Galden® PFPE: Reliability Testing Fluids

Product Data Sheet

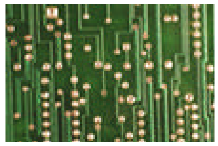
Galden® are low molecular weight perfluoropolyether (PFPE) fluids having the general chemical structure of:

$$CF_3\text{-}[(O\text{-}\underset{\displaystyle CF_3}{CF}\text{-}CF_2)m\text{-}(O\text{-}CF_2)n]O\text{-}CF_3$$

PFPEs have exceptional thermal and oxidative stability, as well as extreme chemical inertness. Their non-reactivity, high dielectric strength, low toxicity, non-flammability and non-solvent features make PFPEs ideal for electronic reliability testing including thermal shock and hermetic seal testing.

All Galden® grades are:

- *Environmentally safe-do not damage the ozone*
- *Highly inert*
- *Good heat transfer medium*
- *Chemically and thermally resistant*
- *Non-toxic*



Typical Properties

Typical Property	Units	DET	D/80	D/100	D02	D02-TS	D03	D05
Boiling Point	°C (°F)	91 (196)	84 (183)	104 (219)	175 (347)	165 (329)	200 (392)	230 (446)
Pour Point	°C (°F)	-110 (-230)	-79 (-110)	-103 (-217)	-97 (-143)	-97 (-143)	-85 (-121)	-77 (-107)
Density, 25°C	g/Cm^3 ($lb./ft^3$)	1.70 (1.70)	1.73 (108.0)	1.77 (110.4)	1.77 (110.5)	1.77 (110.5)	1.79 (111.7)	1.82 (113.6)
Density, -54°C	g/Cm^3 ($lb./ft^3$)	1.85 (1.85)	1.93 (120.6)	1.96 (122.7)	1.95 (121.7)	1.95 (121.7)	1.96 (122.4)	1.98 (123.6)
Kinematic Viscosity, 25°C	cSt	0.60	0.55	0.81	1.8	1.8	2.4	4.4
Kinematic Viscosity, -54°C	cSt	6.0	5.3	9.1	65	45	160	1100
Vapor Pressure, 25°C	Torr (lb/in^2)	<1 (<0.02)	79 (1.53)	35 (0.67)	<1 (<0.02)	<1 (<0.02)	<1 (<0.02)	<1 (<0.02)
Specific Heat, 25°C	cal/g-°C (Btu/lb-°F)	0.23 (0.23)	0.23 (0.23)	0.23 (0.23)	0.23 (0.23)	0.23 (0.23)	0.23 (0.23)	0.23 (0.23)
Heat of Vaporization @Boiling Point	cal/g (Btu/lb)	17 (31)	19 (35)	20 (36)	17 (31)	17 (31)	15 (27)	15 (27)
Thermal Conductivity, 25°C	Watts/cm°C (Btu/lb-ft°C)	0.0007 (0.041)	0.0006 (0.035)	0.0006 (0.035)	0.0007 (0.041)	0.0007 (0.041)	0.0007 (0.041)	0.0007 (0.041)
Coefficient of Expansion	$Cm^3(cm^3)$ (°C), ($ft^3(ft^3)$(°F))	0.0011 (0.0007)	0.0014 (0.0008)	0.0014 (0.0008)	0.0011 (0.0007)	0.0011 (0.0006)	0.0011 (0.0007)	0.0011 (0.0007)
Surface Tension, 25°C	dynes/cm (poundals/in)	16 (0.0029)	17 (0.0031)	16 (0.0029)	17 (0.0033)	18 (0.0031)	19 (0.0035)	20 (0.0037)

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Typical Properties (continued)								
Typical Property	**Units**	**DET**	**D/80**	**D/100**	**D02**	**D02-TS**	**D03**	**D05**
Dielectric Strength, 25°C	KV-2.54mm gap (KV-0.10in gap)	40 (40)	40 (40)	40 (40)	40 (40)	40 (40)	40 (40)	40 (40)
Dielctric Constant 25°C (1Khz)	—	2.1	1.80	1.80	2.1	2.1	2.1	2.1
Dissipation Factor 25°C (1Khz)	—	$2x10^{-4}$	$3x10^{-4}$	$3x10^{-4}$	$2x10^{-4}$	$2x10^{-4}$	$2x10^{-4}$	$2x10^{-4}$
Volume Resistivity, 25°C	Ohm-cm	$1x10^{15}$	$1x10^{15}$	$1x10^{15}$	$1x10^{15}$	$1x10^{15}$	$1x10^{15}$	$1x10^{15}$
Solubility of Air	Ppm(wt.)	14	15	13	14	14	14	14
Solubility of Air	Cm^3 gas/100Cm^3 liquid	26	45	41	26	26	26	26
Average Molecular Weight	a.m.u.	400	390	416	760	760	870	1020

Thermal Shock Testing

Thermal Shock testing is conducted to determine the resistance of a device to extreme temperature changes. The test is carried out by alternately immersing the devices in liquid baths maintained at two different temperatures, as specified in MIL STD 883, Method 1011, or MIL STD 202, Method 107.

Traditionally, 2 different fluids were used in both the hot and cold baths. This practice, while conforming to the MIL STD, presents the following problems: high fluid loss from the cold bath; cross contamination between the hot and cold baths; extensive machine down time; and dual fluid inventory.

Single Fluid = Lower Costs

Galden® D02TS is a single fluid which replaces the dual fluid system. D02TS meets the MIL STDS 883 and 202 for both the hot and cold baths. The single fluid solution allows for a dramatic decrease in operating costs by:

- *Decreasing fluid consumption*
- *Reducing machine downtime*
- *Eliminating cross contamination*
- *Reducing inventory to a single fluid*

For use in condition D, E or F, the following military approved GALDEN® fluids can be used:

Condition D - D05/D100, D80

Condition E (Hot test) - D02

Condition F (Hot test) - D05

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Approved Galden Fluids for Liquid Thermal Shock Testing MIL STD 883 - 1011				
Condition	**Hot step (°C)**	**Cold step (°C)**	**Hot bath**	**Cold Bath**
B	+10 125 -0	+0 -55 -10	D02 D02TS	D/80 D02TS D100
C	+10 150 -0	+0 -65 -10	D02 D02TS	D/80 D02TS D100
D	+10 200 -0	+0 - -10	D05 D100	D/80
E	+10 150 -0	+5 -195 -10	D02 D02TS	Liquid N^2
F	+10 200 -0	+5 -195 -10	D05	Liquid N^2

Hermetic Seal Testing

To guarantee the hermeticity of sealed devices, a leak test procedure as defined by MIL STD 883, Method 1014, MIL STD 750, Method 1071, or MIL STD 202, Method 112 is performed.

Galden®

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Specific physical property requirements have been defined in 883 for detector and indicator fluids:

Physical Property Requirements of Perfluorocarbon Fluids Defined in Test Method 1014.9 (notice 8)

Property	Type I	Type II	Type III	ASTM Test Method
Boiling Point (°C)	50-95	140-200	50-110	D1120
Surface Tension (dynes/cm) @25°C	—	<18	—	D971, D1331
Density @25°C (gm/ml)	>1.6	>1.6	>1.6	D941
Density @125°C (gm/ml)	—	>1.5	—	D941
Dielctric Strength (volts/mil)	>300	>300	>300	D877
Residue (µgm/gm)	>50	>50	>50	D2109
Appearance	Clear Colorless Liquid			

Galden® DET: Detector Fluid Specifically Designed for Vapor Detection Systems

- *Type I fluid that meets the requirements of MIL-STD 883*
- *Lower consumption with respect to traditionally used Type I approved products*
- *Higher reliability as the result of both low and high boiling point components in the fluid*
- *High boiling point components enter the devices via the large leaks and remain liquid until the test is performed*
- *Low boiling point components penetrate into the small leaks*
- *Tested and approved by the major equipment manufacturer of Vapor Detection Systems*

Galden® DET can also be used in bubble test equipment as a detector fluid.

Galden® D02: A Low Consumption Indicator Fluid

- *Higher boiling point, reducing evaporative loss*
- *Lower liquid density than competitive fluids, reducing operating costs*
- *Lower vapor pressure at test temperature, minimizing fluid loss*

Galden® D03: A Lower Cost Indicator Fluid for Non Military Applications

- *Lower consumption compared to other commercially available indicator fluids*

To complete the product offering, Ausimont also offers MIL-STD approved Galden® D/80, a Type I detector fluid and Galden® D/100, a Type III detector fluid.

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