

DIAGNOSTIC REPORT for Ester-based Fluids (Vegetable Oils)



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IEEE C57.147-2008			Table 2		Table 3		Table 4		Table 5			Table B.5		
IEEE Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers			Receipt of Shipment of New Natural Ester Fluids		Received in New Equipment, Prior to Energization		(Provisional) Received in New Equipment, Prior to Energization		Suggested Limits for Continued Use For Service-Aged Natural Ester Fluids			Key Properties Values Triggering Prompt Additional Investigation For Serviced-Aged Natural Ester Fluids		
Apparatus Voltage Class			Not Specified By IEEE		≤69kV	69-230kV	≥230-345kV	>345kV	≤69kV	69-230kV	≥230	≤69kV	69-230kV	≥230
Analysis	ASTM Method	NTT Value	IEEE Limit Values											
Moisture Content (ppm)	D-1533		Tanker	Drum/Tote	Maximum 300	Maximum 150	Maximum 100	User Specific			≥ 400	≥ 200	≥ 150	
			Maximum 200	Maximum 100										
IFT (dyn/cm)	D-971		Not Specified By IEEE		Not Specified By IEEE		Not Specified By IEEE		Not Specified By IEEE			Not Specified By IEEE		
Neutralization Number (mg KOH/g)	D-974		Maximum 0.06		Maximum 0.06		Maximum 0.06		Not Specified By IEEE			≥ 0.3		
Color (ASTM Color Scale)	D-1500		Maximum L1.0		Maximum L1.0		Maximum L1.0		Not Specified By IEEE			≥ 1.5		
Visual	D-1524		Not Specified By IEEE		Bright And Clear		Bright And Clear		Not Specified By IEEE			Not Specified By IEEE		
Power Factor @25°C (%)	D-924		Maximum 0.2		Maximum 0.5		Maximum 0.5		Not Specified By IEEE			≥ 3		
Power Factor @100°C (%)	D-924		Maximum 4.0		Not Specified By IEEE		Not Specified By IEEE		Not Specified By IEEE			Not Specified By IEEE		
DIE (kV)	D-877		Not Specified By IEEE		Not Specified By IEEE		Not Specified By IEEE		Not Specified By IEEE			Not Specified By IEEE		
DIE (kV) (0.04" gap)	D-1816		Tanker	Drum /Tote	Minimum 25	Minimum 30	Minimum 32	Minimum 35	Minimum 23	Minimum 28	Minimum 30	Not Specified By IEEE		
			Minimum 20	Minimum 35										
DIE (kV) (0.08" gap)	D-1816		Tanker	Drum /Tote	Minimum 45	Minimum 52	Minimum 55	Minimum 60	Minimum 40	Minimum 47	Minimum 50	Not Specified By IEEE		
			Minimum 35	Minimum 60										
Viscosity (cSt@0°C)	D-445 (0°C)		Maximum 500		Not Specified By IEEE		Not Specified By IEEE		Not Specified By IEEE			Not Specified By IEEE		
Viscosity (cSt@40°C)	D-445 40 (°C)		Maximum 50		Maximum 50		Maximum 50		Not Specified By IEEE			≥ 10 over baseline value		
Viscosity (cSt@100°C)	D-445 100 (°C)		Maximum 15		Not Specified By IEEE		Not Specified By IEEE		Not Specified By IEEE			Not Specified By IEEE		
Pour Point (°C)	D-971		Maximum -10		Not Specified By IEEE		Not Specified By IEEE		Not Specified By IEEE			Not Specified By IEEE		
Flash Point (°C)	D-92		Minimum 275		Not Specified By IEEE		Not Specified By IEEE		Not Specified By IEEE			≤ 275		
Fire Point (°C)	D-92		Minimum 300		Minimum 300		Minimum 300		Minimum 300			Not Specified By IEEE		
Specific Gravity (15°C/15°C)	D-1298		Maximum 0.96		Not Specified By IEEE		Not Specified By IEEE		Not Specified By IEEE			Not Specified By IEEE		
Impulse Voltage 25C 25.4 mm gap (kV)	D-3300		Minimum 130		Not Specified By IEEE		Not Specified By IEEE		Not Specified By IEEE			Not Specified By IEEE		

Facts about Ester-based Fluids (Vegetable Oils):
 Natural vegetable oil ester insulating fluid differs from conventional mineral oil and other high fire point (less-flammable) fluids in that it is an agricultural product derived from vegetable oil rather than refined from petroleum base or synthesized stocks.

Water Content – The amount of water required to saturate natural ester insulating fluid at room temperature is roughly 20 times that of mineral insulating oil. The relative saturation is based on the amount of water dissolved in the oil divided by the total amount of water the oil could hold at that temperature.

Interfacial Tension (IFT) limits have not been established as of yet. IFT of new natural ester insulating fluids typically range in the 26-30 nM/m range which is lower than that of new mineral oil.

Typical trade names of ester-based fluids include:
BIOTEMP®
 Developed by ABB, Inc.
<http://www.ntworldwide.com/docs/BIOTEMP-ABB.pdf>

Envirotemp FR3®
 Developed by Cooper Power Systems
 Currently owned by Cargill Industrial Specialties
<http://www.ntworldwide.com/docs/fr3brochure.pdf>

Midel® 7131 Synthetic Midel® eN Natural
 Developed by M&I Materials Ltd – UK
<http://www.midel.com>

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