



# Health, Safety and Environmental Characteristics of OptiCool Fluid

## A White Paper

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Electronics Cooling

Specialty Heat Transfer

Dielectric Fluids

BioLubricants

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**Executive Summary:**

OptiCool Fluid is a premier heat transfer fluid used in electrical applications: electrical components in computers, batteries and motors. This paper discusses the Health, Safety and Environmental (HSE) characteristics of OptiCool.

The paper shows how OptiCool is nontoxic, nonhazardous, and safe for workers' health. OptiCool is highly biodegradable and has low aquatic toxicity. It's safe against sparks and flame. OptiCool Fluids have 20 years' experience with a flawless safety record.

For more information or a summary of this study, please contact [tech@dsiventures.com](mailto:tech@dsiventures.com)



**Overview:**

When evaluating cooling fluids for electronics, it's important to look beyond thermodynamic properties and consider the fluids' Health, Safety, and Environmental (HSE) characteristics. This paper examines the characteristics of DSI OptiCool Fluid and discusses any threats to human health, fire and electrical safety, and environmental fate.

**OptiCool Fluid:**

OptiCool Fluid is a heat transfer fluid made from synthetic hydrocarbons. It was originally developed in 1992 to be a safer alternative to standard transformer oil in power and distribution transformers. Because of its excellent heat transfer characteristics and material compatibility, OptiCool Fluid is used to cool electronics, motors, and batteries. OptiCool is so efficient in removing heat that manufacturers can reduce the size and weight of their products.



Since its introduction in 1992, there has never been a report of a fire or worker sensitivity to OptiCool Fluid.

**Components and How It's Made:**

OptiCool Fluid is made from a blend of ultra-pure, food grade synthetic base oils, resulting in an extremely clean, nontoxic hydrocarbon fluid.

OptiCool's blends of synthetic base oils and additives are carefully controlled. The additives enhance the properties of the different fluids – some strengthen the oil's resistance to oxidation and aging, for longer service life. Other additives enhance the long term compatibility with circuit board components.

After blending, the base oils are processed, where they are vacuum dried to less than 35 ppm moisture content. Dissolved gases are removed. This raises the dielectric strength and lowers the flammability of the oils, for extra safety.

The oil is filtered through special “polishing” filters to remove any particulate contamination. Then, it's blended with more additives, packaged and tested. DSI has a complete quality control laboratory and its Quality Program is ISO 9001 Certified.



**The Difference Between OptiCool Fluid and Mineral Oils:**

OptiCool Fluids are Engineered Dielectric Fluids. This is different from plain base oils or white oils, which are refinery commodities that are sold “as-is”, with no processing, additives or testing. There are no specifications on important moisture or dielectric strength parameters, and no information on compatibility.

**OptiCool's Effects on Health:**

OptiCool Fluid is classified by OSHA as nontoxic, non-hazardous and non-carcinogenic. (1) It doesn't contain any solvents, aromatics or any halogens, like fluorine or chlorine. It doesn't have any smell, at room temperature. It feels like a light oil, not like a solvent or chemical.

**Handling:** The base oils used in OptiCool have been extensively tested and found to be “non-irritating to skin” (2). Because of this, there has never been a reported case of allergic reaction due to handling OptiCool Fluid. OptiCool Fluid can be washed off with normal soap and water.

**Accidental Ingestion:** OptiCool Fluid is a food-grade product. When used in heat transfer fluids, the base oils and additives that are used in OptiCool have been approved by the NSF and FDA for incidental contact with food and food preparation surfaces. (3)(4)

**Worker Exposure, Health and Safety**

All of materials used in making OptiCool Fluids have acceptable worker exposure limits. Inhalation risk at operating temperatures is very low with each. OptiCool Fluids carry an aspiration safety warning label. Skin contact is treated by washing with soap and water. All OptiCool fluids are considered non-toxic and non-hazardous.

For specific information, please refer to the Material Safety Data Sheet available from DSI Ventures, Inc.

**Environmental Impact:**

When evaluating the environmental impact of a heat transfer fluid, two parameters are most often used. Biodegradation is the ability for microbes in soil or water to use the fluid as a source of carbon (food). A fluid that is highly biodegradable is easier for bacteria to degrade naturally.



The other parameter used is Aquatic Toxicity. This test measures the effect of a spill on fish and is a good indication of potential dangers or complications caused by an accidental spill.

OptiCool Fluid is highly biodegradable. Testing shows that OptiCool base oils are more than 98% biodegradable. All ingredients used in making OptiCool fluids are chosen for biodegradability and non-toxicity.

OptiCool is also non-toxic to fish. Trout toxicity tests show that OptiCool Fluid is “not acutely lethal”

Table One shows the biodegradation and fish toxicity values for two popular insulating fluids. (5)

Fluid Type	Petroleum Oil	DSI Fluid – OptiCool
Biodegradability, Test Method CEC-L33a	55%	96%
Trout Fish Toxicity, Hours of exposure at 1% concentration to kill 50% of exposed fish:  96 hour Mortality at 1% exposure	not acutely lethal  0	not acutely lethal  0

Table One: Biodegradation and Fish Toxicity Results

Table Two shows typical biodegradation data for a variety of insulating oils (6)

	Mineral Base Oil	White Oil	Vegetable Oil	OptiCool Fluid
Biodegradation, 28 Day Method CECL33a, %	15-35	25-45	>90	>96

Table Two: Typical Biodegradation Data for Various Fluids:

OptiCool also has a very small carbon footprint and very low Global Warming Index (GWI) (15)

### Electrical Safety:

Cooling oils for motors, batteries and electronics should meet safety standards for electrical insulating oils written by industry Standards Organizations such as IEEE (International Electrical and Electronics Engineers) and ASTM (American Society of Testing and Materials). These electrical standards add a significant safety margin against fire and electrical failure.

	IEEE Standard for High Voltage Transformer Oil <sup>(11)</sup>	OptiCool Fluid <sup>(12)</sup>
Dielectric Strength, ASTM D1816, 2 mm gap	40 kV minimum	55 kV
Dielectric Strength, ASTM D877	30 kV minimum	45 kV
Power Factor, ASTM D924 @ 40 C, %	0.15% maximum	0.0005%

### Table Three: Electrical Safety Minimum Standards

OptiCool Fluid is an excellent electrical insulator. OptiCool meets or exceeds all electrical standards set for power transformer oil. It has a high dielectric strength that doesn't change with temperature or humidity. OptiCool Fluid can prevent arcing even when contaminated with water (12).

#### **Fire Safety:**

Flammability of a cooling fluid must be considered when evaluating overall health and safety characteristics. Fire safety standards should be a consensus of industry experts. For over 70 years, IEEE flammability standards have protected power transformers. Table Four shows how OptiCool compares to these IEEE standards set for electrical insulating oils (7).

	IEEE Standard for High Voltage Transformer Oil <sup>(11)</sup>	OptiCool Fluid <sup>(12)</sup>
Fire Point, ASTM D92, degrees C.	145 min	185

### Table Four: Flammability Characteristics for OptiCool Fluid

You can see that the Flash Point of OptiCool Fluid exceeds the standard set for high voltage electrical transformer oil.

OptiCool Fluid is classified as “Non-Flammable” and “Non-Combustible” by the U.S. Department of Transportation (8)



## Conclusion:

- OptiCool Fluid is a cooling fluid for use in electrical applications.
- OptiCool is an Engineered Dielectric Fluid. It's made from synthetic oils, with food grade additives.
- OptiCool Fluid is non-toxic and non-hazardous. OptiCool Fluid is classified as “non-flammable” by the US Dept. of Transportation.
- OptiCool doesn't pose a risk to workers.
- OptiCool exceeds IEEE standards for electrical and fire safety.
- OptiCool Fluid is highly biodegradable to minimize risk to the environment.
- OptiCool Fluid has a very low carbon footprint and Global Warming Index (GWI)





## Reference:

1. "A Guide to the Globally Harmonized System of Classification and Labeling of Chemicals", Occupational Safety and Health Administration (OSHA), available at <https://www.osha.gov/dsg/hazcom/ghsguideoct05.pdf>, see also <https://www.osha.gov/dsg/hazcom/ghd053107.html>
2. According to the criteria of the Federal Hazardous Substance regulations 16CFR 1500
3. The base oils and additives used in blending OptiCool fluids have each been classified as H1 (Allowable for Incidental Contact with Food or Food Preparation Equipment) or HX-1, (Additives for Use In Blending H1 Compliant Lubricants) <http://info.nsf.org/USDA/Listings.asp>
4. As with any chemical product, long-term contact with skin should be avoided.
5. Emmanuel O. Aluyor and Mudiakeoghene Ori-jesu. African Journal of Biotechnology Vol. 8 (6), pp. 915-920, 20 March, 2009
6. Biodegradation data from [http://www.substech.com/dokuwiki/doku.php?id=biodegradation\\_of\\_oils](http://www.substech.com/dokuwiki/doku.php?id=biodegradation_of_oils) and supplier testing.
7. <http://environmentalchemistry.com/yogi/hazmat/placards/class3.html>
8. ASTM Standard Specification D3487 "Standard Specification for Electrical Insulating Oil of Mineral Origin", American Society for Testing and Materials
9. "Choosing the Right Heat Transfer Fluid for Electronics Cooling" Available at [www.dsiventures.com](http://www.dsiventures.com).
10. "C57.106 Guide for Acceptance and Maintenance of Insulating Oil in Equipment" IEEE
11. These values are typical for DSI OptiCool Fluids. Please contact DSI for specification values.
12. "Study performed by Ortech International Laboratories, Mississauga, Ontario, Canada

13. "Minimizing CPU Overheating With Liquid Immersion Cooling"  
Available at [www.dsiventures.com](http://www.dsiventures.com).
14. For continued use of OptiCool Fluid, the maximum amount of water that DSI recommends is 40 ppm. When the moisture content is above 40 ppm, DSI recommends that the OptiCool Fluid be field processed to remove moisture. Contact DSI for more information.
15. "Low Fire and Environmental Hazards of Dielectric Liquids", a paper presented by S.L. Cassidy and J.H. Davis at the 6th BEAMA International Electrical Insulation Conference, Brighton, England
16. ASTM Standard Method D92, "Flash and Fire Point by Cleveland Open Cup Method", ASTM International, Consohocken, PA
17. ASTM Standard D3487, "Standard Specification of Electrical Insulating Oil of Mineral Origin", ASTM International, Conohocken, PA