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## SF 649™ Engineered Fluid Technical Data Sheet

### Introduction

SF 649™ Engineered Fluid is a breakthrough in the field of industrial chemicals, prioritizing safety and environmental sustainability alongside performance. This clear, colorless, and low-odor fluid is a replacement for ODS (ozone-depleting substances) and high GWP (global warming potential substances), like SF<sub>6</sub>, HFCs and HCFCs, offering a balance of physical, thermal, and electrical properties with minimal environmental impact.

### Applications

SF 649 fluid is a versatile heat transfer fluid, effective in systems where non-flammability or environmental considerations are important. It is suitable for systems such as:

- Computer and data center cooling; both single and dual-phase immersion cooling.
- Electronics cooling for power electronics like IGBTs or inverters and as a replacement for SF<sub>6</sub> in transformers and other equipment.
- Organic Rankine Cycle applications, including diesel engines, generators, geothermal, and solar applications.

### Properties Descriptions

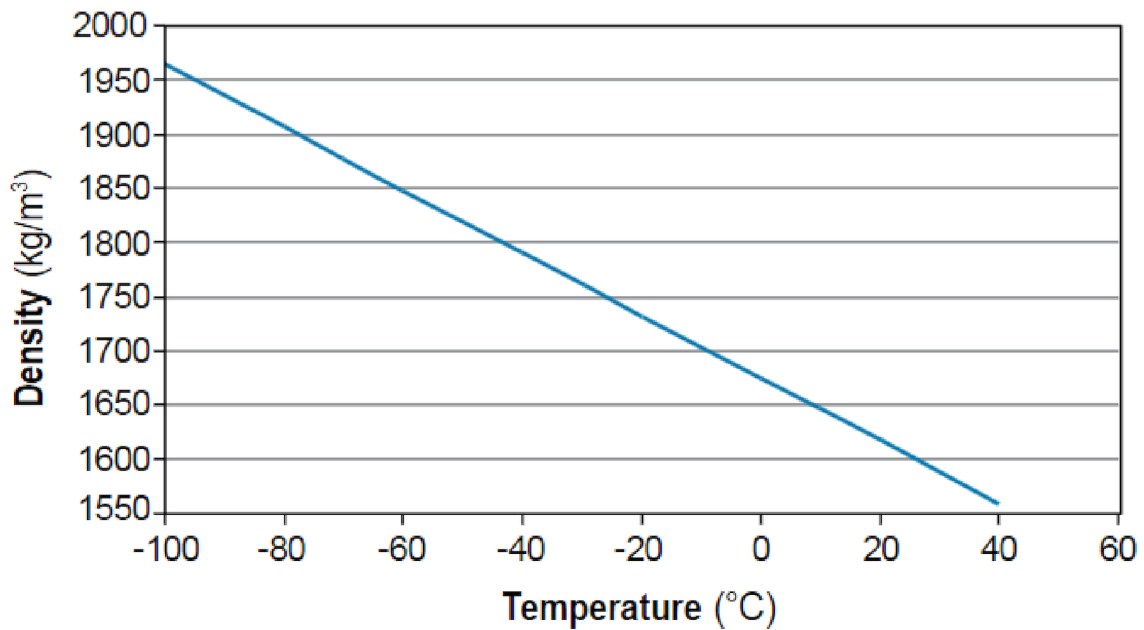
Composition of SF 649™ Engineered Fluid	
Dodecafluoro-2-methylpentan-3-one	99.0 mole %, minimum
Chemical Formula	CF <sub>3</sub> CF <sub>2</sub> C(O)CF(CF <sub>3</sub> ) <sub>2</sub>

Typical Physical Properties	
Boiling Point(°C)	49
Pour Point (°C)	-108
Molecular Weight (g/mol)	316
Critical Temperature (°C)	169
Critical Pressure (MPa)	1.88
Vapor Pressure (kPa)	40
Heat of Vaporization (kJ/kg)	88

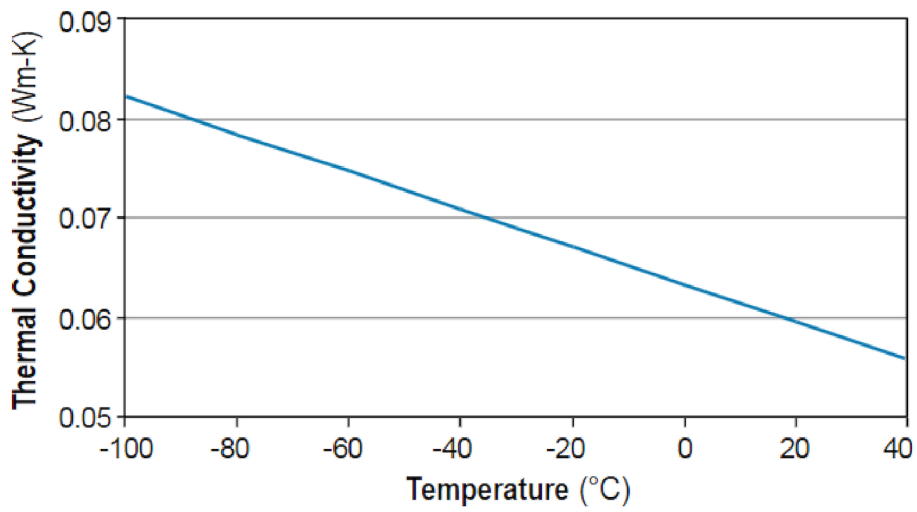
Typical Physical Properties	
Liquid Density (kg/m <sup>3</sup> )	1600
Coefficient of Expansion (K <sup>-1</sup> )	0.0018
Kinematic Viscosity (cSt)	0.40
Absolute Viscosity (cP)	0.64
Specific Heat (J/kg-K)	1103
Thermal Conductivity (W/m-K)	0.059
Surface Tension (mN/m)	10.8
Solubility of Water in Fluid (ppm by wt)	20
Dielectric Strength, 0.1" gap (kV)	>40
Dielectric Constant @ 1kHz	1.8
Volume Resistivity (Ohm-cm)	10 <sup>12</sup>
Global Warming Potential (GWP)	1

## Thermophysical Properties

**Liquid Density (kg/m<sup>3</sup>) = 1674.4 - 2.904T(°C)**



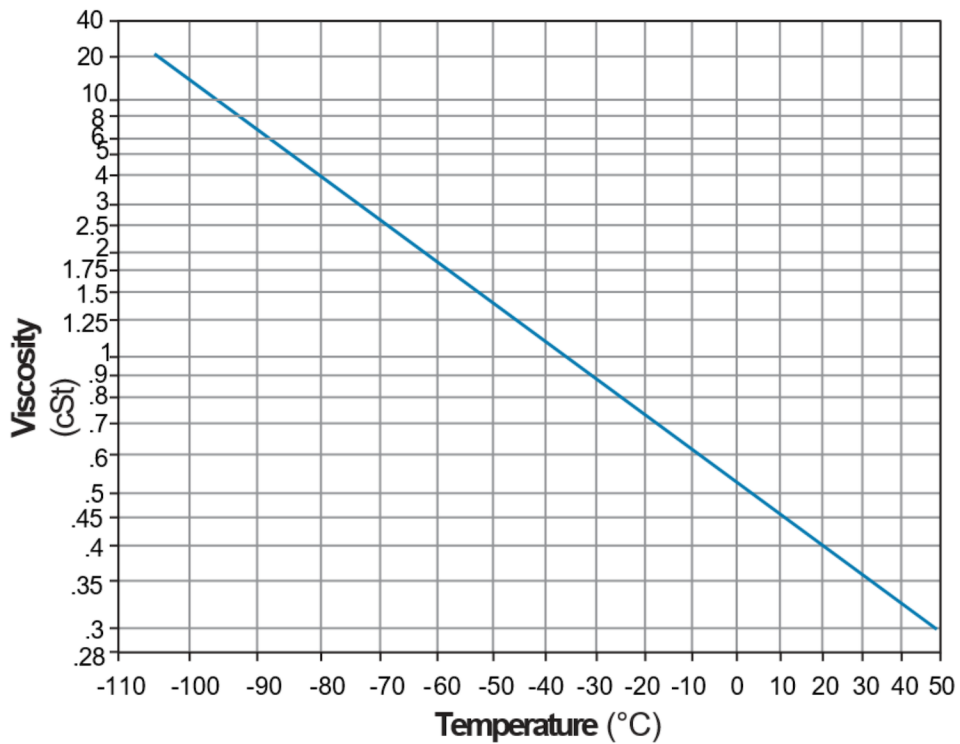
**Liquid Thermal Conductivity**  $(Wm-K) = 0.063403 - 0.000188 T(^{\circ}C)$



**Liquid Specific Heat**  $(J/kg-K) = 1091.9 + 0.3419 T(^{\circ}C) + 0.0039T^2$

**Vapor Pressure**  $\ln(P[Pa]) = -3545.3/T(K) + 22.492$

**SF 649 Fluid Viscosity vs. Temperature**



## Features

SF 649 fluid stands out for its exemplary environmental profile, safety margins, low viscosity, high molecular weight, and exceptional heat transfer performance, making it a preferred choice for a diverse array of heat transfer applications. SF 649 fluid demonstrates compatibility with a broad spectrum of construction materials, eliminating the need for specialized piping or handling systems. Its stability in storage and high dielectric constant ensure safe, direct contact in most electronics and computing applications.

Physical Properties				
Properties	SF 649™ Engineered Fluid	SF <sub>6</sub>	HFC-245fa	HFC-134a
Ozone Depletion Potential (ODP) <sup>1</sup>	0.0	0.0	0.0	0.0
Global Warming Potential <sup>2</sup>	0.1	24,300	962	1,530
Atmospheric Lifetime (years)	0.019	1000	7.9	14

<sup>1</sup> World Meteorological Organization (WMO) 1998, Model-Derived Method.

<sup>2</sup> Intergovernmental Panel on Climate Change (IPCC) 2021 Method, 100 Year ITH.

## Stability

SF 649 fluid is designed for use in sealed systems to prevent interaction with water. Despite its reactivity with liquid water, SF 649 fluid demonstrates remarkable stability in the absence of water, maintaining its integrity at temperatures exceeding 300°C. Our team of application engineers is available to provide insights into system design and to explore the advantages of SF 649 fluid compared to alternative heat transfer fluids or solutions.

## Environmental Health and Safety

SF 649 fluid has been rigorously evaluated by an independent laboratory, confirming its minimal environmental impact. With an estimated atmospheric lifetime of just five days due to sunlight-induced photolysis, its potential to affect climate change is significantly limited. This short-lived presence in the atmosphere results in a Global Warming Potential (GWP) of less than 1, underscoring its low impact on global warming. Furthermore, studies have shown that the photolytic breakdown of SF 649 fluid produces by-products that do not harm the stratospheric ozone layer, affirming its ozone depletion potential of zero.

## Toxicity Profile

SF 649 fluid undergoes rigorous toxicity assessments during its development process to ensure safety. Early evaluations, along with subsequent independent studies, confirm that SF 649 fluid exhibits very low acute and repeat dose toxicity levels. The No Observed Adverse Effect Level (NOAEL) for all acute toxicity endpoints is established at 10% (100,000 ppmV), derived from cardiac sensitization and 4-hour acute inhalation studies. The recommended 8-hour Time Weighted Average (TWA) exposure guideline is set at 40 ppmV. This guideline ensures a significant safety margin under normal usage conditions, providing reassurance for both users and regulators.

## Product Use

All statements, technical information, and recommendations provided in this document are grounded in tests or experiences that Standard Fluids believes to be reliable. However, various external factors beyond Standard Fluids' control can influence the performance and usage of Standard Fluids products in specific applications. These factors may include the operating conditions and environmental circumstances in which the product is utilized. As these elements are uniquely known and controlled by the user, it is imperative for the user to assess the suitability of the Standard Fluids product for their intended purpose and method of application.

## Warranty and Limited Remedy

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## Resources

For technical support and product inquiries, contact The Standard Fluids Corporation at [info@standardfluids.com](mailto:info@standardfluids.com) or 888-322-1248.