



Transformer solutions for a specialised world

FR3 FLUID-FILLED TRANSFORMERS

FR3™ fluid is a Fire Resistant Natural Ester dielectric coolant that has been specifically formulated for use in distribution and power transformers.

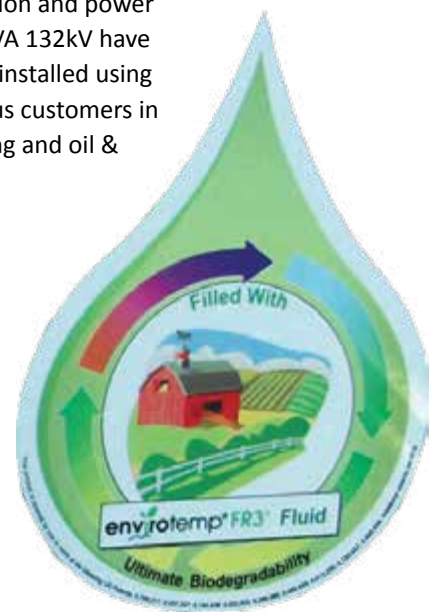
Incorporating unique characteristics such as high dielectric constant, high fire point, and environmental friendliness, FR3 fluid helps extend the life of transformers, reduce fire protection and substation costs, and minimise the carbon footprint.

FR3 fluid is a soy-based natural ester, biodegradable, non-toxic, and has exceptionally high fire point of 360°C and flash point of 330°C. It is approved by FM Global® and classified by Underwriters Laboratories® as a “Less-Flammable Dielectric Liquid”.

Wilson Transformer Company has the capability and experience in designing and manufacturing FR3 fluid-filled transformers, storage and processing facilities for FR3 fluid, and service capability including retro-filling existing transformers with

FR3 fluid. Many distribution and power transformers up to 50MVA 132kV have been manufactured and installed using FR3 since 2004 for various customers in the utility industry, mining and oil & gas sectors.

FM Global® has certified Wilson Transformer FR3 fluid-filled distribution and power transformers as compliant with the applicable requirements according to Approval class number 3990 - Approval Standard for Less or Non-flammable Liquid-Insulated Transformers.



ENHANCED TRANSFORMER PERFORMANCE AND INSULATION LIFE

Transformer life is mainly determined by cellulose insulation condition. The cellulose insulation ageing process is accelerated by temperature (heating), moisture concentration (in paper) and exposure to oxygen.

The recent IEEE Standard C57.154-2012 contains accelerated ageing results which demonstrate “notable reduction in the ageing rate of cellulose insulation material” in ester fluids. This is attributed to the triple effect of higher solubility limit, moisture depletion and trans-esterification in ester-filled transformers. The new standard recommends higher operating temperatures / higher overloads in transformers using high temperature insulation systems including ester fluids.

HEATING

FR3 fluid has distinctive thermal properties which makes it an effective coolant. Replacing the traditional mineral oil with FR3 fluid will help slow the thermal ageing rate of cellulose insulation by the phenomena of trans-esterification. Transformers designed using FR3 fluid can also be optimised for high ratings whilst maintaining the ageing rate defined by IEEE guides and standards.

Transformer Insulating Paper End-of-Life (Hours)[^]

End-of-life Basis	150°C			170°C		
	Mineral Oil	FR3 Fluid	IEEE Basis	Mineral Oil	FR3 Fluid	IEEE Basis
<i>Retained Tensile Strength</i>						
50%	3100	>4000*	1602	240	1300	323
25%	4000	>4000*	3327	490	4000	671
<i>Degree of Polymerization</i>						
200	3200	>4000*	3697	480	3400	746

[^] Paper did not reach end-of-life over the duration of the test. To be conservative, extrapolation was not employed.

MOISTURE

At 100% saturation FR3 fluid can absorb moisture up to 1100ppm while mineral oil is able to absorb only 70ppm. This means that FR3 can extract more moisture from the paper which also decreases the cellulose insulation ageing rate.

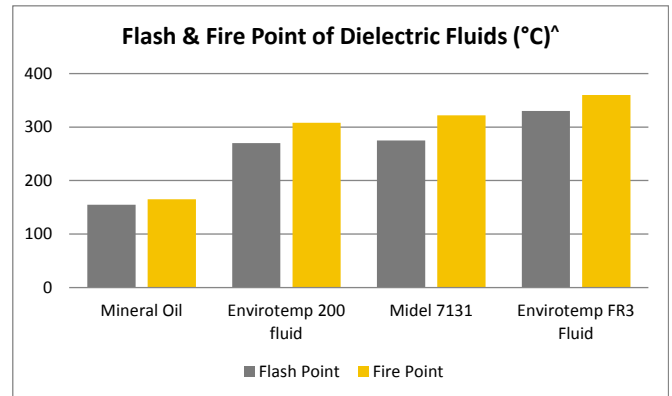
OXYGEN

FR3 fluid-filled transformers are designed to prevent contact between the fluid and air, apart from minimal oxygen generated from the ageing process. This design requirement overcomes the oxidation stability issue with FR3.

IMPROVED FIRE SAFETY

FR3 fluid has exceptionally high fire point of 360° and flash point of 330°. An FR3 fluid pool fire is not possible unless heated from an external source. Several independent agencies have verified the fire safety of FR3 fluid such as Factory Mutual Global, Underwriters Laboratories, Doble Engineering and the US EPA.

According to FM Global® *FM3990 Approval Standard for Less or Non-flammable Liquid-Insulated Transformers* when use in transformers containing up to 10,000 US gallons (37,854 litres) of FR3 fluid, the distance between transformers and buildings and other equipment may be up to 1/10th the distance required for mineral oil filled transformers without fire walls or deluge systems.



SUPERIOR ENVIRONMENTAL PROFILE

Verified by the US and California Environmental Protection Agencies, FR3 fluid is highly biodegradable and non-toxic. When compared with mineral oil, FR3 fluid produces less Greenhouse gases with overall environmental performance impact score only one-fourth of that for mineral oil.

For more information about FR3 fluid-filled transformers, please contact Wilson Transformer Company or visit www.wtc.com.au.

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