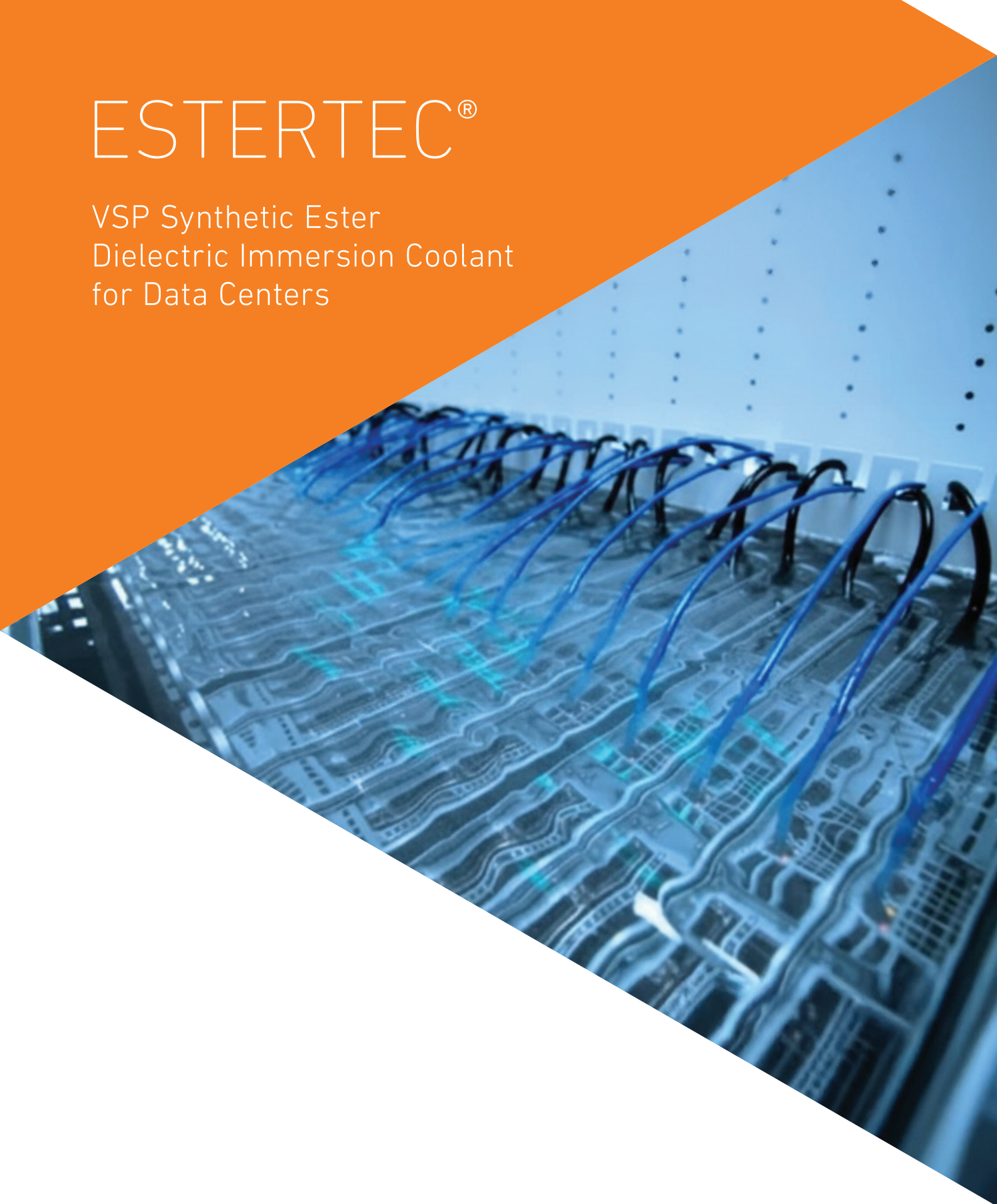


ESTERTEC®

VSP Synthetic Ester
Dielectric Immersion Coolant
for Data Centers

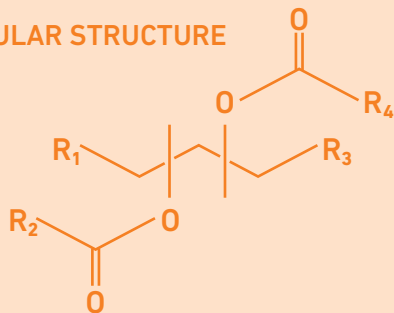


ZSCHIMMER & SCHWARZ

A NEW SYNTHETIC ESTER PRODUCT TECHNOLOGY IS NOW AVAILABLE FOR USE AS A DIELECTRIC IMMERSION COOLANT

EsterTec® VSP synthetic esters offer exceptional performance based on an innovative molecular design achieved via a unique production process. Utilizing standard raw materials that are globally accessible, these esters ensure high stability through vicinal ester molecular positioning. Steric hindrance enhances oxidative stability, while secondary alcohols on adjacent carbons significantly improve hydrolytic stability. Experience the next level of synthetic ester performance and reliability by formulating with EsterTec VSP esters for exceptional value, sustainability, and performance (VSP).

VSP MOLECULAR STRUCTURE



ESTERTEC VSP: BEST-IN-CLASS SYNTHETIC DIELECTRIC IMMERSION COOLANT OIL DESIGNED FOR OUTSTANDING PERFORMANCE, SAFETY, AND RELIABILITY

With a broad viscosity range and operating temperature window, EsterTec affords superior thermal heat transfer and ensures the stability and long life of high-performance dielectric fluids. This advanced base oil component is miscible with PAO and petroleum-based stocks, as well as compatible with standard elastomers and seals. EsterTec excels in heat transfer, features excellent dielectric properties, and exhibits high flash and fire points for enhanced safety in electrical insulating fluid applications. Environmentally friendly, with a high biogenic content, EsterTec is readily biodegradable and USDA BioPreferred, making it a top choice for those seeking efficiency and sustainability on their ESG scorecard.

BENEFIT FROM ALL THE PERFORMANCE ADVANTAGES OF A STANDARD DIESTER OR POLYOL ESTER, PLUS EXCEPTIONAL BENEFITS THAT SET THIS TECHNOLOGY APART:

- ▶ **Best-in-Class Stability:** Enjoy an unparalleled combination of oxidative, thermal, and hydrolytic stability, optimized for extended product life and consistent performance in applications that experience high temperatures or water ingress.
- ▶ **Optimal Heat Transfer and Dielectric Properties:** Achieve excellent thermal management and dielectric insulation, which can be leveraged in data center immersion cooling and EV cooling applications.
- ▶ **High Biogenic Content:** Choose an environmentally friendly option that has a higher biogenic content compared to many synthetic diester or polyol esters.
- ▶ **Cost-Effective:** Save more due to the lower-cost-per-unit volume. The molecular design leads to significantly lower density compared to standard esters.
- ▶ **Wide Temperature Operating Range:** Enjoy reliable operation from -60°C to 240°C, improving low temperature viscometrics and high-temperature stability.
- ▶ **Energy Efficiency:** Lower density fluids require less pumping energy for circulation.
- ▶ **Thermal Heat Transfer Capacity:** Synthetic esters typically have a higher thermal heat capacity than petroleum (mineral) oil, with typical values for synthetic esters ranging 10% to 20% higher. This higher heat capacity means synthetic esters can store more thermal energy for a given temperature increase, potentially leading to better cooling performance in applications like transformers and immersion coolants.
- ▶ **Environmentally Friendly:** This is a sustainable choice for next-generation dielectric immersion coolant fluids.

PERFORMANCE DATA

EsterTec
synthetic esters

EsterTec® VSP: State-of-the-art synthetic ester technology that expands your formulation toolbox.

ESTERTEC VSP PRODUCT RANGE

PRODUCT NAME	ESTERTEC 2N-1416	ESTERTEC 2LN-1418	ESTERTEC 2L-1425	ESTERTEC 2G-1432	ESTERTEC 7GX-1446	ESTERTEC 7GX-1468	ESTERTEC 7GX-14100	ESTERTEC 8LX-14150
KV100, cSt	3.6	4.1	5	7	9	11	14	18
KV40, cSt	16	18	25	32	46	68	100	150
Viscosity Index	115	125	140	180	165	155	140	130
Pour Point, °C	-60	-40	-25	-42	-40	-40	-35	-30
Density	0.895	0.893	0.890	0.890	0.900	0.915	0.925	0.935
Flash/Fire Point, °C	230/255	240/265	250/275	295/315	290/310	290/310	290/310	290/310
Biogenic Content, %	64	65	70	74	60	50	40	30
Specific Heat Capacity, J/g·°K	2.17	2.11	2.16	2.19	2.16	2.13	2.09	2.06
Thermal Conductivity, W/m·K	0.135	0.137	0.142	0.145	0.145	0.146	0.146	0.146
Dielectric Breakdown Voltage, 2mm, kV	>50	>50	>50	>50	>50	>50	>50	>50
Hydrolytic Stability	✓	✓	✓	✓	✓	✓	✓	✓
Oxidative Stability	✓	✓	✓	✓	✓	✓	✓	✓
Cost/Performance Advantage	✓	✓	✓	✓	✓	✓	✓	✓

EsterTec VSP enables direct-contact liquid cooling for electronics, delivering superior thermal efficiency and longer component life.



EsterTec fluids will meet the requirements of UL 2417 – Immersion Cooling Fluids for use with Information and Communication Technology Equipment.

EsterTec® VSP ensures reliable heat transfer with high dielectric stability, optimizing performance in demanding power and process systems.



SUPERIOR VALUE, SUSTAINABILITY, AND PERFORMANCE

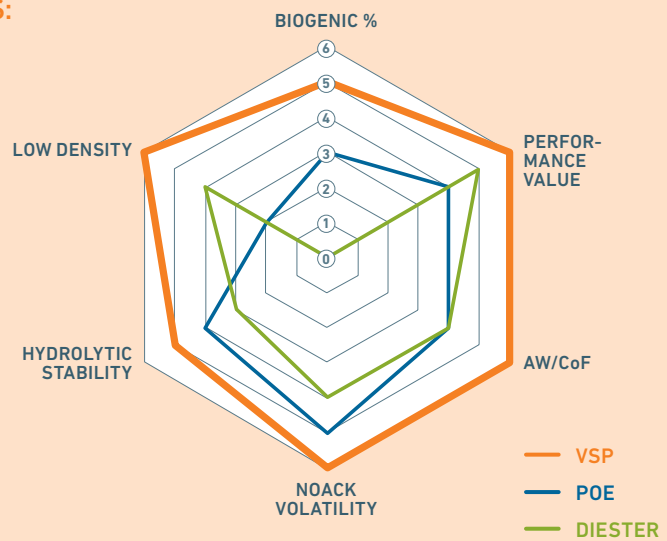
EsterTec VSP esters can be used to optimize premium synthetic coolant formulations for use in high-performance data center cooling applications. Technical and economic benefits include:

- ▶ **Oxidative Stability:** Resists degradation at high temperatures, minimizing deposit formulation; is noncorrosive to iron, steel, aluminum, or copper
- ▶ **Fire Resistance:** Has a combination of low heat combustion and high fire points that makes EsterTec the safe choice for data center immersion coolants; protects the data center from severe fire damage in the event of leaks, overheating, sparks, or electrical fires
- ▶ **Hydrolytic Stability:** Remains stable and effective even in the presence of moisture from condensation or contamination; achieves effective long-life performance in hot oil systems that absorb water from the atmosphere
- ▶ **Energy Efficiency:** Has low density that leads to decreased pumping energy requirements and reduced weight; helps conserve energy usage compared to standard esters
- ▶ **Cost-Effectiveness:** Affords favorable total cost of ownership due to fire resistance, which eliminates the need for a fire suppression system installation and maintenance
- ▶ **Eco-Friendliness:** Has high biogenic content, is readily biodegradable, and has low aquatic toxicity, making EsterTec VSP esters the preferred choice for sustainable formulations

ESTERTEC® DELIVERS PERFORMANCE THAT IS EQUAL TO OR BETTER THAN STANDARD POLYOL ESTERS IN THE FOLLOWING AREAS:

- Pour Point
- Flash Point
- Foam Tendency
- Demulsibility
- Copper Corrosion
- Oxidative Stability
- Thermal Stability
- Specific Heat
- Thermal Conductivity
- Odor
- Color
- Clarity
- Miscibility with PAO
- Compatibility with Elastomers

ESTERTEC® COMPARISON RADAR CHART



EsterTec VSP: Cutting-Edge Synthetic Ester Fire Resistant Immersion Cooling Fluid Technology

EsterTec VSP esters are the latest advancement in synthetic ester molecular design, meticulously created to deliver versatile and reliable functionality. Through its innovative molecular structure and production process, this synthetic coolant component offers:

Superior Stability: The exceptional resistance to oxidation, thermal breakdown, and hydrolysis affords an extended service life.

Exceptional Safety Characteristics: The unique molecular design leads to fire resistance, excellent heat transfer and strong dielectric insulating properties that protect assets and personnel.

Broad Operating Temperature Range: Coolants formulated with VSP esters for cold temperature start-up exhibit low dynamic viscosity and an excellent pour point, ensuring reliable performance in extreme conditions. For high-temperature conditions, VSP esters offer low volatility and a high flash point, enhancing product durability and safety. The excellent viscometric properties of EsterTec VSP contribute to improved energy efficiency, making them the ideal solution for demanding transformer oil and data center dielectric coolant applications.

INVENTED, OPTIMIZED, AND MANUFACTURED IN THE USA





ZSCHIMMER & SCHWARZ

Chemistry tailor-made

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For further information,
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