3M™ Novec™ 774 Engineered Fluid

Introduction

3M™ Novec™ 774 Engineered Fluid is a clear, colorless and low odor fluid, and is one in a line of 3M products designed as replacements for ozone depleting substances (ODSs) and compounds with high global warming potentials (GWPs).

3M Novec 774 Engineered Fluid is an advanced heat transfer fluid, balancing customer needs for physical, thermal and electrical properties, with sustainable environmental properties, minimizing the environmental footprint left behind.

Typical Applications

Novec 774 fluid is an effective heat transfer fluid with a boiling point of 74ºC. Novec 774 fluid is useful in heat transfer applications, particularly where non-flammability or environmental factors are a consideration.

Examples of systems which benefit from using Novec 774 fluid include:

- Electronics cooling (single or dual phase)
  - Power electronics such as IGBTs or inverters
  - Transformers and other equipment
- Computer/data center cooling
- Electronics testing, pressure compensation, other heat transfer applications
- Organic Rankine Cycle
  - Diesel engines
  - Solar applications

Properties Description

Composition of Novec 774 fluid	
Tetradecafluoro-2-methylhexan-3-one Tetradecafluoro-2,4-dimethylpentan-3-one	99.0 mole %, minimum (two isomers)
Chemical Formulas	$(CF_3)_2CFC(O)CF(CF_3)_2$ $CF_3CF_2CF_2C(O)CF(CF_3)_2$

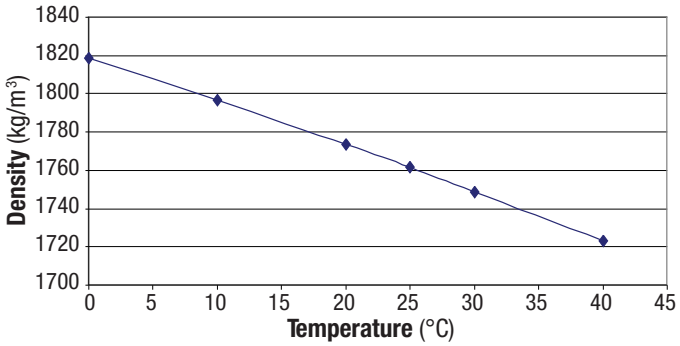
Typical Physical Properties

	Unit	Novec 774
Boiling Point	°C	74
Pour Point	°C	-78
Molecular Weight	g/mol	366
Critical Temperature	°C	195
Critical Pressure	MPa	1.71
Vapor Pressure	kPa	15.7
Heat of Vaporization	kJ/kg	90
Liquid Density	kg/m^3	1670
Coefficient of Expansion	K^{-1}	0.0015
Kinematic Viscosity	cSt	0.52
Absolute Viscosity	cP	0.87
Specific Heat	J/kg-K	1130
Thermal Conductivity	W/m-K	~0.060
Surface Tension	mN/m	12.3
Solubility of Water in Fluid	ppm by wt	20
Dielectric Strength, 0.1" gap	kV	>40
Dielectric Constant @ 1kHz	–	1.9
Volume Resistivity	Ohm-cm	10^{12}
Global Warming Potential	GWP	~1

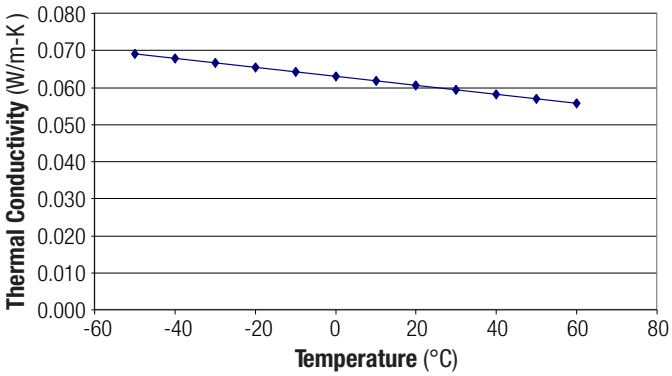
Thermophysical Properties

Not for specification purposes.

Liquid Density (kg/m^3) = 1820.2 – 2.391T(°C)



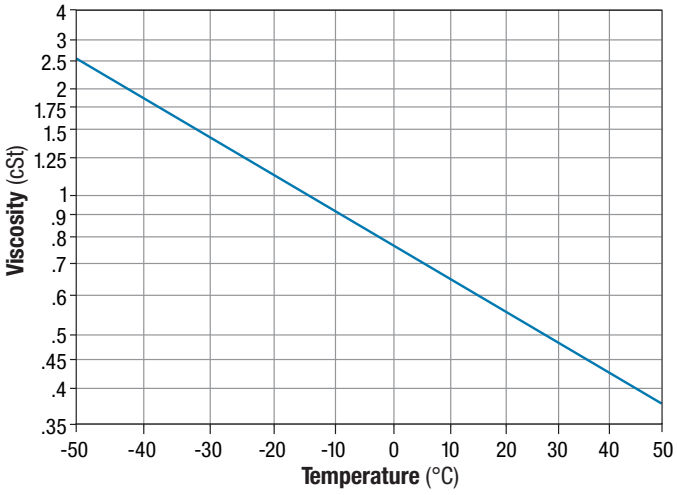
Estimated Liquid Thermal Conductivity (W/m-K) = 0.063 – 0.00012T(°C)



Liquid Specific Heat (J/kg-K) = 1098 + 1.75T(°C)

Vapor Pressure ln(P[Pa]) = -3959/T(K) + 22.938

Novec 774 Fluid Viscosity vs. Temperature



Features

The environmental profile, margin of safety, low viscosity, high molecular weight, low pour point and heat transfer performance of 3M™ Novec™ 774 Engineered Fluid make it an ideal candidate for a variety of heat transfer applications.

Novec 774 fluid is compatible with a wide range of materials of construction and requires no special piping or handling systems, and is very stable in storage. Its high dielectric strength makes it safe for direct contact in most electronics/computing applications.

Stability

Novec 774 fluid should be used in a sealed system to prevent interaction with water. Fluoroketones like Novec 774 fluid, though reactive with liquid water (i.e. a separate water phase), are remarkably stable in its absence to over 300°C. 3M's applications engineers are available to discuss system design and trade-offs for Novec 774 fluid vs. alternative heat transfer fluids or solutions.

Environmental, Health and Safety

Novec 774 fluid contains no chlorine or bromine and therefore does not affect stratospheric ozone. Fluoroketones, like Novec 774 fluid, are also known to degrade rapidly in natural sunlight. This photolysis process leads to very short atmospheric lifetimes for fluoroketones, on the order of a few days or weeks. The potential for Novec 774 fluid to impact the radiative balance in the atmosphere (i.e., climate change) is limited by this very short atmospheric lifetime. Using the Intergovernmental Panel on Climate Change (IPCC) 2007 calculation method the estimated global warming potential (100 yr. ITH) for Novec 774 fluid is 1. When used as substitutes for hydrofluorocarbons, perfluorocarbons, perfluoropolyethers, or hydrofluoropolyethers, fluoroketones can enable greater than a 99 % reduction in GHG emissions.

Toxicity Profile

3M carefully characterizes the toxicity of new materials early in the product development process. These early studies and the subsequent studies required for new chemical notification conducted by independent laboratories indicate that Novec 774 fluid is very low in both acute and repeat dose toxicity. A 1-hour acute inhalation study at 9% (90,000 ppmV) did not result in adverse effects. The No Observed Adverse Effect Level (NOAEL) in a 29-day repeated dose inhalation study (6 hr/day for 5 days per week) is 3000 ppmV. An 8-hour time weighed average (TWA) exposure guideline for Novec 774 fluid of 225 ppmV has been established by 3M with input from an independent third party consultant. In summary, Novec 774 is low in toxicity, is only minimally irritating to skin or eyes, is not a sensitizer and is not mutagenic. On this basis, foreseeable use of Novec 774 fluid under normal operating conditions results in a large margin of safety between anticipated exposure and the exposure guideline.

Resources

3M™ Novec™ 774 Engineered Fluid is supported by global sales, technical and customer service resources, with 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 additional technical information on Novec 774 fluid in the United States, or for the name of a local authorized distributor, call 3M Electronics Markets Materials Division: 800-810-8513.

The 3M™ Novec™ Brand Family

The Novec brand is the hallmark for a variety of proprietary 3M products. Although each has its own unique formula and performance properties, all Novec products are designed in common to address the need for safe, effective, sustainable solutions in industry-specific applications. These include precision and electronics cleaning, heat transfer, fire protection, lubricant deposition and several specialty chemical applications.

3M™ Novec™ Engineered Fluids ▪ 3M™ Novec™ Aerosol Cleaners ▪ 3M™ Novec™ 1230 Fire Protection Fluid ▪ 3M™ Novec™ Electronic Coatings ▪ 3M™ Novec™ Electronic Surfactants

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