



Alpha-1 Fluid: Over 30 Years of Safety

**An Overview of
Characteristics, Use and
Service History**

Soltex, Inc.

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Executive Summary:

Alpha-1 fluid is a fire-resistant dielectric fluid made from synthetic hydrocarbon base oils.

Developed in 1992, Alpha-1 Fluid is used in a variety of applications that require electrical cooling and fire resistance.

Alpha-1 Fluid is nontoxic, nonhazardous, and safe for workers' health. Alpha-1 is safe against sparks and flames. Alpha-1 Fluid has 30 years' experience with a flawless safety record. There has never been a reported fire in any equipment filled with Alpha-1 Fluid.

The paper describes Alpha-1's composition, manufacturing process, cooling performance, and fire resistance, and describes applications for Alpha-1

For more information or a summary of this study, please contact orderentry@soltexinc.com.



Alpha-1 Fluid:

Alpha-1 Fluid is a fire-resistant dielectric fluid made by Soltex, Inc. It's an Engineered Fluid that's made from synthetic hydrocarbons. It is used wherever dielectric cooling and fire resistance are needed.

Alpha-1 Fluid was developed in 1992 to be a safer fluid to cool power and distribution transformers. Now, it's being used in applications such as cooling high tech motors, radio transmitters and military radar installations in the Arctic Circle.

Alpha-1 Fluid has excellent heat transfer characteristics and material compatibility, making it easy to use.

Most customers

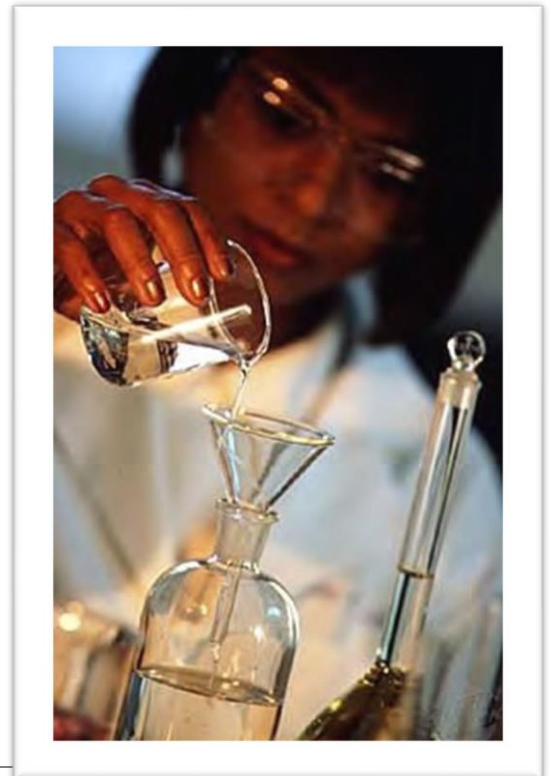
continue to use their standard electrical and cooling designs. Alpha-1 is compatible with other cooling oils, and a variety of electronics systems materials.

Components and How It's Made:

Soltex makes Alpha-1 Fluid from a blend of ultra-pure, food grade synthetic base oils, resulting in an extremely clean, nontoxic hydrocarbon fluid.

Alpha-1's blend of base oils and additives is carefully controlled. The additives enhance the physical and chemical properties of Alpha-1 Fluid - some strengthen the oil's resistance to oxidation and aging, for longer service life. Others enhance the long-term material compatibility.

After blending, the base oil is processed, where it's vacuum dried and dissolved gases are removed. This raises the dielectric strength and lowers the flammability, for extra safety.



Alpha-1 Fluid is filtered through special “polishing” filters to remove any particulate contamination. Then, it’s blended with more additives, packaged, and tested.

Soltex has a complete quality control laboratory, and its Quality Program is ISO 9001 Certified.

Applications

New Power Equipment: Alpha-1 Fluid is used for OEM fill in new distribution transformers and switchgear. Its clarity, compatibility and performance have made it the choice for OEMs and their customers.



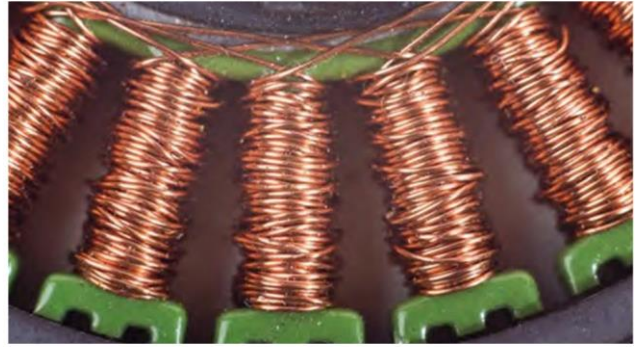
Retrofilled Equipment – Equipment that was designed and originally filled with other fluids can benefit from changing to Alpha-1 Fluid. Alpha-1 Fluid adds a significant safety margin to equipment designed for use with standard, more flammable oils. Alpha-1 mixes well with PCB fluids, Wecosol, mineral oil and vegetable oils. Retrofilling with Alpha-1 Fluid is usually a simple matter of draining, flushing and then refilling the transformer (1). Contact Soltex for more information regarding retrofilling procedures with Alpha-1 Fluid.

Power Electronic Circuitry – Amplifier circuits and other power electronics can be safely cooled with Alpha-1 Fluid

Batteries – Batteries can be cooled with the highest degree of fire protection with Alpha-1 Fluid.



Electric Motors – Electric motors are cooled and insulated with Alpha-1 Fluid. Unlike other dielectric fluids, Alpha-1 has excellent lubricity, which extends the life of moving parts immersed in the fluid.

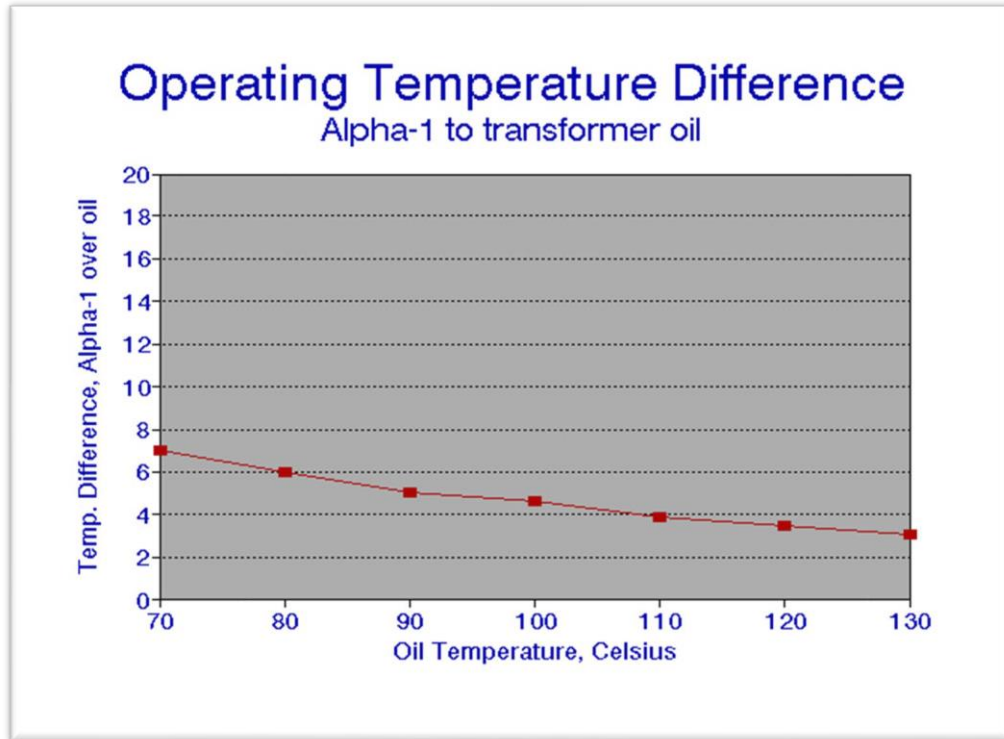


Cooling Performance

Because Alpha-1 has a lower viscosity than other fluids, it cools electrical equipment and circuitry more efficiently. Equipment that was originally designed for using other, more flammable fluids can be changed to Alpha-1 Fluid without any changes in power capacity or cooling design.

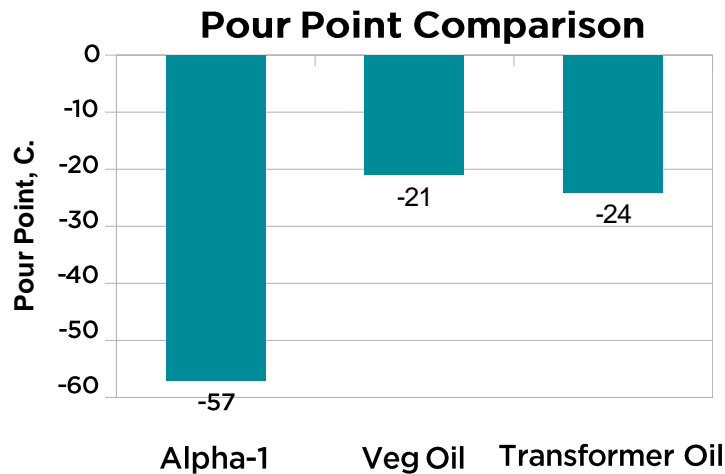
(1)

Figure One shows typical results from heat runs performed on a 3000 kVA pad mount convection cooled transformer. Note that at operating temperatures (90 C.), there is less than five degrees difference between the cooling performance of Alpha-1 and that of mineral oil. Alpha-1 Fluid can be retrofilled into any type of equipment. (2,3)



Low Temperature Performance

Alpha-1 remains fluid down to -57 C., which makes it ideal for use in harsh environments. There is no deterioration of dielectric strength down to the fluid's pour point. (4,5)



Alpha-1's Effects on Health:

Alpha-1 Fluid is classified by OSHA as nontoxic, non-hazardous, and non- carcinogenic. (6) 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 Alpha-1 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 Alpha-1 Fluid. Alpha-1 Fluid can be washed off with normal soap and water.

Accidental Ingestion: Only Food Grade base oils and additives are used to make Alpha-1 Fluid. When used in heat transfer fluids, the base oils and additives used in Alpha-1 have been approved by the NSF and FDA for incidental contact with food and food preparation surfaces. (8)

Worker Exposure, Health and Safety

All of the materials used in making Alpha-1 Fluids have acceptable worker exposure limits. Inhalation risk at operating temperatures is very low with each. Alpha-1 Fluids carry an aspiration safety warning label. Skin contact is treated by washing with soap and water. All Alpha-1 fluids are considered non-toxic and non-hazardous.

For specific information, please refer to the Material Safety Data Sheet available from Soltex, 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.

Alpha-1 Fluid is biodegradable. Testing shows that Alpha-1 base oils are readily biodegradable. All ingredients used in making Alpha-1 fluids are chosen for biodegradability and non-toxicity.

Alpha-1 is not believed to be toxic to fish.

Table Two shows typical biodegradation data for a variety of insulating oils (9,10,11)
 Table Two: Typical Biodegradation Data for Various Fluids:

	Mineral Base Oil	White Oil	Vegetable Oil	Alpha- 1 Fluid
Biodegradation, 28 Day Method CECL33a, %	15-35	25-45	>90	25-45

Alpha-1 also has a very small carbon footprint and very low Global Warming Index (GWI) (12)

Fire Safety

Alpha-1 Fluid has an outstanding fire safety profile. Simply changing to Alpha-1 can provide a significant margin of fire safety to all types of electrical and electronics equipment.

In addition, Alpha-1 Fluid has a flawless safety record. Since its introduction in 1992, there has never been a fire in equipment filled with Alpha-1 Fluid.(13)

The flash and fire point of Alpha-1 Fluid are extremely high, and it has a high autoignition temperature. With a flash point of 306 degrees C., Alpha-1 is classified as a “Less Flammable” hydrocarbon fluid by FM Global Safety Laboratory. (14)

Alpha-1 is Listed by FM Global for use in transformers located indoors and in dangerous locations. It meets or



exceeds all requirements set by the US National Electrical Code Section 450-23, governing the use of high voltage equipment inside buildings.

For over 70 years, IEEE flammability standards have protected power transformers and set baselines and have become industry standards. The following table shows how Alpha-1 compares to these IEEE standards set for electrical insulating oils (15).

	IEEE Standard for High Voltage Transformer Oil (15)	Alpha-1 Fluid ⁽¹⁶⁾
Fire Point, ASTM D92, C..	145 min	306

You can see that the Flash Point of Alpha-1 Fluid exceeds the standard set for high voltage electrical transformer oil.

Alpha-1 Fluid is classified as “Non-Flammable” and “Non-Combustible” by the U.S. Department of Transportation (17)

Electrical Safety:

Cooling oils for transformers, 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.

Table Three: Electrical Safety Minimum Standards

Alpha-1 Fluid is an excellent electrical insulator. Alpha-1 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. Alpha-1 Fluid can prevent arcing even when contaminated with water (19).

	ASTM Standard for High Voltage Transformer Oil⁽¹⁸⁾	Alpha-1 Fluid⁽¹⁶⁾
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%

Conclusion:

- Alpha-1 Fluid is a fire-resistant dielectric fluid used in a variety of electrical applications.
- Alpha-1 is an Engineered Dielectric Fluid. It's made from synthetic oils, with food grade additives.
- Alpha-1 is Listed by FM Global for use in electrical transformers located indoors, per NEC Section 450-23
- Alpha-1 Fluid is non-toxic and non-hazardous. Alpha-1 Fluid is classified as “non-flammable” by the US Dept. of Transportation.
- Alpha-1 doesn't pose a risk to workers.
- Alpha-1 exceeds IEEE standards for electrical and fire safety.
- Alpha-1 Fluid is readily biodegradable to minimize risk to the environment.
- Alpha-1 Fluid has a very low carbon footprint and Global Warming Index (GWI)

References:

1. Please refer to “Guide for Retrofilling Transformers with Alpha-1 Fluid”. Available from Soltex, Inc. orderentry@soltexinc.com or 281-587-0900. Note that other steps or procedures may be necessary, given the details of the retrofill application.
2. “Choosing the Right Heat Transfer Fluid for Electronics Cooling” Available at www.soltexinc.com
3. Redacted.
4. “Insulating Liquids: their Use, Manufacture, and Properties”; A.C.M. Wilson, 1980, IEE Press (London)
5. “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
6. According to the criteria of the Federal Hazardous Substance regulations 16CFR 1500
7. As with any chemical product, long-term contact with skin should be avoided.
8. The base oils and additives used in blending Alpha-1 Fluid 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>
9. Biodegradation data from http://www.substech.com/dokuwiki/doku.php?id=biodegradation_of_oils and supplier testing.
10. Study performed by Ortech International Laboratories, Mississauga, Ontario, Canada
11. Data from base oil suppliers literature
12. Emmanuel O. Aluyor and Mudiakeoghene Ori-jesu. African Journal of Biotechnology Vol. 8 (6), pp. 915-920, 20 March, 2009
13. Soltex Sales records as of July, 2016

14. FM Global Listing for Alpha-1 Fluid. Contact Soltex Inc. for more information.
15. IEEE C57.104, Standard Guide for Acceptance and Maintenance of Transformer Oil of Petroleum Origin.
16. These values are typical for Soltex Alpha-1 Fluids. Please contact Soltex for specification values.
17. <http://environmentalchemistry.com/yogi/hazmat/placards/class3.html>
18. ASTM Standard D3487, "Standard Specification of Electrical Insulating Oil of Mineral Origin", ASTM International, Conshohocken, PA
19. For continued use of Alpha-1 Fluid, the maximum amount of water that Soltex recommends is 40 ppm. When the moisture content is above 40 ppm, Soltex recommends that the Alpha-1 Fluid be field processed to remove moisture. Contact Soltex for more information.

Other Useful Reference Material

- "Insulating Materials for Design and Engineering Practice", Vol 2; F.M. Clarke; 1959, Wiley & Sons
- ASTM Standard Specification D3487 "Standard Specification for Electrical Insulating Oil of Mineral Origin", American Society for Testing and Materials
- IEEE C57.106 Guide for Acceptance and Maintenance of Insulating Oil in Equipment"
- ASTM Standard Method D92, "Flash and Fire Point by Cleveland Open Cup Method", ASTM International, Conshohocken, PA

