3M™ Novec™ 7600 Engineered Fluid

Introduction

3M™ Novec™ 7600 Engineered Fluid is a new fluid with low global warming potential designed for use in heat transfer applications. Novec 7600 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 manufacturing facilities.

Test Equipment

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

Electronic Cooling

Due to compatibilty with most electronic components and dielectric strength, Novec 7600 fluid can be used in single and two-phase cooling of supercomputers, sensitive military electronics and also high voltage transformers and power electronics.

Industrial/Pharmaceutical

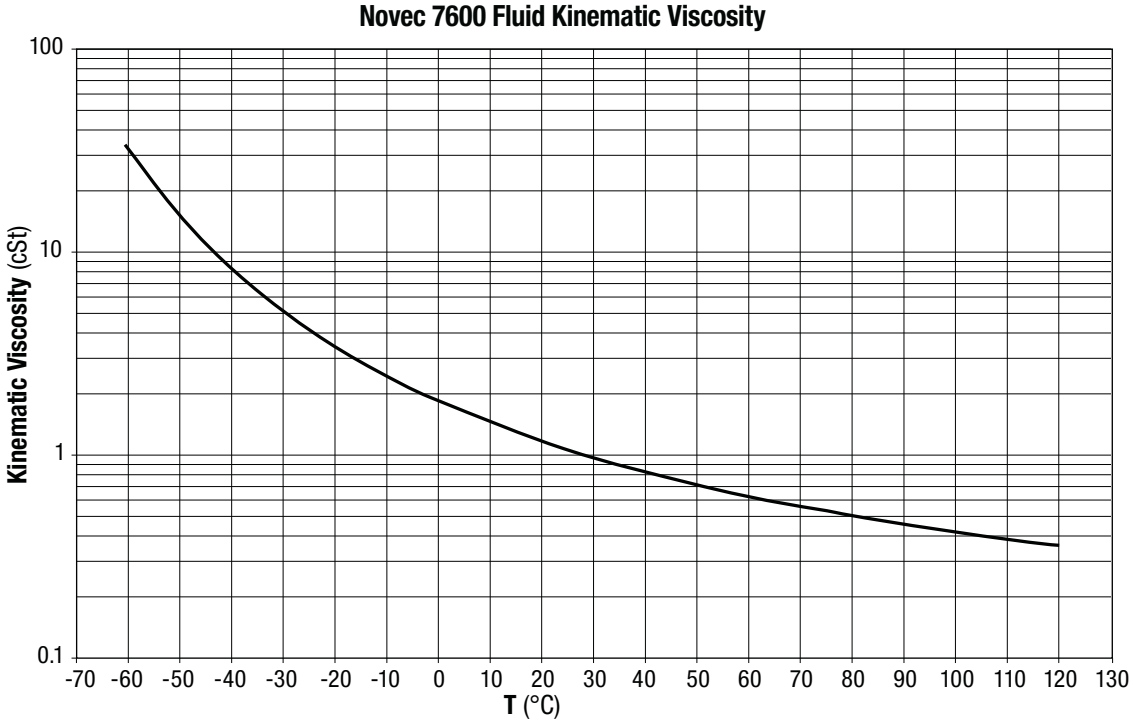
Novec 7600 fluid can also be used as an alternative to commonly used heat transfer fluids in pharmaceutical and chemical process cooling.

The primary advantage of Novec 7600 fluid over a comparable PFC or PFPE, however, is reduced Global Warming Potential (GWP). Novec 7600 fluid has been developed as a low-GWP alternative to perfluorocarbon and perfluoropolyether heat transfer liquids Novec 7600 fluid is also non-ozone-depleting.

Typical Physical Properties

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

Properties	3M™ Novec™ 7600 Engineered Fluid
Boiling Point (°C)	131
Pour Point (°C)	-98
Molecular Weight	346
Boiling Point (°C) @ 760 mmHg	98.0
Freeze Point (°C)	-38
Liquid Density (g/ml)	1540 kg/m^3
Coefficient of Expansion	0.00114 K^{-1}
Latent Heat of Vaporization @ 1 atm. (kJ/kg)	115.6
Surface Tension (dynes/cm)	17.7
Kinematic Viscosity (cSt)	1.07
Critical Temperature (°C)	260
Critical Pressure (Mpa)	1.67
Solubility of Solvent in Water (ppb)	<10 ppm by weight
Solubility of Water in Solvent (ppb)	410 ppm by weight
Dielectric Strength, 2.54 mm gap (kV)	31
Volume Resistivity	3 x 10^{10} ohm-cm
Dielectric Constant	6.4



Kinematic Viscosity, centistokes = EXP (464.403382/(T[°C]+133)-2.881482

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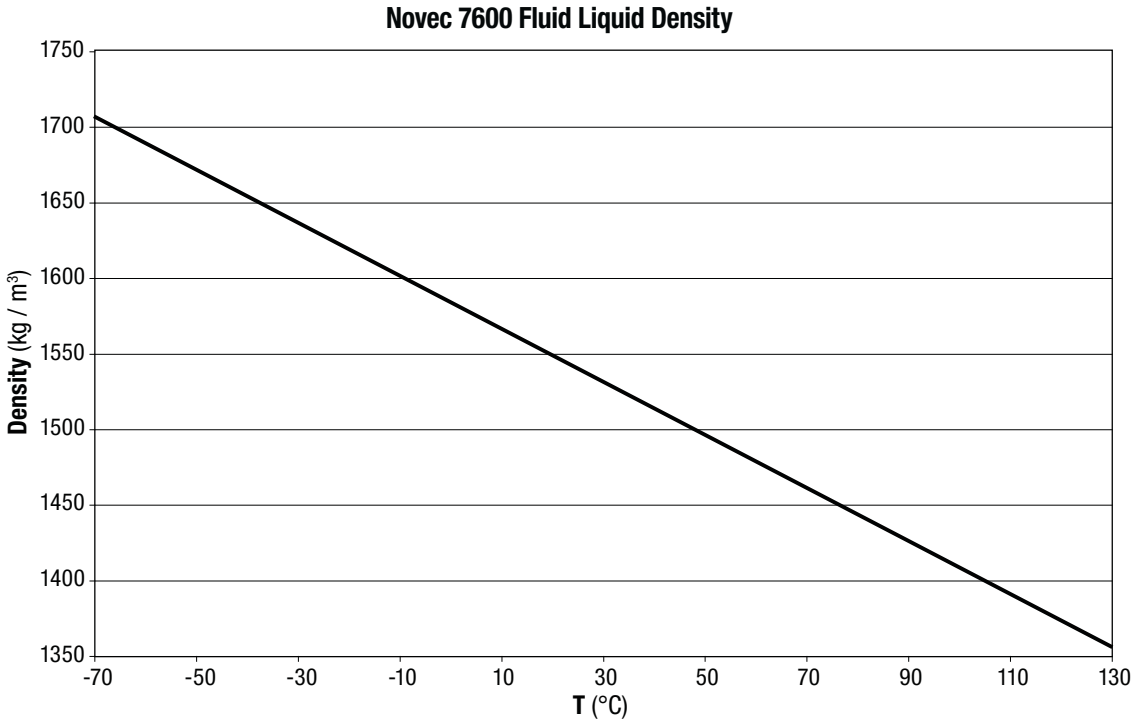
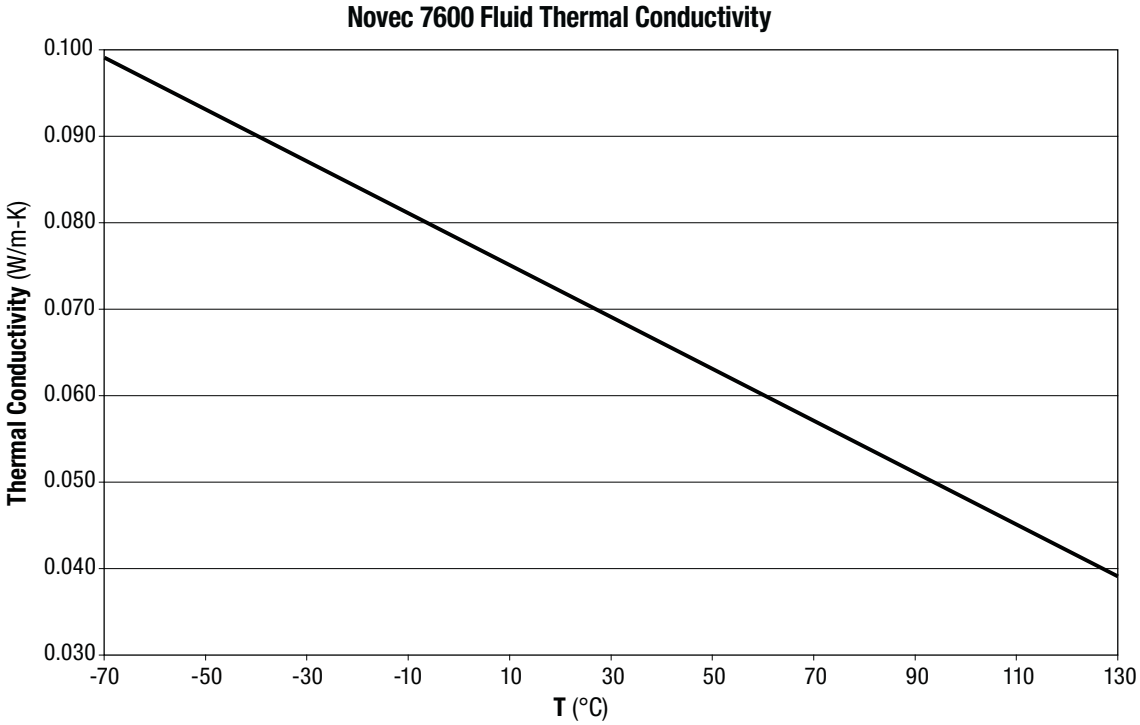
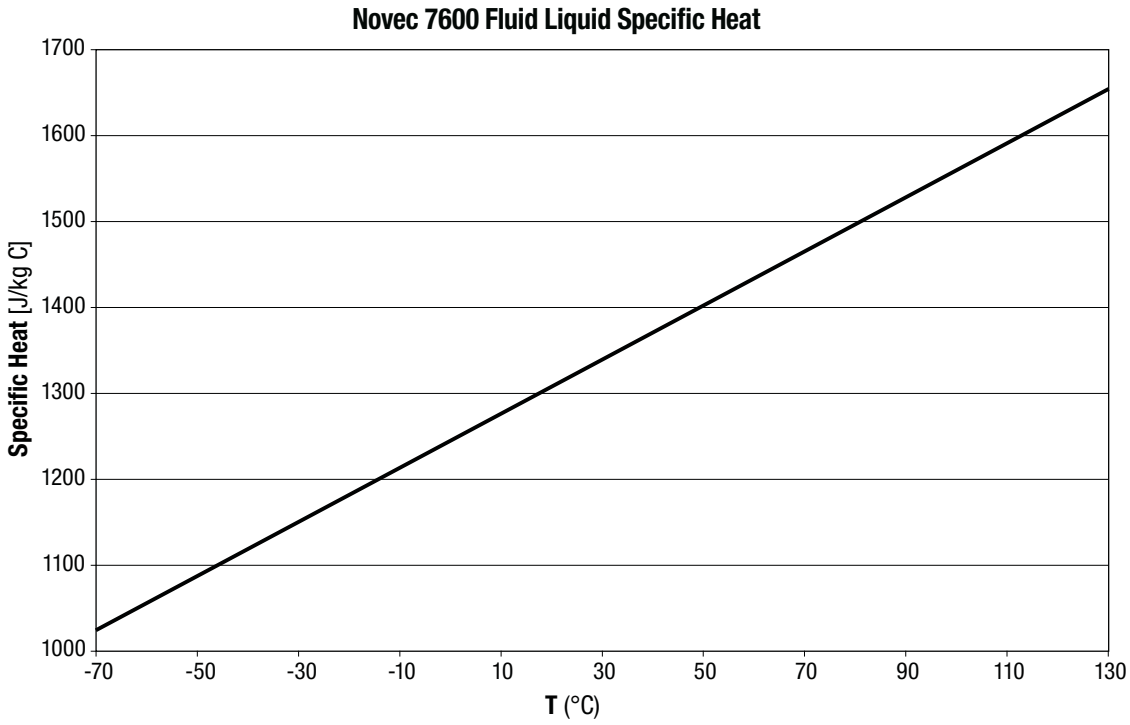


Liquid Density [kg/m^2] = 1538.8-1.755*T[°C]



Thermal Conductivity [W/m-K] = 0.078-0.0003*T[°C]



Liquid Specific Heat [J/kg-K]= 3.1631* T[°C]+1240.2

Toxicity Profile

Not for specification purposes.

3M™ Novec™ 7600 Engineered Fluid indicates very low overall toxicity. The LD50 (rat) is greater than 2000 mg/kg and the results of a 28-day repeated dose oral toxicity study in rats also indicate low repeat dose toxicity. Novec 7600 fluid is expected to be minimally irritating to the eyes and skin and was negative in the two mutagenicity studies conducted.

Environmental Properties

Properties	3M™ Novec™ 7600 Engineered Fluid
Ozone Depletion Potential–ODP[1]	0.0
Global Warming Potential[2]	700
Atmospheric Lifetime (years)	9
Flammability	Nonflammable
Flammability Range in Air	2.9-8.8%

[1] CFC-11 = 1.0
[2] GWP–100 year ITH, CO_2 = 1.0

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™ 7600 Engineered Fluid is nonflammable and 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 fluids differ somewhat from PFCs and PFPEs in their ability to dissolve certain oils. This means that Novec 7600 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 contain 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 7600 fluid, like similar Novec fluids, lies in the range of 15W/cm -20W/cm when boiling from a horizontal 0.5mm diameter platinum wire in a quiescent pool of saturated fluid. The maximum heat flux obtainable in forced convection applications is significantly higher, depending largely on the geometry and flow conditions. A safety interlock between the pump and heater is strongly recommended in applications with heat fluxes approaching $15W/cm^2$.

Regulatory Status

Novec 7600 fluid has been approved by new chemical notification authorities in both Japan and Korea. Notifications are underway in Europe and the United States. Contact your local 3M representative regarding the regulatory status of Novec 7600 fluid in other countries.