3M

Product Information

Fluorinert™ Liquids

For Electronics Manufacturing

Introduction

3M™ Fluorinert™ Liquids are a family of clear, colorless, odorless perfluorinated fluids having a viscosity similar to water. These non-flammable liquids have set the standard in the electronics industry for over 40 years, meeting the demanding and diverse requirements of many heat transfer, manufacturing and testing applications.

Fluorinert liquids are thermally and chemically stable, compatible with most sensitive materials, including metals, plastics and elastomers, and are practically non-toxic through normal routes of industrial exposure.

Fluorinert liquids are completely fluorinated, containing no chlorine or hydrogen atoms. The strength of the carbon-fluorine bond contributes to their extreme stability and inertness. This chemical structure also results in very low intermolecular forces, low surface tension and essentially no solvent action on non-fluorinated compounds.

The dielectric strength of perfluorinated liquids is high—in excess of 35,000 volts across a 0.1 inch gap. Water solubility is on the order of a few parts per million. The nominal boiling point of each fluid in this series is determined during their manufacture. Fluorinert liquids are available with boiling points ranging from 30ºC to 215ºC and pour points as low as -101ºC.

3M™ Fluorinert™ Liquids Typical Properties

(Not for Specification Purposes)

All values determined at 25°C unless otherwise specified

Properties	Fluorinert Liquid									
	FC-87	FC-72	FC-84	FC-77	FC-3255	FC-3283	FC-40	FC-43	FC-70	FC-5312
Average Molecular Weight	290	340	388	415	438	21	650	670	820	820
Typical Boiling Point, °C	30	56	80	97	103	128	165	175	215	215
Pour Point, °C	-101	-90	-95	-95	-30	-50	-50	-40	-25	-25
Density, g/cm^3	1.63	1.68	1.73	1.78	1.77	1.82	1.87	1.88	1.94	1.93
Density, -54°C g/cm^3	1.84	1.90	1.93	1.97	■	■	■	■	■	■
Kinematic Viscosity, cs	0.4	0.4	0.55	0.8	0.71	0.75	2.2	2.8	14.0	12.6
Kinematic Viscosity, -54°C cs	1.1	1.9	4.0	6.9	■	■	■	■	■	■
Vapor Pressure, torr	610	232	79	42	31	11	3	1.3	<0.1	<0.1
Specific Heat, cal/g - °C	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Heat of Vaporization @ Boiling Point, cal/g	24	22	19	20	22	18	17	17	16	16
Thermal Conductivity, watts/(cm^2) (°C/cm)	0.00056	0.00057	0.00060*	0.00063*	0.00064	0.00066*	0.00066*	0.00066	0.00070*	0.00070*
Coefficient of Expansion cm^3/(cm^3)(°C)	0.0016	0.0016	0.0015	0.0014	0.0014	0.0013	0.0012	0.0012	0.0010	0.0010
Surface Tension, dynes/cm	9.5	12	13	15	15	16	16	16	18	18
Refractive Index	1.238	1.251	1.261	1.280	1.270	1.281	1.290	1.291	1.303	1.303
Dielectric Strength, KV(2.54 mm gap)	42	38	42	40	40	43	46	42	40	40
Dielectric Constant, (1KHz)	1.72	1.76	1.81*	1.86	1.90	1.89	1.89	1.90	1.98	1.98
Dissipation Factor, (1KHz)	<0.0005	<0.0003	<0.0003*	<0.0003	N/A	<0.0003*	<0.0003	<0.0001	<0.0001	<0.0001
Volume Resistivity, ohm-cm	5.6x10^{15}	1.0x10^{15}	1.0x10^{15}	1.9x10^{15}	N/A	5.0x10^{15} *	4.0x10^{15}	3.4x10^{15}	2.3x10^{15}	2.3x10^{15}
Solubility of Water ppm(wt.)	7	10	11*	13	11	7*	7	7	8	8
Solubility of Air ml gas/100 ml liquid	54	48	43*	41	N/A	30*	27	26	22	22

* Estimated values ■ Not measured due to relative proximity to pour point N/A–not available

Secondary Fluid 3M™ Performance Fluid PF-5058 Typical Physical Properties

Not for specification purposes

All values determined at 77°F (25°C) unless otherwise specified

Properties	PF-5058	Test Number
Boiling Point, °C	80-100°C	ASTM D1120
Density @ 25°C, gm/ml	1.75	ASTM D941
Appearance	Clear/colorless liquid	Visual

Typical Applications

Application	Recommended Products/BoilingPoints										
	FC-87 30°	**FC-72** 56°	**FC-84** 80°	**FC-77** 97°	**FC-3255** 103°	**FC-3283** 128°	**FC-40** 155°	**FC-43** 174°	**FC-70** 215°	**FC-5312** 215°	**PF-5058** 80-100°
MIL. STD. Tests:											
Gross Leak											
Detector Fluids (Bombing)		X									
Bubble Tank or NID			X								
Indicator Fluids (Bubble Tank)							X	X			
Thermal Shock											
Cold Side				X							
Hot Side							X	X			
Liquid Burn In & ESS (Environmental Stress Screening):							X	X			
VPS Vapor Phase Soldering:											
Primary									X	X	
Secondary											X
Cooling/Thermal Management:				X		X		X	X		
High Voltage/Dielectric Testing:	All 3M™ Fluorinert™ Liquids have high dielectric strength										
Constant Temperature Baths/Calibration:	Match the boiling point and pour point										

Materials Compatibility

3M™ Fluorinert™ Liquids are compatible with most metals, plastics and elastomers.

Toxicity Profile

In general, Fluorinert liquids are non-irritating to the eyes and skin. They also demonstrate very low acute and sub-chronic toxicity through normal routes of industrial exposure.

Safety and Handling

Fluorinert liquids are nonflammable, and are highly resistant to thermal breakdown and hydrolysis in storage and during use. Recommended handling procedures are provided in the Material Safety Data Sheets, which are available upon request.

3M™ Fluorinert™ Liquids Environmental Profile

Fluorinert liquids have zero ozone depletion potential. These materials are not defined by the U.S. EPA, nor regulated, as volatile organic compounds (VOCs) and do not contribute to ground-level smog formation.

Fluorinert liquids, which are perfluorocarbon (PFC) materials, have high global warming potentials and long atmospheric lifetimes. As such, they should be carefully managed to minimize emissions.

3M recommends that users of Fluorinert liquids further limit emissions by employing good conservation practices, and by implementing recovery, recycling and/or proper disposal procedures. 3M offers a program for used fluid return in the U.S. Information about the safe handling and use of 3M products is provided in the Material Safety Data Sheets.

Resources

For additional technical information on Fluorinert liquids, contact:

3M Electronic Materials
800-810-8513

Visit our web site at: **www.3m.com/electronics/chemicals**

United States
3M Electronics Markets Materials Division
800 810 8513

Canada
3M Canada Company
800 364 3577

China
3M China Ltd.
86 21 6275 3535

Europe
3M Belgium N.V.
32 3 250 7521

Japan
Sumitomo 3M Limited
813 3709 8250

Korea
3M Korea Limited
82 2 3771 4114

Malaysia
3M Malaysia Sdn. Berhad
60 3 706 2888

Philippines
3M Philippines, Inc.
63 2 813 3781

Singapore
3M Singapore Pte. Ltd.
65 454 8611

Taiwan
3M Taiwan Limited
886 2 2704 9011

Other Areas
651 736 7123 (U.S.)

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