

FR3TM
ENVIROTEMPTM NATURAL ESTER FLUID

Envirotemp™ FR3™ fluid

THE NATURAL ESTER SOLUTION.

Envirotemp FR3 fluid is a natural ester fluid derived from renewable vegetable oils – providing environmental benefits that are superior to mineral oil and unsurpassed by any other dielectric coolants.

- Ultimately biodegradable as designated by the EPA
- Reduced carbon footprint – 56x less carbon emissions than mineral oil
- Non-toxic – Contains no petroleum, halogens, silicones or sulfurs
- Maintains dielectric strength in cold temperatures

High fire point delivers improved fire safety

FR3 fluid possesses a 100% fire safety record making it the ideal choice for transformers positioned indoors, underground, and in close proximity to buildings and other equipment:

- Prevent costly replacements due to fires (transformers, property damage, etc.)
- No fire mitigation or deluge systems required
- Exceptionally high fire and flash points of 360°C and 330°C, respectively
- Highest ignition resistance of any high fire point dielectric fluid available
- FR3 fluid is FM Global Approved and Underwriters Laboratories classified as a Less-Flammable Dielectric Liquid.

Trusted worldwide for both new transformers and refilling existing transformers

Some of the largest utilities and transformer manufacturers around the world trust Envirotemp FR3 fluid. You will find FR3 fluid in power and distribution transformers of all sizes and applications through 420kV.

Improve performance

- Uses up to 15% less fluid and up to 3% less construction materials
- Increases loadability up to 20%
- Increases reliability
- Twice the fire and flash point as mineral oil significantly increases fire safety for workers and the community

Gain cost efficiencies

- Slows asset replacement
- Reduces routine maintenance
- No need for fire mitigation systems
- Potentially reduces insurance premiums due to increased fire safety
- Minimize need for concrete basins
- Supports supply chain sustainability
- Optimizes inventory management

Take advantage of environmental benefits

- Ultimately biodegradable and non-toxic makes spill remediation easier and faster
- Carbon neutral
- Made from renewable vegetable oil

Envirotemp™ FR3™ fluid properties: standard acceptance values and typical values

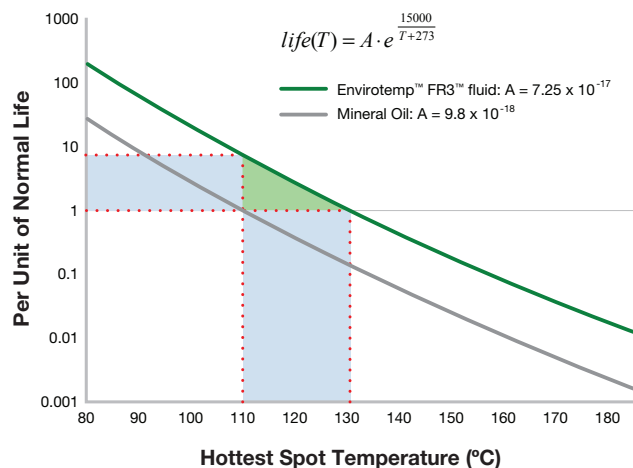
Property	Standard Test Methods		ASTM D6871	IEC 62770	Envirotemp FR3 Fluid	
	ASTM	ISO/IEC	As-Received New Fluid Property Requirements	Unused New Fluid Property Requirements	Typical	
Physical						
Color	D1500	ISO 2211	≤1.0		0.5	
Flash Point PMCC (°C)	D93	ISO 2719		≥250	255	
Flash Point COC (°C)	D92	ISO 2592	≥275		320 – 330	
Fire Point (°C)	D92	ISO 2592	≥300	>300	350 – 360	
Pour Point (°C)	D97	ISO 3016	≤-10	≤-10	-18 – -23	
Density at 20°C (g/cm³)		ISO 3675		≤1.0	0.92	
Relative Density (Specific Gravity) 15°C/15°C	D1298		≤0.96		0.92	
Viscosity (mm²/sec)	D445	ISO 3104				
	100°C		≤15	≤15	7.7 – 8.3	
	40°C		≤50	≤50	32 – 34	
	0°C		≤500		190	
Visual Examination	D1524	IEC 61099 9.2	bright and clear	clear, free from sediment and suspended matter	clear, light green	
Biodegradation		OECD 301	readily biodegradable	readily biodegradable	ultimately biodegradable	
Electrical						
Dielectric Breakdown (kV)	D877		≥30		47	
Dielectric Breakdown (kV)						
	1mm gap	D1816	≥20		28	
	2mm gap	D1816	≥35		48 – 75	
		IEC 60156		≥35	73	
2.5mm gap						
Gassing Tendency (mm/min)	D2300		≤0		-79	
Dissipation Factor						
	25°C (%)	D924	≤0.20		0.010 – 0.15	
	90°C (tan δ)			≤0.05	0.02	
		IEC 60247				
100°C (%)	D924		≤4.0		0.41 – 3.85	
Chemical						
Corrosive Sulfur	D1275	IEC 62697	non-corrosive	non-corrosive	non-corrosive	
Water Content (mg/kg)	D1533	IEC 60814	≤200	≤200	4 – 50	
Acid Number (mg KOH/g)	D974	IEC 62021.3	≤0.06	≤0.06	0.013 – 0.042	
PCB Content (mg/kg)	D4059		not detectable	free from PCBs	not detectable	
Oxidation Stability (48 hrs, 120°C)		IEC 61125C				
	Total Acidity (mg KOH/g)			≤0.6	0.1	
	Viscosity at 40°C (mm²/sec)		ISO 3104		≤30% increase over initial	17.1
	Dissipation Factor at 90°C (tan δ)		IEC 60247		≤0.5	0.1

NOTE: Specifications should be written referencing only the defined ASTM or IEC industry standard acceptance values and test methods. The listed 'typical' values are average values summarized from a significant number of data points over many years; they are not to be identified as acceptance values.

ASTM D6871 Standard Specification for Natural (Vegetable Oil) Ester Fluids Used in Electrical Apparatus

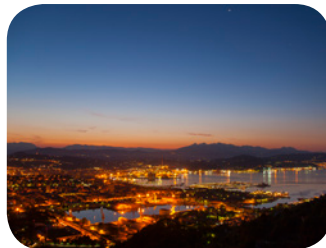
IEC 62770: Fluids for electrotechnical applications – Unused natural esters liquids for transformers and similar electrical equipment.

Unit Life vs. Hottest Spot Temperature



**Optimize Transformer Performance,
Reduce Operating & Maintenance Costs**

FR3 fluid gives utilities the ability to increase overload capacity up to 20% or extend asset life. This results in significant cost savings over the life of each transformer.



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