

## 3M™ Fluorinert™ Electronic Liquid FC-3284

### Product description

3M™ Fluorinert™ Electronic Liquid FC-3284 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 (-73°C to 50°C) makes it ideal for a variety of applications such as etchers, ion implanters, testers, rectifiers and others. Because Fluorinert liquid FC-3284 is primarily a single compound, its composition will not shift or fractionate with time. This keeps fluid loss to a minimum enabling transport properties to remain unchanged.

### Typical physical properties

Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes. Final product specifications and testing methods will be outlined in the products Certificate of Analysis (COA) that is shipped with the commercialized product. All values @ 25°C unless otherwise specified.

Properties	3M™ Fluorinert™ Electronic Liquid FC-3284
Appearance	Clear, colorless
Average Molecular Weight	299 (g/mol)
Boiling Point (@ 1 atm)	50 °C (122°F)
Pour Point	-73 °C (-99.4°F)
Calculated Critical Temperature	161 (°C)
Calculated Critical Pressure	1.94 x 10 <sup>6</sup> (pa)
Vapor Pressure	35.7 x 10 <sup>3</sup> (pa)
Latent Heat of Vaporization (at normal boiling point)	105 (J/g)
Liquid Density	1710 (kg/m <sup>3</sup> )
Kinematic Viscosity	0.42 (cSt)
Absolute Viscosity	0.71 (cP)
Liquid Specific Heat	1100 (J kg <sup>-1</sup> °C <sup>-1</sup> )
Liquid Thermal Conductivity	0.062 (W m <sup>-1</sup> °C <sup>-1</sup> )
Coefficient of Expansion	0.0016 (°C <sup>-1</sup> )
Surface Tension	13 (dynes/cm)
Refractive Index	1.27
Ozone Depletion Potential	0
Flash Point	None

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## Typical electrical properties

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Properties	3M™ Fluorinert™ Electronic Liquid FC-3284
Dielectric Strength (0.1" gap)	40 (kV)
Dielectric Constant (@ 1 kHz)	1.86
Electrical Resistivity (ASTM D-257)	$7 \times 10^{15}$ (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-3284 at various temperatures.

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

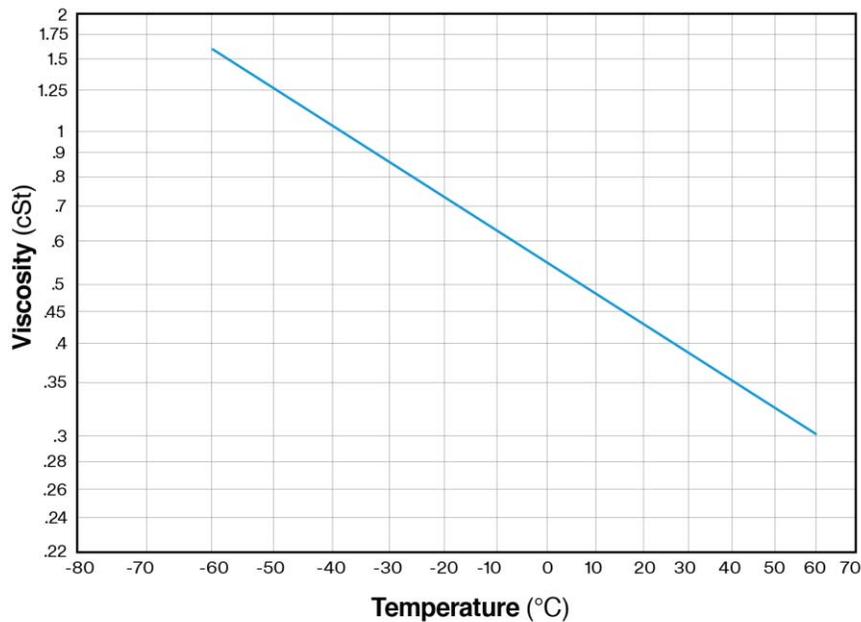
$$\text{Thermal Conductivity (W m}^{-1} \text{ }^{\circ}\text{C}^{-1}) = 0.065 - 0.00013 (T, \text{ }^{\circ}\text{C})$$

$$\text{Density (kg/m}^3) = 1776 - 2.65 (T, \text{ }^{\circ}\text{C})$$

$$\text{Log}_{10} (\text{Vapor Pressure (pascals)}) = 10.062 - (1643/(T, \text{ K}))$$

The following graph can be used to determine the viscosity of Fluorinert liquid FC-3284 over the indicated temperature range.

**3M™ Fluorinert™ Electronic Liquid FC-3284 Viscosity vs. Temperature**



## Materials compatibility

Fluorinert liquid FC-3284 is compatible with most metals, plastics and elastomers. Contact 3M for more information.

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## Storage and shelf life

The shelf life of 3M™ Fluorinert™ Electronic Liquid FC-3284 is 36 months from the date of manufacture when stored in the original packaging materials and stored at 21°C (70°F) and 50% relative humidity.

## Toxicity profile

Not for specification purposes.

3M™ Fluorinert™ Electronic Liquid FC-3284 is virtually non-irritating to the skin and eyes. The product also demonstrates very low toxicity and is not a cardiac sensitizer. A Safety Data Sheet (SDS) is available from [www.3m.com/SDS](http://www.3m.com/SDS).

## Safety and handling

Before using this product, please thoroughly read the current product SDS and label, following all applicable safety precautions described therein (e.g., recommended storage and safe handling, appropriate exposure controls and personal protective equipment (PPE), addressing accidental spills, disposal considerations, etc.). Fluorinert liquid FC-3284 is nonflammable and is resistant to thermal breakdown and hydrolysis during typical use and storage.

## Environmental properties

Fluorinert liquid FC-3284 has zero ozone depletion potential. Additionally, this product has negligible photochemical reactivity and therefore it does not appreciably contribute to ground-level smog formation. As such, it is not defined or regulated by the U.S. EPA as a volatile organic compound (VOC).

As a perfluorocarbon (PFC), this product 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 Electronic Liquid FC-3284 further limit emissions by employing good conservation practices, and by implementing recovery, recycling and/or proper disposal procedures. In general, 3M recommends that Fluorinert-branded liquids be disposed of by incineration at a permitted industrial waste facility capable of handling halogenated materials, in accordance with all applicable local, regional, national, and/or international regulations. See product SDS for further details. 3M also offers a Used Fluid Disposal Program.