

Choose the fluid that works harder and smarter.

Derived from over 95% rapeseed/canola oil, a renewable resource, FR3r™ natural ester is a higher performing, more reliable, and more sustainable dielectric fluid compared to mineral oil. FR3r fluid meets or exceeds all IEC 62770 and IEEE C57.147 standards.



Exceptional reliability

- Easily handles high heat with up to 140°C top fluid temperature limit¹
- Continuously dries paper insulation without creating any damaging byproducts or sludge for up to 8X longer paper insulation life



Increased loading capacity

- Up to 20% more loading capacity compared to mineral oil
- Design a smaller transformer with the same loading capacity, the same sized transformer with up to 20% more loading capacity, or any combination in between



More sustainable

- 100% biodegradable in as little as 10 days
- Non-toxic in water, soil, and to wildlife and humans
- Derived from >95% rapeseed oil, a renewable resource



Superior fire safety

- Over 2X higher fire and flash points compared to mineral oil
- K-class fluid with an exceptionally high fire point of 360°C



Cost savings

- Design a more power dense transformer and save on expensive materials like steel, aluminum, copper, and insulating paper
- Eliminate downtime and save valuable resources with no maintenance needed under normal operating conditions
- Remove or greatly reduce expensive fire remediation and spill containment systems with K-class fire certification and 100% biodegradability

¹ According to IEC 60076-14, IEEE C57-154



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FR3r™ Natural Ester fluid properties: standard acceptance values and typical values

PROPERTY	Standard test methods		ASTM D6871/IEEE C57.147	IEC 62770	FR3r™ Natural Ester	
	ASTM	ISO/IEC	As-received new fluid property requirements	Unused new fluid property requirements	TYPICAL	
Physical						
Color	D1500	ISO 2211	≤1.0	–	PASS	
Flash Point PMCC (°C)	D93	ISO 2719	–	≥250	260	
Flash Point COC (°C)	D92	ISO 2592	≥275	–	330	
Fire Point (°C)	D92	ISO 2592	≥300	>300	360	
Pour Point (°C)	D97	ISO 3016	<-10	≤-10	-33	
Density at 20°C (g/cm³)	–	ISO 3675	–	≤1.0	0.92	
Relative Density (Specific Gravity) 15°C	D1298	–	≤0.96	–	0.92	
Viscosity (mm²/sec)						
	100°C	D445	ISO 3104	≤15	≤15	8.0
	40°C			≤50	≤50	37
	0°C			≤500	–	225-235
	-20°C			–	–	850-950
Visual Examination	D1524	IEC 62770 4.2.1	bright and clear	clear, free from sediment and suspended matter	clear, light	
Biodegradation	OECD 301B		readily biodegradable	readily biodegradable	readily biodegradable	
Aquatic and Oral Acute Toxicity	OECD 202, 203, OECD 420		non-toxic	non-toxic	non-toxic	
Electrical						
Dielectric Breakdown (kV)	D877	–	≥30	–	>45	
Dielectric Breakdown (kV)						
	1mm gap	D1816	–	≥20	–	>25
	2mm gap	D1816	–	≥35	–	>50
	2.5mm gap	–	IEC 60156	–	≥35	>70
Dielectric Breakdown under Impulse (kV)						
	25.4mm gap	D3300	–	>130	–	136
Gassing Tendency (µl/min)	D2300	–	≤0	–	≤0	
Dissipation Factor						
	25°C (%)	D924	–	≤0.20	–	0.010 - 0.15
	90°C (tan δ)	–	IEC 60247	–	≤0.05	0.01 - 0.03
	100°C (%)	D924	–	≤4.0	–	1.00 - 3.85
Chemical						
Corrosive Sulfur	D1275	IEC 62697	non-corrosive	non-corrosive	non-corrosive	
Water Content (mg/kg)	D1533	IEC 60814	≤200	≤200	<50	
Acid Number (mg KOH/g)	D974	IEC 62021.3	≤0.06	≤0.06	0.01 - 0.06	
PCB Content (mg/kg)	D4059	IEC 61619	not detectable	free from PCBs	not detectable	
Total Additives	–	IEC 60666	–	Max weight fraction 5%	<2%	
Oxidation Stability (48 hrs, 120°C)	–	IEC 61125 IEC 62770	–	–	–	
	Total Acidity (mg KOH/g)	–	IEC 62621.3	–	≤0.6	0.1 - 0.2
	Viscosity at 40°C (mm²/sec)	–	ISO 3104	–	≤30% increase over initial	18% - 25% increase
	Dissipation Factor at 90°C (tan δ)	–	IEC 60247	–	≤0.5	0.1-0.2
Oxidation Induction Time 130°C/500psi (min)	D6186**	–	–	–	>94	



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FR3r™ fluid is fully compatible with FR3™ fluid.

* Measurement of viscosity near pour point may be inaccurate.

** A more specific version of the test indicated by ASTM D6186 is under development.

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.

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Learn more about how FR3r™ fluid can power your transformers more reliably and more sustainably at FR3rfluid.com.

