



Fluorinert™ Electronic Liquid FC-40

Introduction

3M™ Fluorinert™ Electronic Liquid FC-40 is a clear, colorless, thermally stable, fully-fluorinated liquid ideal for use in many single phase heat transfer applications in the semiconductor manufacturing industry. Its liquid range (-57°C to 165°C) makes it ideal for a variety of applications such as etchers, ion implanters, testers and others. Because Fluorinert liquid FC-40 is primarily a single compound, its composition will not shift or fractionate with time. This keeps fluid loss to a minimum and insures that transport properties will not change with time.

Physical Properties

**Not for
specification
purposes.**

All values are
determined at
25°C unless
otherwise
specified.

Properties	FC-40
Appearance	Clear, colorless
Average Molecular Weight	650
Boiling Point (1 atm)	165°C
Pour Point	-57°C
Calculated Critical Temperature	543 K
Estimated Critical Pressure	1.18 x 10 ⁶ pascals
Vapor Pressure	287 pascals
Latent Heat of Vaporization (at normal boiling point)	69 J/g
Liquid Density	1855 kg/m ³
Kinematic Viscosity	2.2 centistokes
Absolute Viscosity	4.1 centipoise
Liquid Specific Heat	1100 J kg ⁻¹ °C ⁻¹
Liquid Thermal Conductivity	0.065 W m ⁻¹ °C ⁻¹
Coefficient of Expansion	0.0012°C ⁻¹
Refractive Index	1.290
Water Solubility	<7 ppmw
Solubility in Water	<5 ppmw
Ozone Depletion Potential	0

3M™ Fluorinert™ Electronic Liquid FC-40 Electrical Properties

Properties	FC-40
Dielectric Strength	46 kV, 0.1" gap
Dielectric Constant	1.9
Electrical Resistivity (ASTM D-257)	4.0×10^{15} ohm cm

Heat Transfer Properties

The following formulas can be used to calculate the specific heat, thermal conductivity, density and vapor pressure of 3M™ Fluorinert™ Electronic Liquid FC-40 at various temperatures.

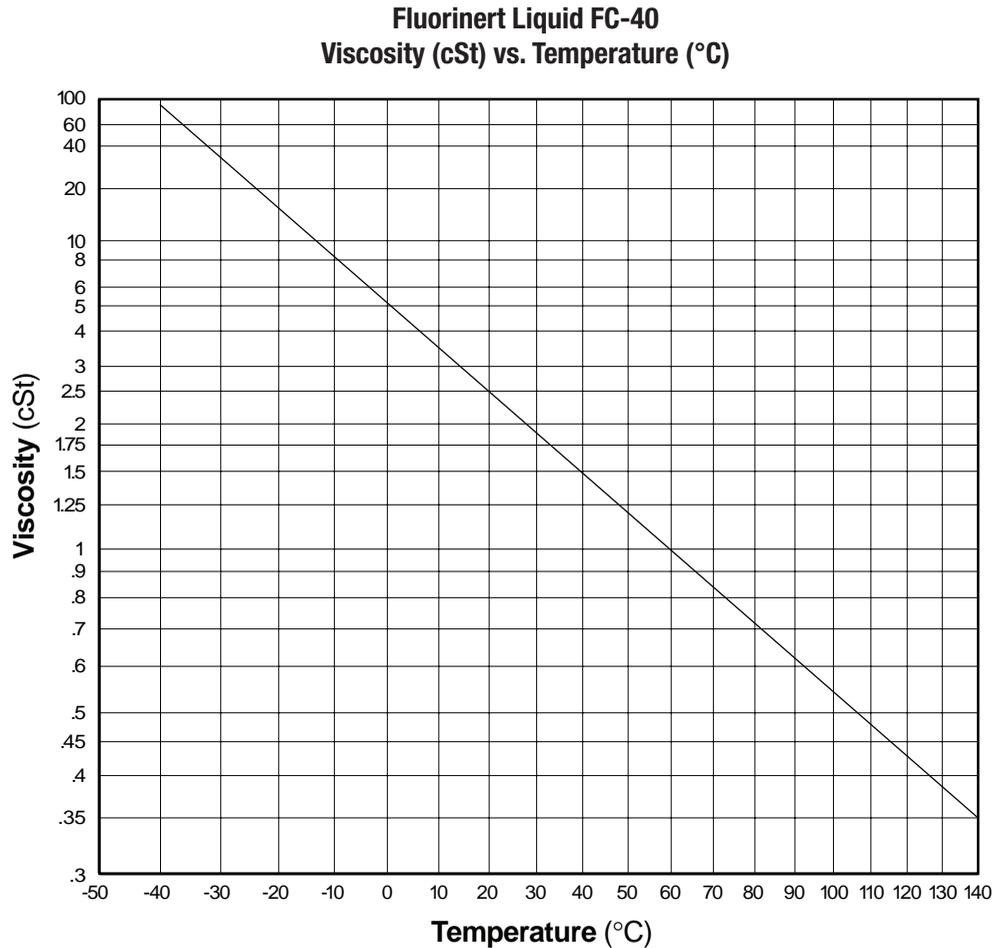
$$\text{Specific Heat (J kg}^{-1} \text{ }^{\circ}\text{C}^{-1}) = 1014 + 1.554 (T, \text{ }^{\circ}\text{C})$$

$$\text{Thermal Conductivity (W m}^{-1} \text{ }^{\circ}\text{C}^{-1}) = 0.067 - 0.000069 (T, \text{ }^{\circ}\text{C})$$

$$\text{Density (kg/m}^3\text{)} = 1909 - 2.16 (T, \text{ }^{\circ}\text{C})$$

$$\text{Log}_{10} (\text{Vapor Pressure (pascals)}) = 10.448 - (2381/(T, \text{ K}))$$

The following graph can be used to determine the viscosity of Fluorinert liquid FC-40 over the indicated temperature range.



3M™ Fluorinert™ Electronic Liquid FC-40 Materials Compatibility

3M™ Fluorinert™ Electronic Liquid FC-40 is compatible with most metals, plastics and elastomers.

Toxicity Profile

Fluorinert liquid FC-40 is non-irritating to the eyes and skin, and is practically non-toxic orally. The product also demonstrates very low acute and sub-chronic inhalation toxicity, and it is not a mutagen (ames). 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-40 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-40 has zero ozone depletion potential. The material is exempt from the U.S. EPA and most State definitions of a volatile organic compound (VOC), and does not contribute to ground-level smog formation.

Fluorinert liquid FC-40, a perfluorocarbon (PFC), has a high global warming potential and a long atmospheric lifetime. As such, it should be carefully managed so as to minimize emissions.

3M recommends that users of FC-40 liquid 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-40 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-40 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-40 in the U.S., call 3M Performance Materials, 800-810-8513, or visit our web site at: www.3M.com/electronics

Product Use: All statements, technical information and recommendations contained in this document are based on tests or experience that 3M believes are reliable. However, many factors beyond 3M's control can affect the use and performance of a 3M product in a particular application, including conditions under which the product is used and the time and environmental conditions in which the product is expected to perform. Since these factors are uniquely within the user's knowledge and control, it is essential that the user evaluate the 3M product to determine whether it is fit for a particular purpose and suitable for the user's method of application.

Warranty and Limited Remedy: Unless stated otherwise in 3M's product literature, packaging inserts or product packaging for individual products, 3M warrants that each 3M product meets the applicable specifications at the time 3M ships the product. Individual products may have additional or different warranties as stated on product literature, package inserts or product packages. 3M MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR ANY IMPLIED WARRANTY ARISING OUT OF A COURSE OF DEALING, CUSTOM OR USAGE OF TRADE. User is responsible for determining whether the 3M product is fit for a particular purpose and suitable for user's application. If the 3M product is defective within the warranty period, your exclusive remedy and 3M's and seller's sole obligation will be, at 3M's option, to replace the product or refund the purchase price.

Limitation Of Liability: Except where prohibited by law, incidental, or consequential regardless of the legal theory asserted, including warranty, contract, negligence or strict liability.



3M Electronics Markets Materials Division

3M Center, Building 224-3N-11
St. Paul, MN 55144-1000
www.3M.com/electronics
1-800-810-8513

Please recycle. Printed in USA.
© 3M 2010. All rights reserved.
Issued: 3/10 7062HB
98-0212-2305-6

3M and Fluorinert are trademarks of 3M Company.
Used under license by 3M subsidiaries and affiliates.