



Novec[™]

Brand

Technical Data | September 2021

3M[™] Novec[™] 7000 Engineered Fluid

Product Description

3M[™] Novec[™] 7000 Engineered Fluid is a clear, colorless, thermal stable dielectric fluid capable of extreme low temperature operation (-120C). The properties of Novec 7000 make it very useful in a variety of heat transfer applications in the semiconductor, electronics, chemical manufacturing industries. Novec 7000 can also be used as a direct expansion refrigerant. Novec[™] 7000 Engineered Fluid is non-ozone depleting and has very low global warming potential making it an attractive alternative to perfluorocarbon and perfluoropolyether heat transfer liquids.

Key Features

- Low viscosity at very low temperatures.
- Excellent dielectric properties
- Low global warming potential (GWP)
- Zero ozone depletion potential (ODP)
- Good materials compatibility
- Low toxicity
- Non-flammable
- Non-corrosive
- Good thermal stability

Applications

- Semiconductor heat transfer:
 - Ion implanters
 - Dry etchers
 - CVD/PVD tools
 - Electronic Automated Test Equipment (ATE)
- Industrial/Pharmaceutical heat transfer:
 - Chemical reactors
 - Freeze dryer
 - VOC capture
- CryopumpsElectronic Cooling:
 - Supercomputers
 - Sensitive military electronics
 - High voltage transformers
- Electronics Reliability Testing:
 - Thermal shock, Leak detection
 - Temperature calibration
- Autocascade refrigeration:
 - HCFC-123 replacement
- Medical Lab:
 - Histobath working fluid

3M™ Novec™ 7000 Engineered Fluid

Materials Description

3M™ Novec™ 7000 Engineered Fluid is a clear-colorless liquid composed of 1-methoxyheptafluoropropane (C₃F₇OCH₃), 99.5% minimum. It has non-volatile residue (NVR) of 25.0 ppm maximum.

Typical Physical Properties

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

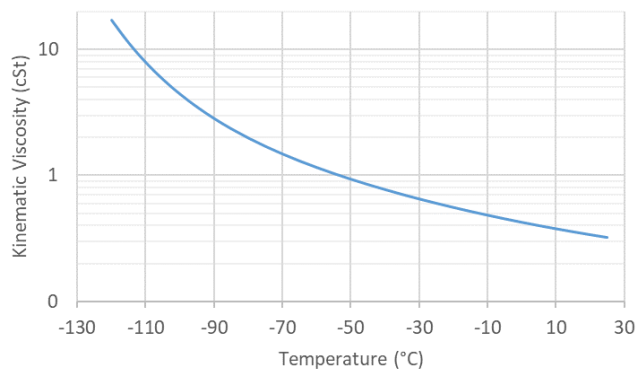
Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes. Final product specifications and testing methods will be outlined in the product's Certificate of Analysis (COA) that is shipped with the product or available by request from your 3M Technical Service Representative.

Properties	Units	3M™ Novec™ 7000 Engineered Fluid
Boiling Point (@ 1 atm)	°C	34
Freeze/Pour Point	°C	-122
Molecular Weight	g/mol	200
Critical Temperature	°C	165
Critical Pressure	MPa	2.48
Vapor Pressure	kPa	65
Latent Heat of Vaporization	kJ/kg	142
Liquid Density	kg/m ³	1400
Coefficient of Expansion	K ⁻¹	0.0022
Kinematic Viscosity	cSt	0.32
Kinematic Viscosity (@ -80°C)	cSt	2.0
Kinematic Viscosity (@ -120°C)	cSt	17
Absolute Viscosity	cP	0.45
Specific Heat	J·kg ⁻¹ ·K ⁻¹	1300
Thermal Conductivity	W·m ⁻¹ ·K ⁻¹	0.075
Surface Tension	dynes/cm	12.4
Solubility of Water in Fluid	ppmw	~60
Solubility of Fluid in Water	ppmw	<5
Solubility of Air in Fluid	Vol%	~31
Dielectric Strength (0.1" gap)	kV	>25
Dielectric Constant	–	7.4
Volume Resistivity	Ohm-cm	10 ⁸

3M™ Novec™ 7000 Engineered Fluid

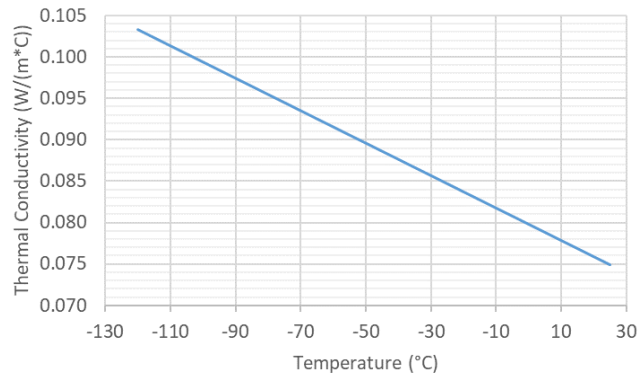
3M™ Novec™ 7000 Engineered Fluid Typical Physical Properties

Kinematic Viscosity



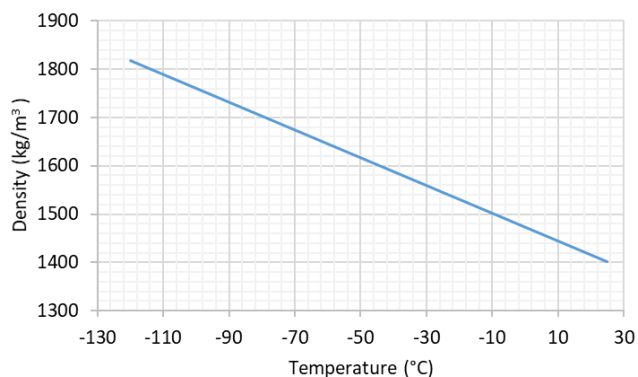
$$\begin{aligned} \text{Kinematic Viscosity [cSt]} \\ &= Z \cdot \text{EXP}(-0.7487 - 3.295 \cdot Z + 0.6119 \cdot Z^2 - 0.3193 \cdot Z^3) \\ \text{where: } Z &= 10^{(10^{(10.151 - 4.606 \cdot \text{Log}(T[^\circ\text{C}] + 273.15))) - 0.7} \end{aligned}$$

Thermal Conductivity



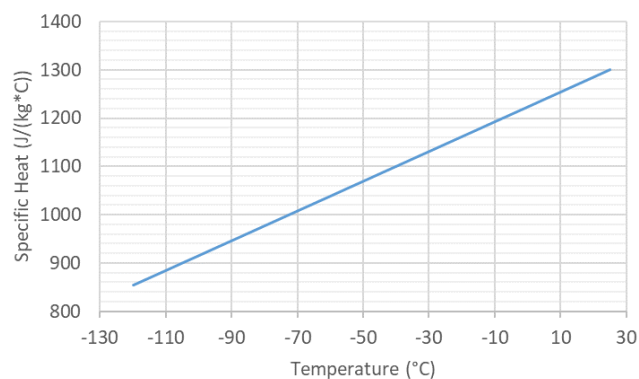
$$\begin{aligned} \text{Thermal Conductivity [W} \cdot \text{m}^{-1} \cdot \text{K}^{-1}] \\ &= 0.0798 - 0.000196 \cdot T[^\circ\text{C}] \end{aligned}$$

Liquid Density



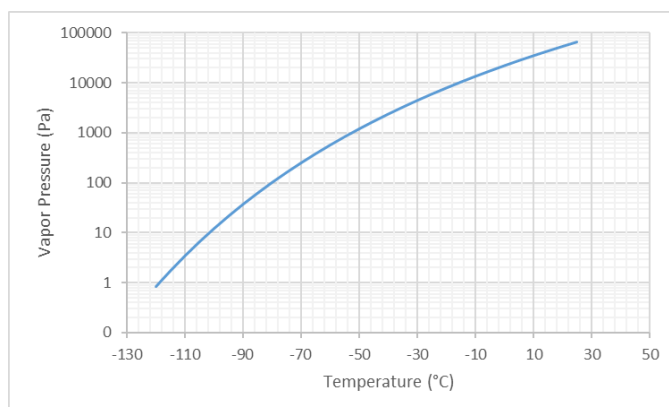
$$\text{Liquid Density [kg/m}^3] = 1472.6 - 2.880 \cdot T[^\circ\text{C}]$$

Specific Heat



$$\text{Specific Heat [J} \cdot \text{kg}^{-1} \cdot \text{K}^{-1}] = 1223.2 + 3.0803 \cdot T[^\circ\text{C}]$$

Vapor Pressure



$$\text{Vapor Pressure (Pa)} = \text{EXP}(-3548.6 / (T[^\circ\text{C}] + 273.15) + 22.978)$$

$$-30^\circ\text{C} < T < T_c$$

3M™ Novec™ 7000 Engineered Fluid

Materials Compatibility

Testing of 3M™ Novec™ 7000 Engineered Fluid demonstrates compatibility with a wide range of metals, plastics and elastomers. The materials listed below were deemed compatible by 48-hour Soxhlet extraction testing.

Novec fluids are, in general, compatible with metals, glasses, ceramics and “hard, machinable” polymers. Material compatibility testing for “soft” or elastomeric polymers in Novec fluids is primarily focused on two effects: the extraction of mobile organics such as plasticizers from the polymer and the absorption of the fluid into the polymer. The former is associated with hardening or shrinking of the polymer and the latter with swelling and softening of the polymer or diffusion of the fluid through it. Novec fluids are unlikely to swell common hydrocarbon elastomers such as EP, EPDM, nitrile and butyl. Other materials, such as highly fluorinated or silicone elastomers, are prone to absorption and swelling. Material compatibility testing can be used to quantify these effects. This testing reveals significant variation in the extractable content of elastomers within any elastomer category. Application experience reveals that not all applications are equally sensitive to dimensional and hardness changes. For these reasons, material compatibility should be treated on a case-by-case basis at the discretion of the system designer with the specific application in mind. 3M has tested a wide range of materials and can assist with compatibility testing and materials selection.

3M™ Novec™ 7000 Engineered Fluid is compatible with most metals and hard polymers such as:

Metals	Plastics	Elastomers ¹
Aluminum	Acrylic (PMMA)	EPDM
Copper ²	Polyethylene	EPR
Carbon Steel	Polycarbonate	Polyurethane
Stainless Steel	Polyester	Fluorosilicone
Brass ²	ABS	
	PEEK	
	PTFE	

(1) As with most fluorinated liquids, Novec 7000 fluid will absorb into fluorinated plastics (e.g. PTFE) and elastomers (e.g. FFKM, FKM types) over longer exposures. Absorption and swelling of silicone rubber are also observed. Not all formulations of these polymers are compatible, contact a 3M Application Development Engineer for help in product selection.

(2) Some surface oxidation of copper during testing.

Heater Selection

The critical heat flux of Novec 7000 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 any application depends strongly upon the geometry and flow conditions. Exceeding this heat flux can lead to thermal decomposition of the fluid. Please consult 3M technical service engineers if you are unsure about your application.

Other Application Notes

The usage life of 3M fluids is virtually indefinite if it is kept clean, contained, uncontaminated, and used within 3M suggested operating conditions. This list of common materials and equipment suggestions will help in fluid applications.

- Pumps - canned or magnetically driven pumps, avoid rotating shaft seals.
- Fittings - compression or flare fittings, NPT fittings with a compatible thread sealant, barbed fittings and quick disconnects may require some evaluation before use.
- Halogen leak detector will detect fluorinated fluids and will help to identify leaks and help reduce or eliminate fluids losses.
- In most applications used fluid can be filtered with activated carbon for solubilized hydrocarbons, activated alumina for decomposition products, silica gel for water and polyethylene/polypropylene or PVDF filter for particulates.

3M™ Novec™ 7000 Engineered Fluid

Safety & Handling

Before using this product, please review the current product Safety Data Sheet (www.3m.com/SDS) and the precautionary statement(s) on the product label. Follow all applicable precautions and directions. This product does not display a closed cup flash point and therefore is not classified as a flammable liquid.

Environmental Properties

3M™ Novec™ 7000 Engineered Fluid has zero ozone depletion potential. Additionally, the hydrofluoroether component of this product has negligible photochemical reactivity and therefore does not appreciably contribute to ground-level smog formation. As such, that component is not defined or regulated by the U.S. EPA as a volatile organic compound (VOC). See 40 CFR 51.100(s).

3M recommends that users of 3M™ Novec™ 7000 Engineered Fluid further limit emissions by employing good conservation practices, and by implementing recovery, recycling and/or proper disposal procedures. In general, 3M recommends that fluorinated fluids 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.

Property	3M™ Novec™ 7000 Engineered Fluid
Ozone Depletion Potential ¹ (ODP)	0.0
Global Warming Potential ² (GWP)	530
Atmospheric Lifetime (years)	4.9

¹ CFC-11 = 1.0

² GWP 100-year integrated time horizon (ITH). IPCC 2013.

Used Fluid Disposal Program

As part of 3M's commitment to product stewardship and customer service, we offer the 3M Used Fluid Disposal Program for free pickup of used 3M fluids in the U.S. This program is provided through Clean Harbors Environmental Services. Working with Clean Harbors will ensure that your used 3M fluids will be managed properly and responsibly. A minimum of 30 gallons of used 3M fluid is required for participation in this free program. Amounts of less than 30 gallons will be at your own expense and will be determined based upon quantity and approved profile of waste.

For additional information on the 3M Used Fluid Disposal Program, send an email to 3Musedfluid@cleanharbors.com.

Storage and Shelf Life

The shelf life of 3M™ Novec™ 7000 Engineered Fluid is 24 months from the date of manufacture when stored in the original packaging materials and stored at 21°C (70°F) and 50% relative humidity.

Certificate of Analysis (COA)

The 3M Certificate of Analysis (COA) for this product is established when the product is manufactured and is deemed commercially available from 3M. The COA contains the 3M specifications, test methods and test results for the product's performance attributes that the product will be supplied against. Contact your local 3M representative for this product's COA.

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Safety Data Sheet: Consult Safety Data Sheet before use. https://www.3m.com/3M/en_US/company-us/SDS-search/

Regulatory: For regulatory information about this product, contact your 3M representative.
https://www.3m.com/3M/en_US/company-us/SDS-search/

Technical Information: The technical information, recommendations and other statements contained in this document are based upon tests or experience that 3M believes are reliable, but the accuracy or completeness of such information is not guaranteed.

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