



Novec™

Brand

3M™ Novec™ 7000 Engineered Fluid

Product Description

3M™ Novec™ 7000 Engineered Fluid, 1-methoxyheptafluoropropane, is a non-flammable, low global warming potential (GWP) heat transfer fluid capable of reaching -120°C. It is also useful as a direct expansion refrigerant.

Key Features

- Low GWP (530, 100-year ITH)
- Excellent dielectric properties
 - In event of leakage or other failure, will not damage electronic equipment
- Zero ozone depletion potential (ODP)
- Good materials compatibility
- Low toxicity
- Non-flammable
- Non-corrosive
- Good thermal stability
- Useful at extreme low temperatures
 - Viscosity is less than 20 cSt at -120°C

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
- Cryopumps/Electronic Cooling:
 - Supercomputers
 - Sensitive military electronics
 - High voltage transformers
- Electronics:
 - Reliability testing
 - 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.

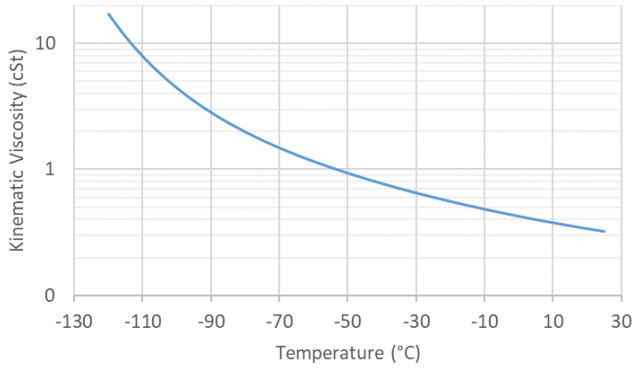
Note: The following technical information and data should be considered representative or typical only and should not be used for specification purposes. Final product specifications and testing methods will be outlined in the product's Certificate of Analysis (COA) that is shipped with the product or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

Properties	3M™ Novec™ 7000 Engineered Fluid
Molecular Weight (g/mol)	200
Boiling Point @ 1 atmosphere (°C)	34
Freeze Point (°C)	-122.5
Liquid Density (kg/m ³)	1400
Kinematic Viscosity (cSt)	0.32
Kinematic Viscosity @ -80°C (cSt)	2.0
Kinematic Viscosity @ -120°C (cSt)	17
Coefficient of Expansion	0.00219 K ⁻¹
Critical Density (kg/m ³)	553
Critical Pressure (MPa)	2.48
Critical Temperature (°C)	165°C
Dielectric Constant	7.4
Dielectric Strength (kV)	~40
Flash Point	None
Latent Heat of Vaporization (kJ/kg)	142
Solubility of Water in Fluid (ppmw)	~60
Solubility of Air in Fluid (vol %)	~35
Specific Heat (J·kg ⁻¹ ·K ⁻¹)	1300
Surface Tension (dynes/cm)	12.4
Thermal Conductivity (W·m ⁻¹ ·K ⁻¹)	0.075
Vapor Pressure (kPa)	64.6
Volume Resistivity (ohm-cm)	108

3M™ Novec™ 7000 Engineered Fluid

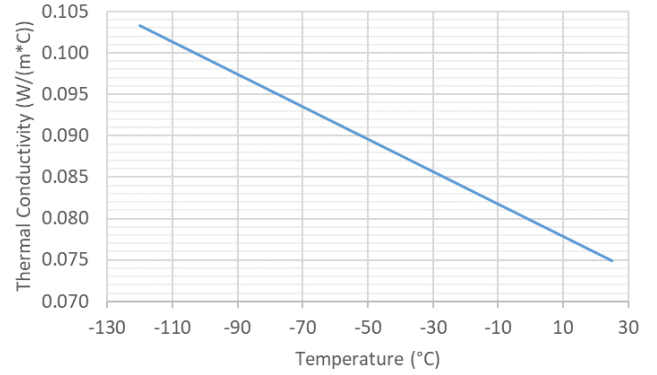
3M™ Novec™ 7000 Engineered Fluid Typical Physical Properties

Kinematic Viscosity



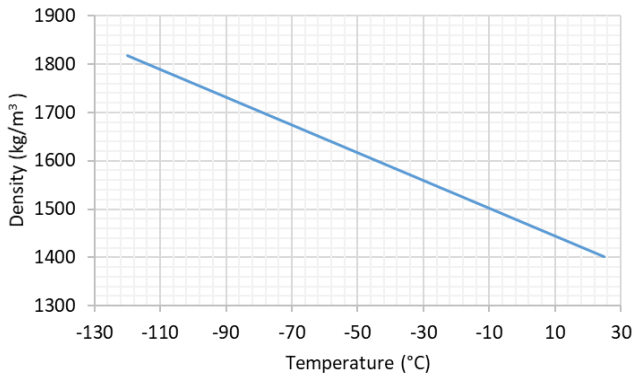
Kinematic Viscosity [cSt]
 $= Z \cdot \text{EXP}(-0.7487 - 3.295 \cdot Z + 0.6119 \cdot Z^2 - 0.3193 \cdot Z^3)$
 where: $Z = 10^{(10^{(A+B \cdot \text{Log}(T[^\circ\text{C}] + 273.15))) - 0.7}$

Thermal Conductivity



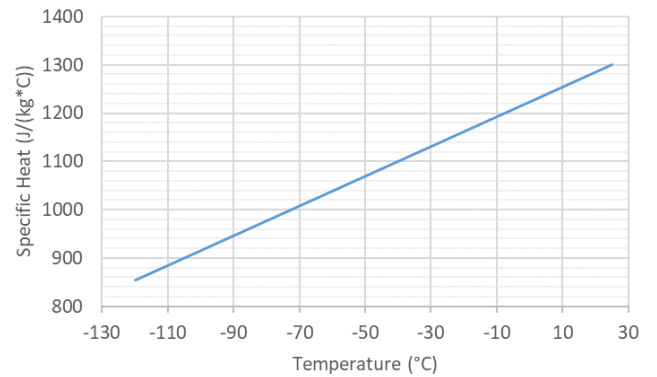
Thermal Conductivity [$\text{W} \cdot \text{m}^{-1} \cdot \text{K}^{-1}$]
 $= 0.0798 - 0.000196 \cdot T (^\circ\text{C})$

Liquid Density



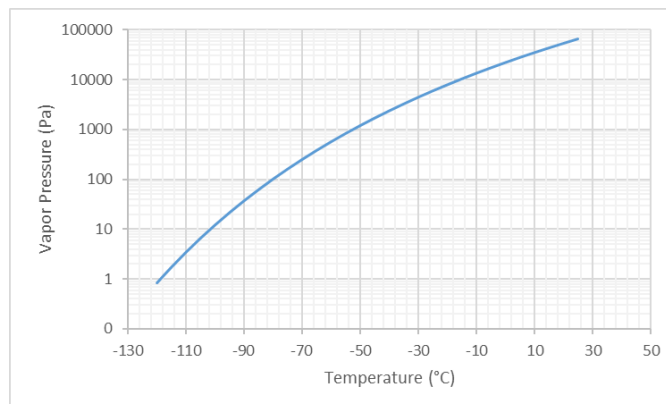
Liquid Density [kg/m^3] = $1472.6 - 2.880 \cdot T (^\circ\text{C})$

Specific Heat



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

Vapor Pressure



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

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

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—most materials that are used in electronics manufacturing. The materials listed below were deemed compatible after one hour of exposure to the fluid at its boiling point.

It is important to consider material compatibility when designing a system that will use Novec fluids. Compatibility may be defined as the measure of how stable two or more substances are when in contact with each other. Novec fluids do not chemically react with most materials under normal use conditions. Potential materials incompatibility with Novec fluids is primarily focused on two effects: the extraction of organic additives from materials and absorption of the fluid into materials.

Elastomeric materials should be limited to those compounds that contain the least amount of extractible plasticizer. 3M engineers can help with suggestions for appropriate compounds or assist with test procedures.

Proper material selection can help minimize the effects of extraction and absorption. Generally, a good starting point is to avoid plastics and elastomers that contain plasticizers that could be extracted and change the bulk properties of the material. Other materials, such as highly fluorinated or silicone elastomers, are prone to absorption of Novec fluids leading to dimensional swelling and weight gain. Material compatibility testing can help identify suitable material candidates. Due to the complexity and degree of unknowns about how Novec fluids may be used, specific materials cannot be identified as universally compatible. Materials 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)	Butyl Rubber ²
Copper ³	Polyethylene	Natural Rubber
Carbon Steel	Polypropylene	EPDM
302 Stainless Steel	Polycarbonate	EPR
Brass	Polyester	
Molybdenum	Epoxy	
Tantalum	PET	
Tungsten	Phenolic	
Cu/Be Alloy C172	ABS	
Mg Alloy AZ32B	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.

(2) Butyl Rubber best for extended exposure > one month.

(3) 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 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.

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.

3M™ Novec™ 7000 Engineered Fluid

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

¹CFC-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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