

Transformers

**BIOTEMP – ABB sensible solution**  
The superior biodegradable, high fire  
point dielectric insulating fluid

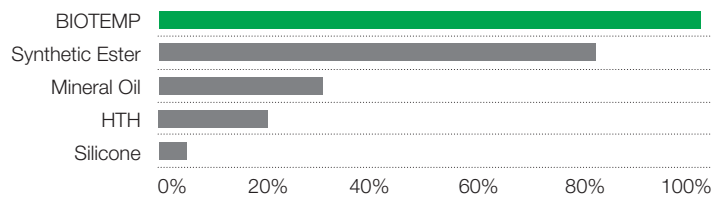
# Advantages overview

At ABB, we are entirely dedicated to improving power reliability and efficiency while minimizing environmental impact. Sustainability considerations influence how we design and manufacture products, what we offer customers, how we engage suppliers, and how we behave in the communities where we operate.

In that respect, we developed BIOTEMP® as a superior dielectric insulating fluid combining environmental friendliness, superior fire resistance and high temperature stability with excellent dielectric characteristics.

BIOTEMP is a natural ester fluid made from renewable and biodegradable vegetable-based oil. Below are some of the environmental, fire safety and operational advantages of using BIOTEMP:

## Biodegradability (According to the CEC L-33-A 21-day test)



## Environmental advantages

- Even though secondary containment is still required, BIOTEMP spills can be disposed through normal means and not treated as hazardous or toxic waste.
- BIOTEMP minimizes air pollution by producing only carbon dioxide and water during combustion.
- BIOTEMP also offers the potential for relief from Government regulatory penalties, resulting in less costly spill cleanups.

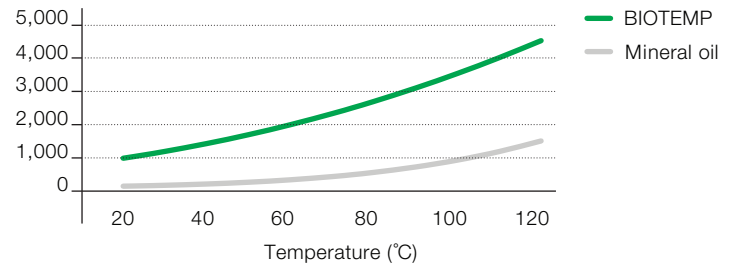
BIOTEMP is listed as a “less flammable” dielectric fluid by Factory Mutual (FM Global) and is classified as a “less hazardous” dielectric medium in respect to fire hazard by Underwriters Laboratories (UL).

## Fire safety advantages

- BIOTEMP offers greater risk mitigation on collateral damage from transformer explosion and fire, potentially lowering insurance premiums.
- Active fire suppression and barrier walls can essentially be eliminated with BIOTEMP when minimal spacing is maintained.
- BIOTEMP can alternatively be used safely indoors and in tighter spaces outdoors typically without additional fire safety requirements.

BIOTEMP has a much greater affinity for water than mineral oil. Consequently, in a BIOTEMP/paper insulating system, the paper stays drier than in a mineral oil/paper insulating system.

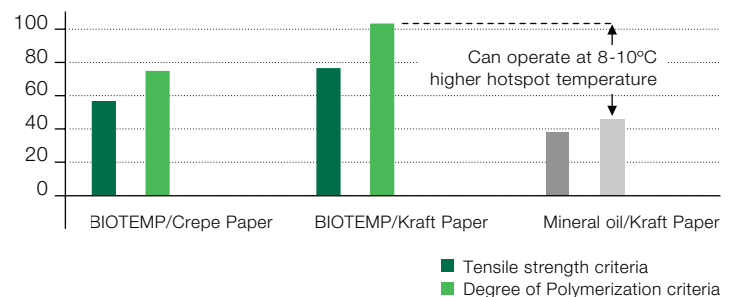
## Water saturation point (ppm)



## Operational advantages

- BIOTEMP impregnated paper experiences a much lower aging rate compared to mineral oil impregnated paper leading to an increase in the insulation system lifetime (grid reliability).
- BIOTEMP impregnated paper can alternatively operate at a higher hotspot temperature and attain the same life expectancy as mineral oil impregnated paper increasing the transformer peak load or overload capacity (energy efficiency).

## Life expectancy at 100°C (Years)



## Superior advantage

BIOTEMP was developed as the most stable vegetable-based oil with acceptable electrical properties. It is made from high-oleic oils, such as sunflower and safflower, which contain more than 75 percent of mono-unsaturated fatty acids increasing the oil stability when exposed to air as compared to competing products containing much lower levels (typically less than 25 percent). Comparative oxidation stability test results

## Comparative oxidation stability test results

(According to ASTM D 2440)

- BIOTEMP successfully passed the 164-hour test
- Competitor low-oleic oil reached irreversible gel formation after less than 72 hours

# Properties, handling instructions and specification guide



## Materials compatibility

BIOTEMP is not affected by reactions with other materials used in transformer construction and is non-oxidizing and non-corrosive at temperatures considerably above normal operating temperatures.

## Storage and handling

BIOTEMP can be transferred and stored similar to petroleum-based fluids. Transfer equipment and storage vessels should be clean and free of contaminants and moisture. During storage, the vessel should be airtight and is preferably stored under dry nitrogen (to minimize exposure to moisture and oxygen). BIOTEMP is not an aggressive solvent and is not known to degrade rubber hoses or membranes.

## Recommended maintenance

Degassing and refilling the headspace with dry nitrogen after prolonged or frequent exposure to air (totaling more than five hours) is recommended to preserve the life of the fluid. Periodic maintenance tests should follow the same schedule used for mineral oil-filled equipment.

## Retrofilling transformers

BIOTEMP mixes in all proportions with mineral oils. Concentrations of mineral oil in excess of seven percent by weight may lower the fire point below 300°C. BIOTEMP does not mix with silicone fluids.

## Areas of application

BIOTEMP is suitable for application indoors and in outdoor areas of heightened environmental and safety sensitivity.

## Specification guide

The dielectric coolant shall be listed as a less-flammable fluid meeting the requirements of National Electrical Code, Section 450-23, including a minimum fire point of 300°C and the requirements of the National Electrical Safety Code (IEEE C2-1997), Section 15. The fluid shall be nontoxic, non-bioaccumulating and biodegradable. It shall be FM Global approved and UL classified, BIOTEMP fluid or equal.

BIOTEMP typical properties								
Chemical/environmental			Physical			Electrical		
Property	Value	Test method	Property	Value	Test method	Property	Value	Test method
Biodegradability (21-day test)	97 to 99%	CEC L-33-A	Coefficient of thermal expansion	$7.50 \times 10^{-4}/^{\circ}\text{C}$	ASTM D 1903	Dielectric constant (relative permittivity)	3.1	ASTM D 924 IEC 60247
Corrosive sulfur	Non-Corrosive	ASTM D 1275B IEC 62535	Flash point	340°C	ASTM D 92	Dielectric strength	1-mm gap 39 kV 2-mm gap 76 kV	ASTM D 1816
			Fire point	360°C	ASTM D 92			
			Pour point	-15 to -20°C	ASTM D 97 ISO 3016			
Moisture (water) content	< 50 ppm	ASTM D 1533 IEC 60814	Kinematic viscosity		ASTM D 445	Dissipation (power) factor	at 25°C 0.09% at 100°C 0.19%	ASTM D 974
			at 100°C	9 mm <sup>2</sup> /s (cSt)	ISO 3104			
			at 40°C	42 mm <sup>2</sup> /s (cSt)				
Neutralization (acid) number	0.03 mg KOH/gm	ASTM D 974 IEC 62021	Specific gravity		ASTM D 1298	Gassing tendency	-50 µL/min	ASTM D 2300 IEC 60628
			at 25°C	0.91 kg/m	ISO 12185			
Oxidation stability	after 164 hrs	ASTM D 2440	Specific heat		ASTM D 2766	Volume resistivity	at 25°C	1.5x10 <sup>13</sup> Ω cm
Sludge	0.12% per mass	IEC 61125	at 25°C	0.57 Cal/gm/°C				
Acid number	0.36 mg KOH/g		at 100°C	0.60 Cal/gm/°C				
PCB content	Non-detectable	ASTM D 4059 IEC 61619	Thermal conductivity		ASTM D 2717			
			at 25°C	0.17 W/m K				
			at 100°C	0.26 W/m K				

Note: The equivalent IEC/ISO test methods listed above are for reference purposes.

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BIOTEMP classed 4 to 5 times less hazardous than paraffin oil in respect to fire hazard. Flash point (closed cup) 243°C (470°F). Fire point 354°C (670°F). Ignition temperature 426°C (799°F).

BIOTEMP conforms to the ASTM Std D 6871 and to the IEEE Std C57.147™.