



Fluorinert™

Electronic Liquid

FC-77

Product Information

Introduction

3M™ Fluorinert™ Electronic Liquid FC-77 is a thermally stable, fully-fluorinated liquid that has long been used as a heat transfer fluid in a variety of industries.

The inertness of Fluorinert liquid FC-77 permits its use as a direct contact single and two-phase coolant in supercomputers and sensitive military electronics. Its high dielectric strength and electrical resistivity are ideal for applications in high voltage transformers and power electronics.

In the semiconductor manufacturing industry, its wide liquid range makes Fluorinert liquid FC-77 ideal for cooling ion implanters, dry etchers and CVD machines. Its low pour point also permits its use in thermal shock and test equipment.

Physical Properties

Not for specification
purposes

All values determined
at 25°C unless
otherwise specified

Properties	FC-77
Appearance	Clear, colorless
Average Molecular Weight	416
Boiling Point (1 atm)	97°C
Pour Point	-110°C
Calculated Critical Temperature	495 K
Calculated Critical Pressure	1.58 x 10 ⁶ pascals
Vapor Pressure	5.62 x 10 ³ pascals
Latent Heat of Vaporization (at normal boiling point)	89 J/g
Liquid Density	1780 kg/m ³
Kinematic Viscosity	0.72 centistokes
Absolute Viscosity	1.3 centipoise
Liquid Specific Heat	1100 J kg ⁻¹ °C ⁻¹
Liquid Thermal Conductivity	0.063 W m ⁻¹ °C ⁻¹
Coefficient of Expansion	0.00138 °C ⁻¹
Surface Tension	13 dynes/cm
Refractive Index	1.28
Water Solubility	13 ppmw
Solubility in Water	<5 ppmw
Ozone Depletion Potential	0

3M™ Fluorinert™ Electronic Liquid FC-77 Electrical Properties

Properties	FC-77
Dielectric Strength	40 kV, 0.1" gap
Dielectric Constant	1.9
Electrical Resistivity (ASTM D-257)	1.9×10^{15} ohm cm

Heat Transfer Properties

The following formulas can be used to calculate the specific heat, thermal conductivity and density of 3M™ Fluorinert™ Electronic Liquid FC-77 at various temperatures.

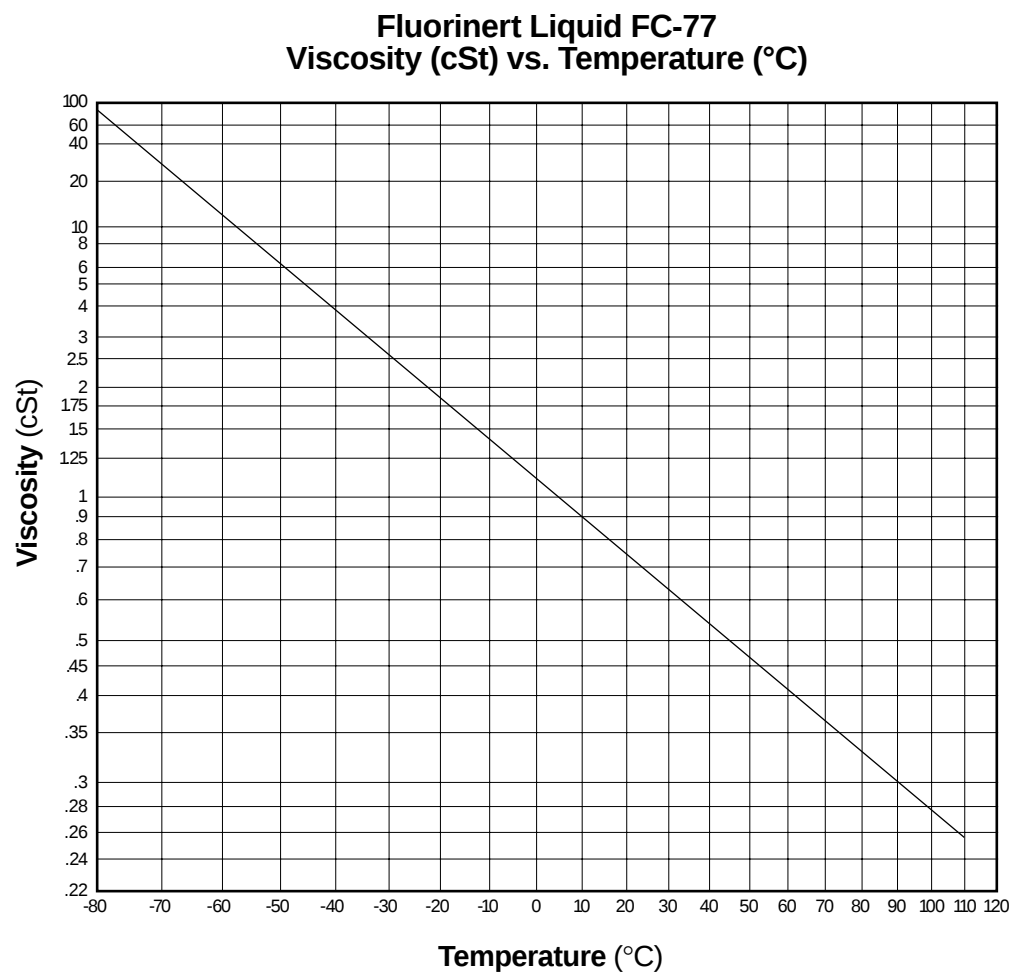
$$\text{Specific Heat (J kg}^{-1} \text{ }^{\circ}\text{C}^{-1}) = 1014 + 1.554 (T, ^{\circ}\text{C})$$

$$\text{Thermal Conductivity (W m}^{-1} \text{ }^{\circ}\text{C}^{-1}) = 0.065 - 0.00008 (T, ^{\circ}\text{C})$$

$$\text{Density (kg/m}^3) = 1838 - 2.45 (T, ^{\circ}\text{C})$$

$$\text{Log}_{10}(\text{Vapor Pressure (pascals)}) = 10.216 - (1928/(T, \text{K}))$$

The following graph can be used to determine the viscosity of Fluorinert liquid FC-77 over the indicated temperature range.



3M™ Fluorinert™ Electronic Liquid FC-77 Materials Compatibility

3M™ Fluorinert™ Electronic Liquid FC-77 is compatible with most metals, plastics and elastomers.

Toxicity Profile

Fluorinert liquid FC-77 is non-irritating to the eyes, minimally irritating to the skin, and is practically non-toxic orally and dermally. The product also demonstrates very low acute and sub-chronic inhalation toxicity. It is not a mutagen (ames) or skin sensitizer. A Material Safety Data Sheet is available upon request.

Safety and Handling

Before using this product, please read the current product Material Safety Data Sheet (available through your 3M sales or technical service representative) and the precautionary statement on the product package. Follow all applicable precautions and directions. Fluorinert liquid FC-77 is nonflammable, and is highly resistant to thermal breakdown and hydrolysis in storage and during use. Recommended handling procedures are given in the Material Safety Data Sheet.

Environmental Properties

Fluorinert liquid FC-77 has zero ozone depletion potential. The material is not defined by the U.S. EPA, nor is it regulated, as a volatile organic compound (VOC). FC-77 liquid does not contribute to ground-level smog formation.

Fluorinert liquid FC-77, a perfluorocarbon (PFC), has a high global warming potential and a long atmospheric lifetime. As such, its use should be carefully managed to minimize emissions.

3M recommends that users of Fluorinert liquid FC-77 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.

Environmental Policy

3M will recognize and exercise its responsibility to:

- prevent pollution at the source wherever and whenever possible
- develop products that will have a minimal effect on the environment
- conserve natural resources through the use of reclamation and other appropriate methods
- assure that its facilities and products meet and sustain the regulations of all Federal, State and local environmental agencies
- assist, wherever possible, governmental agencies and other official organizations engaged in environmental activities

3M™ Fluorinert™ Electronic Liquid FC-77 Used Fluid Return Program

3M offers a program for free pickup and return of used 3M Specialty Materials in the U.S. through Safety-Kleen Corporation. A pre-negotiated handling agreement between users and this service provider offers users broad protection against future liability for used 3M product. The fluid return program is covered by independent third-party financial and environmental audits of treatment, storage and disposal facilities. Necessary documentation is provided. A minimum of 30 gallons of used 3M Specialty Materials is required for participation in this free program.

Safety-Kleen Corporation has a network of 156 branch service centers in the U.S. This large fleet will provide timely, economical fluid disposal service.

For additional information on the 3M Used Fluid Return Program, contact Safety-Kleen Corporation at this toll-free line: 1.888.932.2731.

Resources

3M™ Fluorinert™ Electronic Liquid FC-77 customers are supported by global sales, technical and customer sales resources, with fully staffed technical service laboratories in the U.S., Europe, Japan, Latin America and Southeast Asia. Users benefit from 3M's broad technology base and continuing attention to product development, performance, safety and environmental issues.

For other 3M global offices and additional information on Fluorinert electronic liquid FC-77 in the U.S., call 3M Performance Materials, 800.833.5045, or visit our web site at: www.3m.com/fluids

Important Notice to Purchaser: The information in this publication is based on tests that we believe are reliable. Your results may vary due to differences in test types and conditions. You must evaluate and determine whether the product is suitable for your intended application. Since conditions of product use are outside of our control and vary widely, the following is made in lieu of all express or implied warranties (including the warranties of merchantability or fitness for a particular purpose): 3M's only obligation and your only remedy is replacement of product that is shown to be defective when you receive it. In no case will 3M be liable for any special, incidental, or consequential damages based on breach of warranty or contract, negligence, strict tort, or any other theory.



Specialty Materials

3M Center, Building 223-6S-04
St. Paul, MN 55144-1000

Issued: 05/00

© 2000 3M IPC

98-0212-2309-8 (HB)