



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.

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

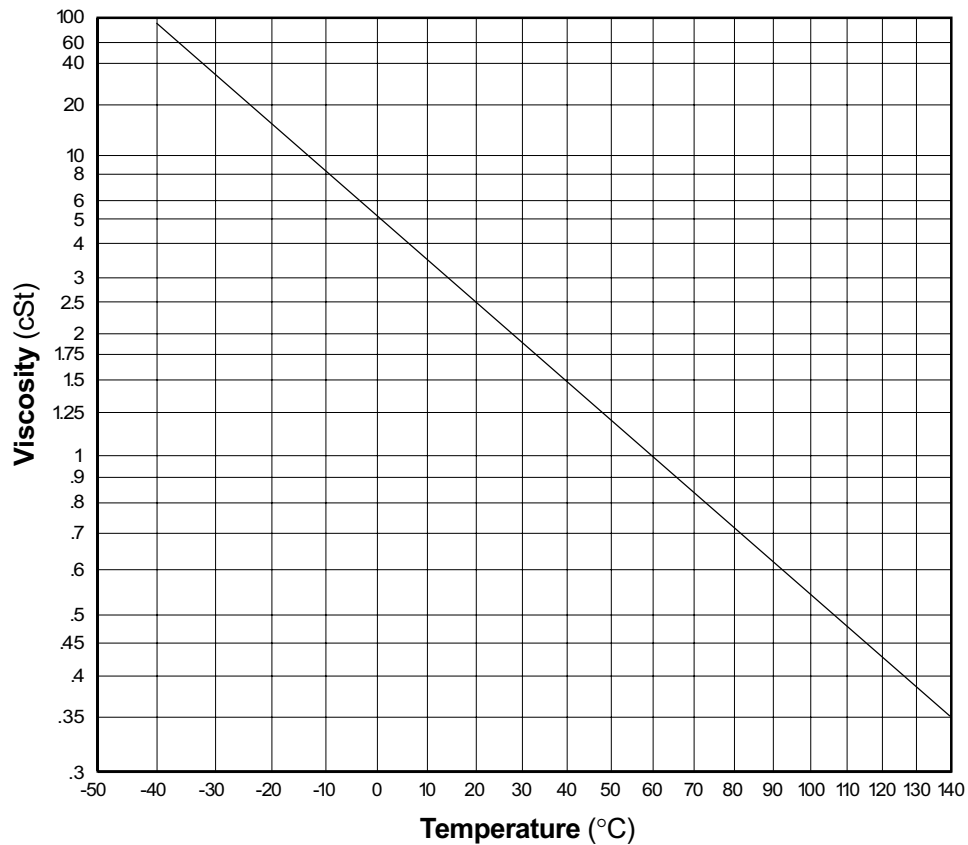
$$\text{Thermal Conductivity (W m}^{-1} \text{ }^{\circ}\text{C}^{-1}) = 0.067 - 0.000069 (T, \text{ }^{\circ}\text{C})$$

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

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

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

**Fluorinert Liquid FC-40
Viscosity (cSt) vs. Temperature (°C)**



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