Trust the Original and Most Proven Natural Ester

FR3™ fluid is the original, most tested and proven natural ester in the world. Used for nearly 30 years in over 3.5 million distribution and power transformers and validated through hundreds of field and laboratory tests, FR3 natural ester continues to be trusted by leading OEMs and transformer users around the globe. Derived from over 95% renewable vegetable oil, FR3 natural ester outperforms mineral oil resulting in more reliable, higher performing, and more sustainable transformers. It's the smartest choice in dielectric fluids–for performance, value, and peace of mind.

Exceptional Reliability

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

More Sustainable

- 100% biodegradable in as little as 10 days
- Non-toxic in water, soil, and to wildlife and humans
- Reduce dependency on fossil-based materials in your transformers

Increased Loading Capacity

- Up to 20% more loading capacity compared to mineral oil without impacting transformer lifespan
- 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*

Superior Fire Safety

- 0 reported fires in over 25 years
- K-class fluid with over 2X higher flash and fire points compared to mineral oil (360 °C fire point)

Cost Savings

- Design a smaller, more power dense transformer and save on expensive materials like steel, aluminum, copper and insulating paper
- Remove or greatly reduce expensive fire remediation and spill containment systems because of K-class fluid certification and 100% biodegradability

*Compared to mineral oil

FR3™
a Cargill brand

Acceptable limits for receipt of shipments of FR3™ fluid

FR3™ fluid Acceptance Limits

	Standard test methods		ASTM D6871/IEEE C57.147	IEC 62770	FR3™ fluid
PROPERTY	**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	260-270
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	-21
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/s)	D445	ISO 3104			
100 ˚C			15	≤15	7.7 - 8.3
40 ˚C			≤50	≤50	32 - 34
0 ˚C			≤500	–	190
-20 ˚C	–	–	–	–	650*
Visual Examination	D1524	IEC 60247 4.2.1	Bright and clear	Clear, free from sediment and suspended matter	Clear, light green
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)					
2mm gap	D1816	–	≥35	–	60-70
2.5mm gap	–	IEC 60156	–	≥35	70-80
Dielectric Breakdown under Impulse (kV) 25.4mm gap	D3300	–	>130	–	140
Gassing Tendency (ml/min)	D2300	–	≤0	–	-79
Dissipation Factor					
25 ˚C (%)	D924	–	≤0.20	–	0.010 - 0.15
90 °C (tan ∂)	–	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	4 - 50
Acid Number (mg KOH/g)	D974	IEC 62021.3	≤0.06	≤0.06	0.01 - 0.05
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 h, 120 ˚C)	–	IEC 61125 IEC 62770			
Total Acidity (mg KOH/g)	–	IEC 62621.3	–	≤0.6	0.1 - 0.3
Viscosity at 40°C (mm²/s)	–	ISO 3104	–	≤30% increase over initial	17% - 23% increase
Dissipation Factor at 90°C (tan ∂)	–	IEC 60247	–	≤ 0.5	0.1
Oxidation Induction Time 130˚C/500psi (min)	D6186	–	–	–	62+2 min

Measurement of viscosity near pour point may be inaccurate.

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. A transformer filled with FR3 fluid complies with the transformer temperature operating range requirements defined in IEEE C57.12.00 and IEC 60076-1.