

3M™ Novec™ 7500 Engineered Fluid

Introduction

3M™ Novec™ 7500 Engineered Fluid is a nonflammable fluid with very low global warming potential for use in heat transfer applications. Novec 7500 fluid shares many of the inertness and dielectric properties of perfluorocarbons (PFCs) and perfluoropolyethers (PFPEs), and is a viable option for replacing them in a wide array of applications.

A unique heat transfer fluid with favorable environmental properties

Semiconductor

This Novec fluid can be used in cooling of ion implanters, dry etchers and CVD machines in semiconductor and flat panel display manufacturing facilities.

Test Equipment

The fluid may be used to cool semiconductor thermal shock and test equipment.

Electronic Cooling

Because Novec 7500 fluid is compatible with most electronic components, it can be used in direct contact single- and two-phase cooling of supercomputers and sensitive military electronics, and to cool high voltage transformers and power electronics.

Industrial/Pharmaceutical

Novec 7500 fluid can also be used as an alternative to commonly used fluids in pharmaceutical and chemical manufacturing processes, such as freeze drying and reactor cooling.

The primary advantage of Novec 7500 fluid over a comparable PFC or PFPE, however, is reduced Global Warming Potential (GWP). Novec 7500 fluid has been developed as a low-GWP alternative to perfluorocarbon and perfluoropolyether heat transfer liquids.

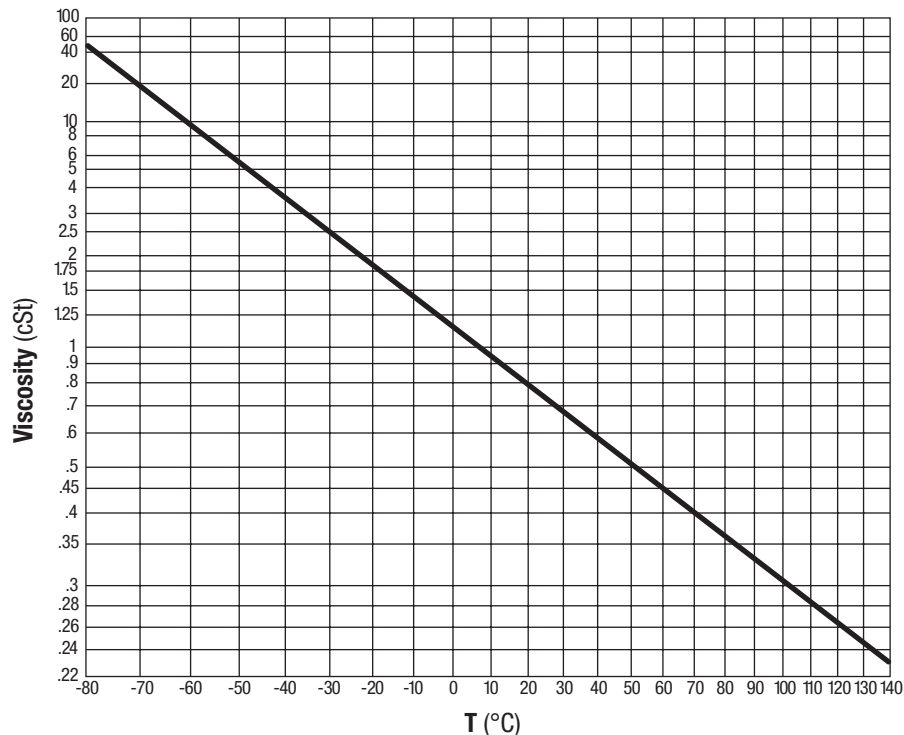
Novec 7500 fluid is non-ozone-depleting and has been exempted from the U.S. EPA definition of a volatile organic compound (VOC) because it does not contribute to the formation of photochemical smog.

Typical Physical Properties

Not for specification purposes. All values @ 25°C unless otherwise specified.

Properties	Novec™ 7500 Engineered Fluid
Boiling Point @ 1 atm	128°C (262°F)
Pour Point	-100°C (-148°F)
Molecular Weight	414
Liquid Density	1614 kg/m ³
Coefficient of Expansion	0.00129 K ⁻¹
Latent Heat of Vaporization @ 1 atm.	88.5 kJ/kg
Surface Tension	16.2 dynes/cm
Viscosity	0.77 cSt
Critical Temperature	261°C (502°F)
Critical Pressure	1.55 Mpa
Solubility of Fluid in Water	<3 ppm by weight
Dielectric Strength	35 kV, 0.1" gap
Volume Resistivity	2.2x10 ⁸ ohm-cm
Dielectric Constant	5.8
Flammability	Nonflammable

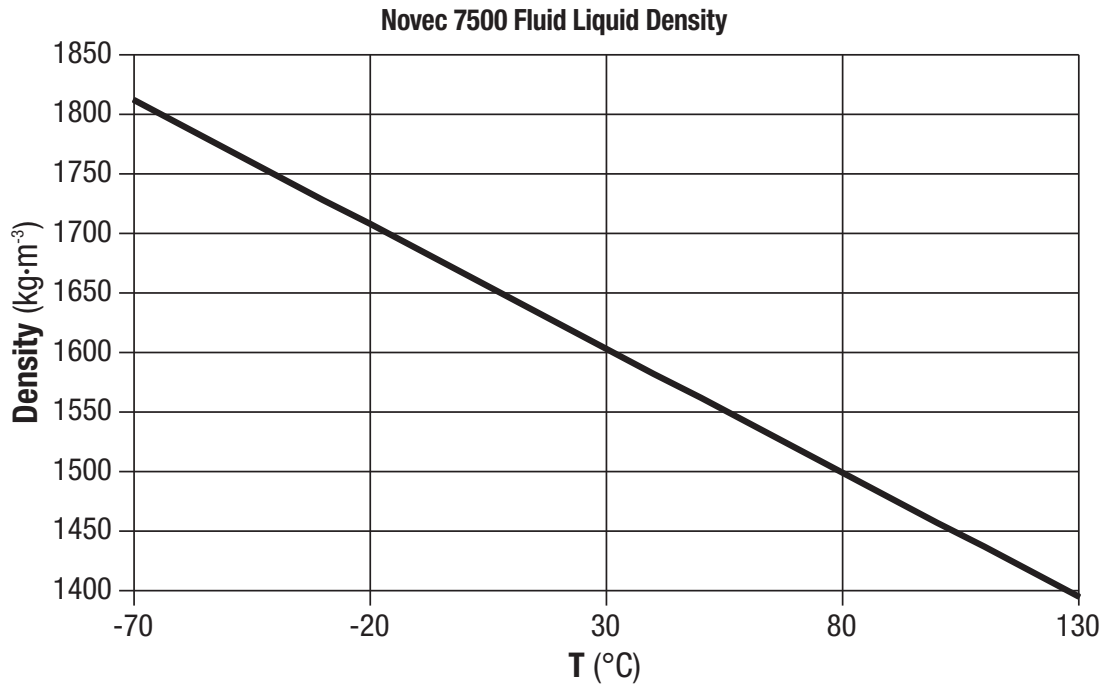
Novec 7500 Fluid Kinematic Viscosity



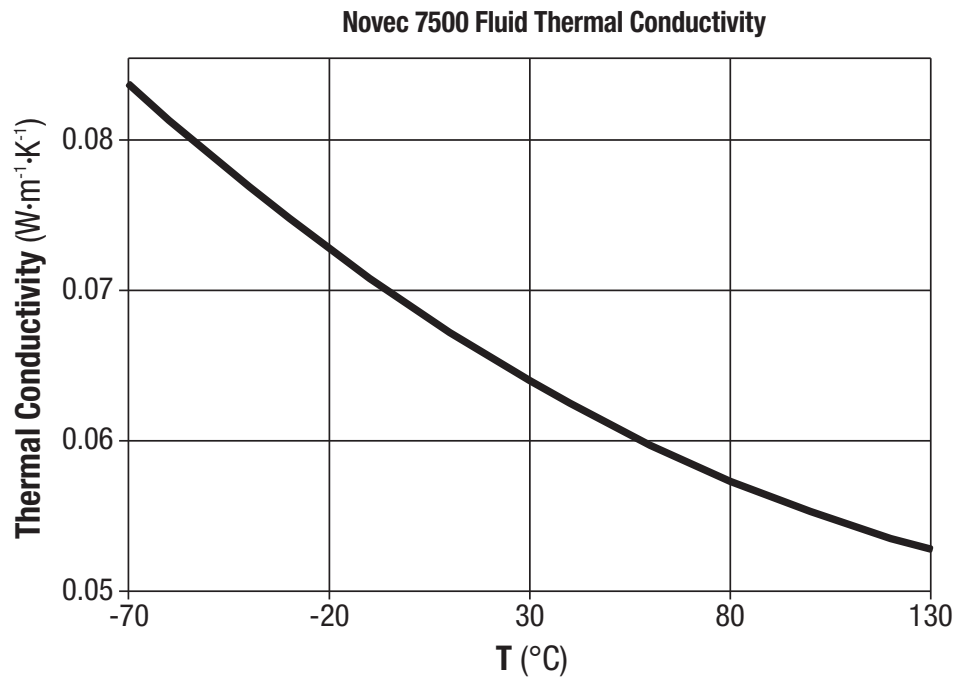
To determine the viscosity at a given temperature T in Kelvin, calculate
 $Z = 10^{(10^{(11.843 - 5.0874 \cdot \log(T[K]))})}$
 Then, Viscosity [cSt] = $(Z - 0.7) \cdot \exp(-0.7487 - 3.295(Z - 0.7) + 0.6119(Z - 0.7)^2 - 0.3193(Z - 0.7)^3)$

Typical Physical Properties

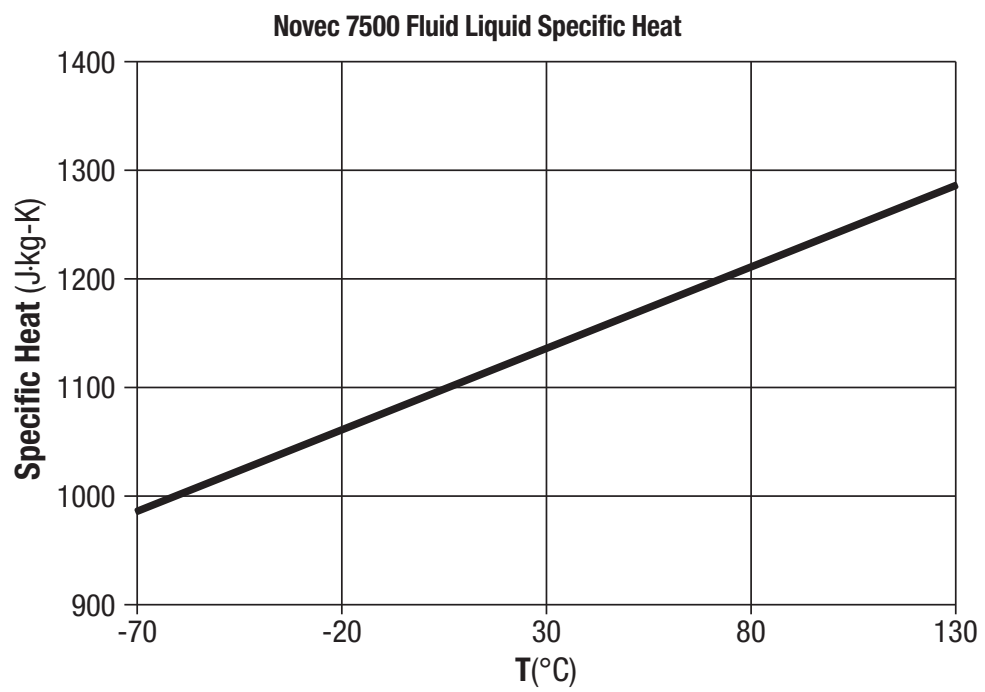
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$$\text{Liquid Density [kg/m}^3\text{]} = -2.0845 \cdot T[\text{°C}] + 1665.8$$



$$\text{Thermal Conductivity [W/m·K]} = 0.069 - 1.798\text{E-}04 \cdot T[\text{°C}] + 4.24\text{E-}07 \cdot T[\text{°C}]^2$$



Liquid Specific Heat [J/kg-K] = $1.4982 \cdot T(^{\circ}\text{C}) + 1091$

Toxicity Profile

Not for specification purposes.

The toxicological testing completed on 3M™ Novec™ 7500 Engineered Fluid indicates very low overall toxicity.

The material is minimally irritating to the skin and eyes and tested negative in two mutagenicity screens.

In its intended applications a large margin of safety exists between anticipated exposure and the eight hour time weighted average exposure guideline of 100 ppm. In a 28-day oral toxicity study no adverse effects were observed at 1000 mg per kg body weight.

Toxicological Test Results

Properties	Novec™ 7500 Engineered Fluid
Oral LD50	>200 mg/kg
Acute lethal inhalation concentration	>10,000 ppm (6 hour)
Eye irritation	Minimally irritating
Skin irritation	Non-irritating
Dermal sensitization	Negative
Mutagenicity	Negative in the two assays conducted
Ecotoxicity	Very low aquatic toxicity
28-day oral toxicity	NOAEL 1000 mg/kg

Environmental Properties

Properties	Novec™ 7500 Engineered Fluid
Ozone Depletion Potential ¹ (ODP)	0.0
Global Warming Potential ² (GWP)	90
Atmospheric Lifetime (years)	2.2
Volatile Organic Compound (VOC)	No

¹ CFC-11 = 1.0

² GWP = pounds equivalent CO₂, 100-year integrated time horizon (ITH), IPCC 2001 method.

Environmental, Health and Safety

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. 3M™ Novec™ 7500 Engineered Fluid is nonflammable and does not exhibit flammability characteristics under normal operation and storage conditions. The fluid is resistant to thermal breakdown and hydrolysis during storage and use. Recommended handling procedures are provided in the Material Safety Data Sheet, which is available from your local 3M representative upon request.

Materials Compatibility

In practice, Novec engineered fluids differ somewhat from PFCs and PFPEs in their ability to dissolve certain oils. This means that Novec 7500 fluid is more likely to extract plasticizers from elastomeric materials. For this reason, elastomeric O-ring and seal materials should be limited to those that contains a low amount of plasticizer. EPDM, EPR and butyl typically fall into this category. 3M engineers can suggest appropriate compounds or assist with test procedures.

Heater Selection

The critical heat flux of Novec 7500 fluid was found to be 18 W/cm² when boiling from a horizontal 0.5 mm diameter platinum wire in a quiescent pool of saturated fluid. The maximum heat flux obtainable in forced convection applications is significantly higher, but depends strongly upon the geometry and flow conditions. A safety interlock between the pump and heater is strongly recommended in applications with heat fluxes exceeding 15 W/cm².

Regulatory Status

The components of this product are in compliance with the chemical notification requirements of the United States (TSCA), Europe (ELINCS), Korea and the Philippines. Novec 7500 fluid is not acceptable for commercial sale in Japan. Certain restrictions apply. Contact the selling division for additional information.

Contact your local 3M representative regarding the regulatory status of Novec 7500 fluid in other countries.

Recycle and Disposal Options

Used Fluid Return Program

3M offers a program for free* pickup and return of used 3M specialty fluids in the U.S. through Safety-Kleen Corp. A pre-negotiated handling agreement between users and Safety-Kleen offers users 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 fluid is required for participation in this free program.*

Safety-Kleen Corp. 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 at this toll-free line: 1.888.932.2731. Contact your local 3M representative for fluid return programs outside the U.S.

* Must have a 30 or more gallon purchase to participate in the 3M paid program. Used product of 5-30 gallons can be returned through Safety-Kleen at the user's expense.

Resources

3M™ Novec™ Engineered Fluids are supported by global sales, technical and customer service 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 additional technical information on 3M™ Novec™ 7500 Engineered Fluid in the United States, call 3M Customer Service, **800 810 8513**.

For information on additional 3M fluids, coatings and other chemical products for the electronics industry, visit our web site at: **www.3M.com/electronics**.

United States	China	Europe	Japan	Korea	Singapore	Taiwan
3M Electronics Markets Materials Division 800 810 8513	3M China Ltd. 86 21 6275 3535	3M Belgium N.V. 32 3 250 7521	Sumitomo 3M Limited 813 3709 8250	3M Korea Limited 82 2 3771 4114	3M Singapore Pte. Ltd. 65 454 8611	3M Taiwan Limited 886 2 2704 9011

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