

Zschimmer & Schwarz

**Innovating
Collaborating
Introducing:**

EsterTec
synthetic esters



ZSCHIMMER & SCHWARZ



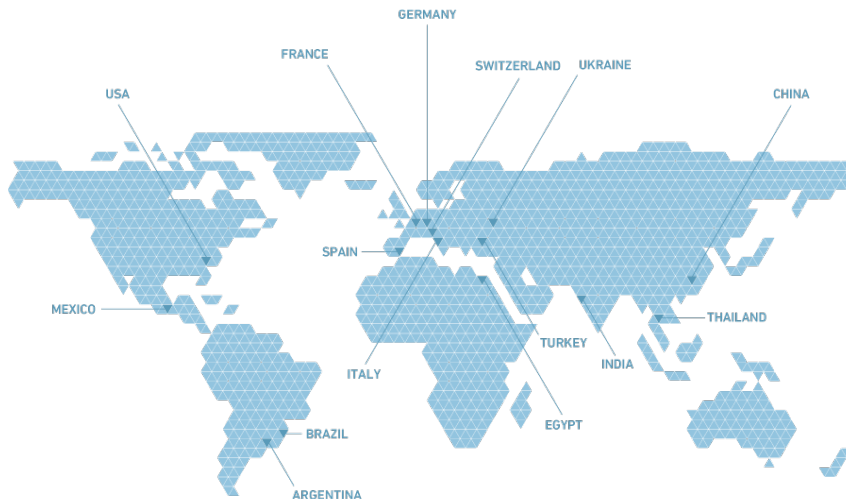
Zschimmer & Schwarz – Company Profile

Key figures 2023

Turnover €M ~700

Number of employees 1,558

27 subsidiaries
in 16 countries
on 5 continents



- ▼ Lubricant Components
- ▼ Industrial Specialities
- ▼ Fibre/Textile Auxiliaries
- ▼ Personal Care
- ▼ Ceramic Auxiliaries
- ▼ Leather Auxiliaries
- ▼ Cleaning Specialities



1894

Foundation of the company in Chemnitz, Germany

First in-house production

1909



1959 - 2019

New company headquarters in Oberlahnstein,
Rapid growth and globalisation



Construction of new company headquarters

2019



2024

130th anniversary



Z&S Lubricant Components

Offering the world's most extensive line of synthetic ester base stocks for industrial, marine, transport and dielectric applications

Explore our broad portfolio of high-performance lubricant base stocks and metalworking additives, or request a tailor-made product that meets your specific formulation needs



Zschimmer & Schwarz

VALUE PROPOSITION

Market Trends Favor Synthetic Lubricant Components

Higher Performance and Longer Life for Overall Lower Cost

- ▶ Improved Performance Value
- ▶ Wider temperature range performance
- ▶ Improved control of friction and wear
- ▶ Energy efficiency advantages
- ▶ Environmentally friendly with ESG and carbon footprint advantages whenever possible



Market Trends Favor Synthetic Lubricant Components

Higher Performance and Longer Life for Overall Lower Cost

- ▶ Group III- Hydrocracked Petroleum
- ▶ GTL- Gas-to-Liquid Hydrocarbons
- ▶ PAO- Polyalphaolefins
- ▶ PAG- Polyalkylglycols
- ▶ POE- Polyol Esters
- ▶ AN- Alkylated Naphthalenes



Z&S introduces a new and improved POE for your formulation toolbox



All the Performance Advantages expected from a Polyol Ester, Plus....

- ▶ Natural energy efficiency advantages from low density, high VI and superior lubricity
- ▶ High biogenic content compared to many synthetic polyol esters
- ▶ Excellent heat transfer and dielectric fluid properties
- ▶ Lower cost per unit volume due to 5% lower density
- ▶ Best in class hydrolytic stability

EsterTec
synthetic esters

zslubes.com/estertec



Product Name	ESTERTEC 2N-1416	ESTERTEC 2LN-1418	ESTERTEC 2G-1432	ESTERTEC 7GX-1446	ESTERTEC 7GX-1468	ESTERTEC 8LX-14100	ESTERTEC 8LX-14150
KV100, cSt	3.6	4.1	6.8	9	11	14	18
KV40, cSt	16	18	32	46	68	100	150
Viscosity Index	115	125	180	165	155	140	130
Pour Point, °C	-60	-40	-42	-40	-40	-35	-30
Density	0.895	0.893	0.890	0.900	0.915	0.925	0.935
NOACK volatility, %	9	7	1	1	1	1	1
Biogenic Content, %	64	65	74	60	50	40	30
Oxidative Stability	☑	☑	☑	☑	☑	☑	☑
Hydrolytic Stability	☑	☑	☑	☑	☑	☑	☑
Friction/Wear Reduction	☑	☑	☑	☑	☑	☑	☑
Energy Efficiency Advantage	☑	☑	☑	☑	☑	☑	☑
Cost/Performance Advantage	☑	☑	☑	☑	☑	☑	☑



Fields of application for

EsterTec
synthetic esters

- ▶ Metalworking fluids
- ▶ Hydraulic fluids
- ▶ Grease
- ▶ Compressor fluids
- ▶ Transformer oils
- ▶ EALs for environmentally sensitive applications
- ▶ Bearing lubricants
- ▶ Engine oils
- ▶ Transmission fluids
- ▶ Gear oils
- ▶ Drilling mud lubricants
- ▶ Food processing H1 lubricants
- ▶ Multifunctional Dielectric/Coolant/Lubricants

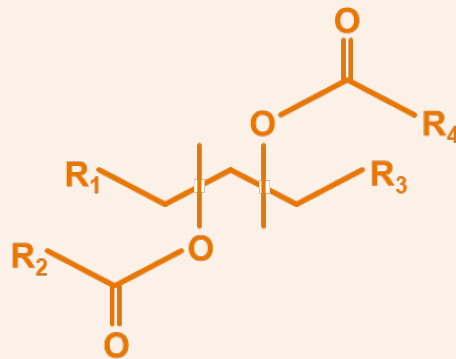


A New Ester Technology is Now Available

EsterTec “VSP” Esters with Improved Performance

- ▶ Novel structure, unique production process
- ▶ Standard raw materials that are globally and readily available commodities
- ▶ High stability vicinal ester molecular positioning
- ▶ Steric hindrance improves oxidative stability
- ▶ Secondary alcohols on adjacent carbons improve hydrolytic stability

EsterTec
synthetic esters

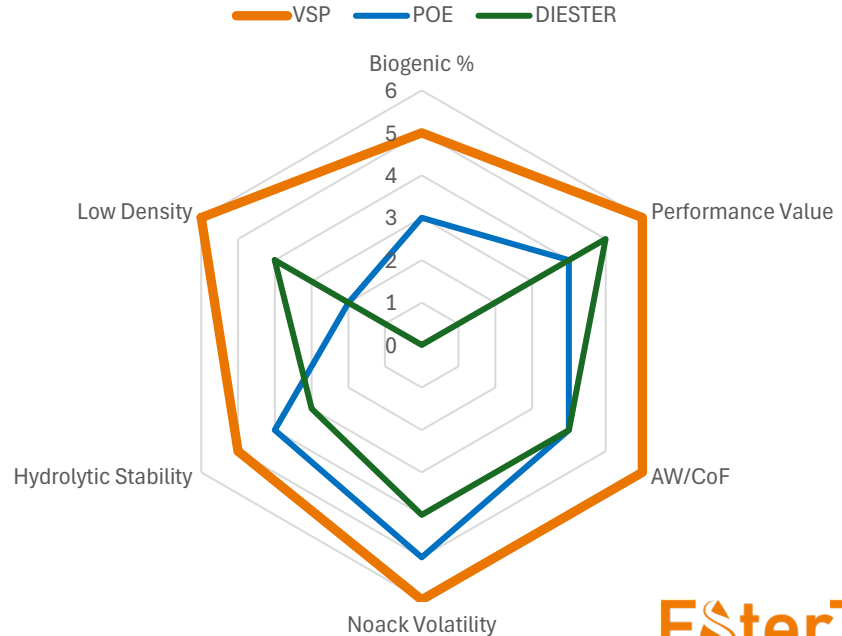


Vicinal Secondary Polyol (VSP) Ester

All the Performance Advantages expected from a standard Diester or Polyol Ester, **Plus....**

Equal or Better Performance Features:

- 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
synthetic esters

EsterTec “VSP” Esters Value Proposition

► Reduced Friction and Wear

- Simplify formulations with reduced additive content (metalworking, automotive, industrial)
- EV lubricant/coolants need better EP/AW (EVs are heavier, higher and lower speed torque, new bearing designs)

► Excellent Hydrolytic Stability

- Metalworking emulsions
- ICE engine oils, H2ICE engine oils,
- HFO refrigeration compressor oils
- Paper machine oils

► Low Density

- Reduced weight in mobile systems (EV immersion coolants, UTHF, Mobile equipment HF)
- Freight cost savings on base oil and formulated product shipments

► Low Volatility

- Improved low viscosity lubricant performance (0W engine oils, high speed EV motors)
- Extended fluid life in high temperature applications (bearing grease, mist lubes, engine oils)



EsterTec AT Lab Testing Capabilities – Ready to Support your Formulation Development Program

- ▶ High and low temperature viscosity, pour point.
- ▶ Flash and fire point
- ▶ Foam tendency, Air release, Demulsibility
- ▶ Oxidative stability with DSC, RPVOT
- ▶ Deposit formation with Pan test and Panel Coker test
- ▶ Volatility by TGA (NOACK) and VOC methods
- ▶ Hydrolytic stability
- ▶ Copper corrosion
- ▶ Friction, Wear and Extreme Pressure measurements
- ▶ Material compatibility, seal swell testing, paint/coatings/elastomers
- ▶ Hot/Cold stability and compatibility
- ▶ Dielectric properties
- ▶ Thermal Conductivity



Zschimmer & Schwarz

PERFORMANCE DATA DETAILS

EsterTec 2N-1416

Performance Data

Ester Class		VSP	Diester				Polyol Ester		Glyceryl Ester
	Test Method	EsterTec 2N-1416	DIDA	DINA	DIOA	DOA	TMP C7/8/10	TMP-C7	C8/10
KV100, cSt	ASTM D7042	3.6	3.6	3.1	2.7	2.3	4.0	3.4	4.0
KV40, cSt	ASTM D7042	16	14	11	9	8	18	14	15
Pour Point, °C	ASTM D5950	-60	-60	-60	-60	-50	-65	-65	-15

Density	ASTM D4052	0.896	0.920	0.923	0.930	0.925	0.950	0.963	0.950
EsterTec Density Advantage	Δ	---	2.6%	2.9%	3.7%	3.1%	5.7%	7.0%	5.7%

4-Ball Wear, mm*	ASTM D4172	0.52	0.84	0.79	0.89	1.00	0.74	0.65	0.69
Wear Protection Improvement**	Δ	---	78%	75%	80%	84%	71%	59%	65%

Coefficient of Friction*	ASTM D4172	0.167	0.208	0.221	0.247	0.223	0.183	0.217	0.196
CoF Decrease, %	Δ	---	25%	32%	48%	34%	10%	30%	17%

Noack Volatility, %	ASTM D6375	9%	15%	19%	26%	32%	5%	10%	8%
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*40kg load, 1200 rpm, 75C, 52100 steel, 1 hour

**Considering the Hertzian contact diameter of 0.43mm



How does Density impact Product Cost?

Product	Specific Gravity	Density, lb/gal	Density Difference	*Price, \$/lb	*Price, \$/gallon	\$/Gal % Difference
EsterTec VSP	0.890	7.43		2.50	18.58	
Standard Ester Example A	0.941	7.85	5.7%	2.50	19.62	+6%
Standard Ester Example B	0.941	7.85	5.7%	3.00	23.55	+27%
Standard Ester Example C	0.960	8.01	7.9%	3.50	28.04	+51%

Z&S sells VSP Esters to Formulators by weight. (lbs/kg)
Formulators sell lubricants to Users by volume. (gallons/liters)
Equipment operators fill machines by volume.



EsterTec 2N-1418

Performance Data

Ester Class	VSP	Diester	Polyol Ester				Glyceryl
	EsterTec 2LN-1418	DIDA	TMP-C9	TMP C8/10	NGDC	TMP C7/8/10	C8/10
KV100, cSt	4.1	3.6	4.6	4.4	4.0	4.0	4.0
KV40, cSt	18	14	21	20	18	18	15
Pour Point, °C	-40	-60	-50	-40	0	-65	-15

Density	0.893	0.92	0.94	0.94	0.90	0.95	0.95
Density Advantage	---	2.9%	5.0%	5.0%	0.8%	6.0%	6.0%

4-Ball Wear, mm*	0.50	0.84	0.77	0.65	0.72	0.74	0.69
Wear Protection Improvement**	---	83%	79%	68%	76%	77%	73%

Coefficient of Friction*	0.175	0.208	0.215	0.173	0.191	0.183	0.196
CoF Decrease, %	8%	15%	3%	6%	12%	5%	8%

Noack Volatility, %	7%	15%	3%	6%	12%	5%	8%
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*40kg load, 1200 rpm, 75C, 52100 steel, 1 hour

**Considering the Hertzian contact diameter of 0.43mm



EsterTec 2G-1432

Performance Data

Ester Class	VSP	Diester	Polyol Ester				
	EsterTec 2G-1432	DTDA/1	TMP-TO	PE 4810	NGDO	PE C7/9	TMP C8/10
KV100, cSt	7.0	5.4	9.4	6.1	5.8	5.0	4.4
KV40, cSt	32	27	46	32	24	25	20
Pour Point, °C	-42	-60	-40	-5	-30	-55	-40

Density	0.890	0.915	0.917	0.96	0.903	0.985	0.94
EsterTec Density Advantage	---	2.7%	2.9%	7.3%	1.4%	9.6%	5.3%

4-Ball Wear, mm*	0.63	0.75	0.77	0.58	0.72	0.81	0.65
Wear Protection Improvement**	---	38%	41%	-33%	31%	47%	9%

Coefficient of Friction*	0.182	0.210	0.246	0.168	0.201	0.204	0.173
CoF Decrease, %	---	15%	35%	-8%	10%	12%	-5%

Noack Volatility, %	1%	7%	1%	1%	5%	5%	4%
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*40kg load, 1200 rpm, 75C, 52100 steel, 1 hour

**Considering the Hertzian contact diameter of 0.43mm



EsterTec 7GX-1446

Performance Data

Ester Class	VSP	Polyol Ester			Aromatic
	EsterTec 7GX-1446	TMP+C18	PE + C5/9	PE+2EH	Trimellitate
KV100, cSt	9	9	7	6	8
KV40, cSt	46	46	46	46	50
Pour Point, °C	-40	-40	-40	-15	-50

Density	0.900	0.915	0.970	0.980	0.970
EsterTec Density Advantage	---	1.6%	7.2%	8.2%	7.2%

4-Ball Wear, mm*	0.61	0.77	0.89	0.95	0.99
Wear Protection Improvement**	---	47%	61%	65%	68%

Coefficient of Friction*	0.178	0.218	0.227	0.235	0.257
CoF Decrease, %	---	22%	28%	32%	44%

Noack Volatility, %	1.5%	3%	3%	6%	4%
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*40kg load, 1200 rpm, 75C, 52100 steel, 1 hour

**Considering the Hertzian contact diameter of 0.43mm



EsterTec 7GX-1468

Performance Data

Ester Class	VSP	Polyol Ester			
	EsterTec 7GX-1468	PE+C18	DPE + C5/10	PE+C5/9	Complex
KV100, cSt	11	12	10	8.6	11
KV40, cSt	68	67	68	68	68
Pour Point, °C	-40	-20	-40	-30	-15

Density	0.915	0.926	0.990	0.960	0.98
EsterTec Density Advantage	---	1%	8.2%	4.9%	7.1%

4-Ball Wear, mm*	0.73	0.69	0.82	0.95	0.89
Wear Protection Improvement**	---	-20%	38%	29%	35%

Coefficient of Friction*	0.178	0.184	0.212	0.207	0.243
CoF Decrease, %	---	39%	42%	33%	36%

Noack Volatility, %	<1%	<1%	2%	4%	1%
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*40kg load, 1200 rpm, 75C, 52100 steel, 1 hour

**Considering the Hertzian contact diameter of 0.43mm



EsterTec 8LX-14100

Performance Data

Ester Class	VSP	Polyol Ester		
	EsterTec 8LX-14100	DPE+C18	DPE + C5/9	Complex
KV100, cSt	14	18	12	14
KV40, cSt	100	110	100	100
Pour Point, °C	-35	-25	-35	-30
Density	0.925	0.930	0.990	0.950
EsterTec Density Advantage	---	0.5%	6.6%	2.6%
4-Ball Wear, mm*	0.78	0.85	0.82	0.87
Wear Protection Improvement**	---	17%	10%	20%
Coefficient of Friction*	0.198	0.205	0.222	0.220
CoF Decrease, %	---	4%	12%	11%
Noack Volatility, %	1%	1%	1%	1%

*40kg load, 1200 rpm, 75C, 52100 steel, 1 hour

**Considering the Hertzian contact diameter of 0.43mm



EsterTec 8LX-14150

Performance Data

Ester Class	VSP	Polyol Ester		
	EsterTec 8LX-14150	DPE+C5/9	DPE + C5/12	Complex
KV100, cSt	18	18	19	20
KV40, cSt	150	160	170	150
Pour Point, °C	-30	-30	-25	-30

Density	0.935	0.980	0.970	0.962
EsterTec Density Advantage	---	4.8%	3.7%	2.9%

4-Ball Wear, mm*	0.80	0.90	0.88	0.85
Wear Protection Improvement**	---	27%	22%	12%

Coefficient of Friction*	0.180	0.246	0.232	0.200
CoF Decrease, %	---	37%	29%	11%

Noack Volatility, %	<1%	<1%	<1%	<1%
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*40kg load, 1200 rpm, 75C, 52100 steel, 1 hour

**Considering the Hertzian contact diameter of 0.43mm



Hydrolytic Stability, ISO 15 – 150 Viscosity Grades

EsterTec demonstrates excellent hydrolytic stability

- All esters compared with no inhibitor or passivation additives

ASTM D2619	EsterTec 2N-1416	EsterTec 2G-1432	EsterTec 8LX-14150	NGDO	DIOA	DTDA/1	PE C7/9	TMP C8/10	Pass/Fail*
Oil Tan Δ, mg KOH/g	0.03	0.01	0.10	2.90	0.16	0.05	0.10	0.05	<0.2
Water Layer Acidity, mg KOH	1.00	0.80	0.30	18.0	3.47	3.75	1.65	1.26	<5.0
Copper Corrosion Rating, ASTM D130	1b	1b	1b	2	1b	1b	1b	1b	<2

Rating Scale:
0-2 = HIGH
2-5 = MED
>5 = LOW



*Typical limits for a formulated lubricant





Questions?

Discover More at: www.estertec.com



ZSCHIMMER & SCHWARZ