE 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 LVAC fluid, such as Y LVAC 06/6, 14/6, or 25/6.

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 ³	1.88	1.89	1.89	1.90
Kinematic Viscosity (20°C) (68°F)	cSt	64	148	168	276
Viscosity Index (20°C) (68°F)	—	71	97	110	113
Vapor Pressure					
@ 25°C (68°F)	torr	8x10 ⁻⁷	1x10 ⁻⁷	2x10 ⁻⁶	6x10 ⁻⁸
@100°C (212°F)	torr	3x10 ⁻³	2x10 ⁻⁴	2x10 ⁻⁴	6x10 ⁻⁵
Pour Point	°C	-50	-45	-45	-35
	°F	-58	-49	-49	-31
Heat of Vaporization (200°C) (392°F)	cal/g	11	8	8	7
Surface Tension	dyne/cm	21	22	22	22
Evaporation Loss	% by wt.	2.8	2.6	3.9	0.6
(22 hrs; 149°C for 14/6, 16/6, and 25/6, 120°C for 06/6)					
Ultimate Total Pressure	torr	1.7x10 ⁻³	1.4 x ⁻³	2.4x ⁻³	1.2x10 ⁻³
Specific Oil Consumption	cm ³ /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
- 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
- Non-flammable
- Resistant to oxidation

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 ³	1.89	1.90	1.91	1.92
Flash Point	—	None	None	None	None
Kinematic Viscosity					
@20°C (68°F)	cSt	190	285	474	1508
@100°C (212°F)		9	12		
@200°C (392°F) cSt		2	2.6		
Pour Point	°C	-42	-35	-32	-23
Refractive Index, n _{20D} @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

Fomblin® PFPE vac Greases

Chemically inert lubricating greases are required when handling corrosive or oxidizing substances. Fomblin® PFPE fluorinated fluids are excellent base oils for high temperature, high performance greases. Fomblin® PFPE greases are derived by thickening Fomblin® PFPE fluids with tetrafluoroethylene telomers, silicates, etc. Many of the greases have USDA H1 listing.

General Properties

Fomblin® PFPE greases are homogenous, white, thick and particularly resistant to oxidation and to chemical agents. Further, they are compatible with all types of material (glass, metals, elastomers, plastics, and ceramics) and their properties remain unaltered over wide temperature ranges. Fomblin® PFPE greases can be used in the presence of water, oils, vapor and, in general, with all organic substances and solvents which are not highly fluorinated, without being removed, dissolved or modified in any way.



Typical Properties of Fomblin® PFPE Greases

Grease Type	YVAC 2	YVAC 3
Viscosity of base fluid at 20°C (ASTM D 445) (cSt)	1450	1500
Thickener	PTFE	PTFE
Penetration unworked after 60 strokes (ASTM D 217) mm/10	285	240/245
NLGI Class	2	3
Stability after 10,000 strokes (ASTM D 217) (mm/10)	295	260
Anti-rust additives	No	No
Apparent viscosity poise at 20°C		
Shear rate 100 sec -1	190	280
Shear rate 300 sec -1	100	140
Oil separation FTMS 791-321 weight loss (%)		
at 204°C / 30 hrs	8.5	8
Evaporation (ASTM D 2595) weight loss (%)		
at 204°C / 22h / 120 l/h	-3	0.3
Range of continuous use	-20	-20
temperature (°C)	250	250

Standard Properties of Fomblin® PFPE Greases

Thermal stability: Fomblin® PFPE greases have dropping points above 300° C and can be used at high temperatures and in oxidizing conditions.

Chemical resistance: Fomblin® PFPE greases are inert and do not react even at high temperatures with fuels, acids, inorganic alkalis, halogens, fuming nitric acid, or oxidizing solutions.

Lubricating properties: Shell Four Ball EP tests results are given in the table below.

Solubility/wash-out: Fomblin® PFPE greases are stable, do not emulsify with water, and are resistant to all solvents except highly fluorinated solvents. Therefore Delifrene LS (1, 1, 3 Trichlorotrifluoroethane) and Galden® SV, can be used to clean surfaces lubricated with Fomblin® PFPE greases. The compatibility of Fomblin® PFPE greases with common solvents is given in the table below.

Oxygen compatibility: Bundesanstalt für Materialprüfung, Berlin (BAM), has approved the use of Fomblin® PFPE fluids and greases in the presence of oxygen. Furthermore the National Aeronautics and Space Administration (NASA) and the Naval Ship Engineering Center of the US Navy have both approved the use of Fomblin® PFPE fluids and greases in liquid oxygen applications. Temperature and pressure limits of oxygen with Fomblin® PFPE greases are given in the table below.

Compatibility with metals and structural materials: Fomblin® PFPE greases are compatible with all types of polymers, elastomers, and elastomers. During tests over one month at 20°C none of these materials (nitrile, butyl, polyfluorosiloxane, EPDM rubber) revealed swelling, mechanical or physical alterations. Melamine, phenolic, polyoxymethylene, polyolefin resins are not altered after contact with Fomblin® PFPE greases for one month at 100°C. Fomblin® PFPE greases can be used in continuous contact with metal and oxygen, at temperatures up to 200°C.

Extreme Pressure Properties of Fomblin® PFPE Lubricating Greases (Typical Values)

Fomblin® PFPE Grease	Seizure Load kg./cm ²	Welding Load kg./cm ²	M.Hertz Load kg./cm ²
YVAC 2	178	794	100
YVAC 3	178	794	100

*Shell four ball EP test-method IP 239: operating conditions: 1450RPM 10 seconds duration

Compatibility with Solvents

Fomblin® PFPE Grease	
Solvent	Behavior
Petroleum Ether	Unaltered
Octane	Unaltered
Benzene	Unaltered
Ethyl Ether	Unaltered
Dioxane	Unaltered
Ethyl Acetate	Unaltered
Dimethylketone	Unaltered
Trichloroethylene	Unaltered

Fomblin® PFPE Grease	
Solvent	Behavior
Chloroform	Unaltered
Carbon Tetrachloride	Unaltered
Methanol	Unaltered
Water	Unaltered
Perfluorooctane	Soluble
Delifrene LS®	Soluble
Galden® SV	Soluble

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- OFHC Copper Gaskets
- Bellows, Tubing, & Seals
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- Ferro-Magnetic Fluid Rotary Drives
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- Scroll & Diaphragm
- Screw & Roots Blowers
- Turbo & Diffusion
- Cryogenic & Ion
- Traps & Filters
- Complete Offering of Pump Repair Services

Vacuum Fluids

- Full Line of Mechanical Pump Oils
- Fomblin® PFPE - Inert PFPE
- Galden® PFPE - Heat Transfer Fluid
- Vacuum Greases, Sealants, & Solvents
- Pump Oil with R/O Additives
- Silicon Diffusion Pump Oils
- Pump Oil Recycling

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- Multi-Gauge Controllers
- Replacement Gauge Tubes
- MKS Baratron®

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- Linear Positioners
- Wobble Sticks & Port Aligners
- XYZ Manipulators
- Multi-Axis Manipulators
- Sample Transfer Probes
- Sample Heating & Rotation
- Motion Control
- Sample Distribution Center

Vacuum Services

- Full Line Pump Repair/Rebuild Services
- Pump Oil Recycling
- Technical Information
- Technical Consulting
- Decontamination
- Magnetron Cathode Service
- Contract Manufacturing

PROCESS EQUIPMENT™ DIVISION

Deposition Sources

- Torus® Magnetron Sputtering Sources
- Electron Beam Evaporation
- Organic Material Sources
- Electron Beam Sources
- Ion Sources
- Thermal Evaporation Sources

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- Film Thickness
- Mass Flow Controllers
- RF & DC Power Supplies
- Pulsed DC Power Supplies
- Power Supplies for Evaporation

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- Comprehensive Engineering Design Support
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- High Temperature & Bakeout Heater Assemblies
- Heater Power Supplies
- Substrate Load Locks & Transfer Vessels

Vacuum Systems

- Thin Film Deposition Systems
- Cluster Tools
- Box Coaters
- General PVD Systems
- Computerized Systems
- Combinatorial Systems
- Organic Material Deposition Systems
- R&D Sputter Tools
- Vacuum Furnaces & Ovens
- Atomic Layer Deposition (ALD)
- Drum Coaters
- In-line & Linear Systems
- R2R Systems

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- Precious Metals & Reclaim
- Evaporation Pieces
- Thermal Evaporation Sources
- E-Beam Crucible Liners
- Bonding Service
- Backing Plates
- Ceramic Materials Manufacturing (CMM)

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- Standard Pyrex® Glass Bell Jars & Cylinders
- Standard Building Blocks to Customize Your System
- Custom Chambers
- Array of Finishes & Materials
- Easily Build Your Own Chamber with the Custom Chamber Configurator On-line

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