Zschimmer & Schwarz

# Innovating
# Collaborating
# Introducing:

EsterTec
synthetic esters

ZSCHIMMER & SCHWARZ

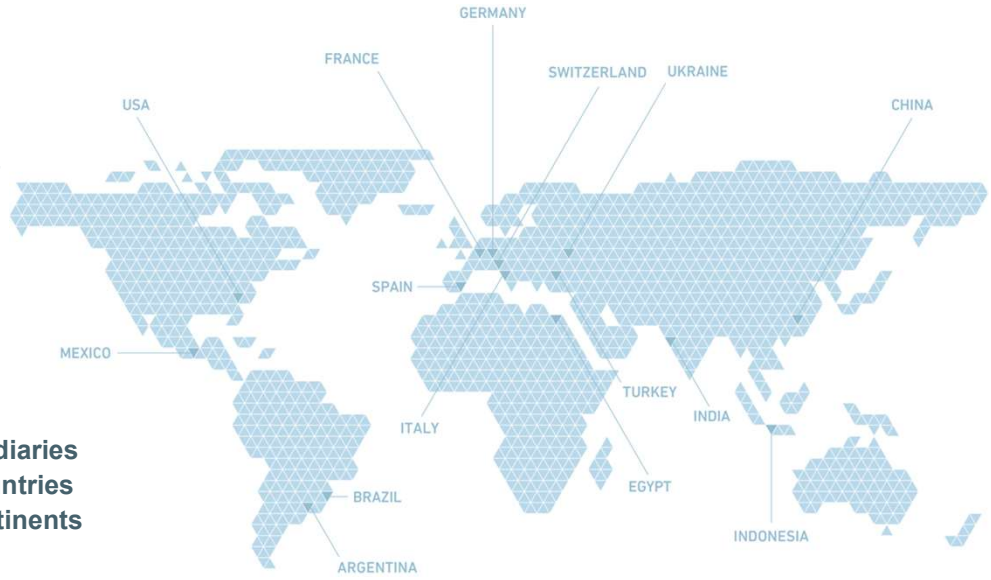
# Business divisions

- Lubricants
- Personal Care
- Industrial Specialities
- Fiber and Textile Auxiliaries
- Leather Auxiliaries
- Ceramic Auxiliaries
- Cleaning Specialities
- Paints & Coatings

# Zschimmer & Schwarz – Company Profile

## Key figures 2023

| | |
|---|---|
| Turnover | €M 834 |
| Number of employees | 1,568 |




**28 subsidiaries in 16 countries on 5 continents**

- Lubricants
- Industrial Specialties
- Fibre Auxiliaries
- Textile Auxiliaries
- Personal Care
- Ceramic Auxiliaries
- Paints & Coatings
- Leather Auxiliaries
- Cleaning Specialties

**1894**

Foundation of the company in Chemnitz, Germany

**1909**

First in-house production

**1959 - 2019**

New company headquarters in Oberlahnstein,

Rapid growth and globalisation

**2019**

125th anniversary and construction of new company headquarters

**2020**

Restructuring of business divisions

# 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

Lubricants

# 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

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

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

EsterTec
synthetic esters

zslubes.com/estertec

EsterTec
synthetic esters

| Product Name | ESTERTEC 2N-1416 | ESTERTEC 2LN-1418 | ESTERTEC 2G-1432 |
|---|---|---|---|
| | | | |
| KV100, cSt | 3.6 | 4.1 | 7 |
| KV40, cSt | 16 | 18 | 33 |
| Viscosity Index | 115 | 125 | 180 |
| Pour Point, °C | -60 | -40 | -42 |
| Density | 0.895 | 0.893 | 0.890 |
| NOACK volatility, % | 9 | 7 | 1 |
| Biogenic Content, % | 64 | 65 | 74 |
| Oxidative Stability | ☑ | ☑ | ☑ |
| Hydrolytic Stability | ☑ | ☑ | ☑ |
| Friction/Wear Reduction | ☑ | ☑ | ☑ |
| Energy Efficiency Advantage | ☑ | ☑ | ☑ |
| Cost/Performance Advantage | ☑ | ☑ | ☑ |

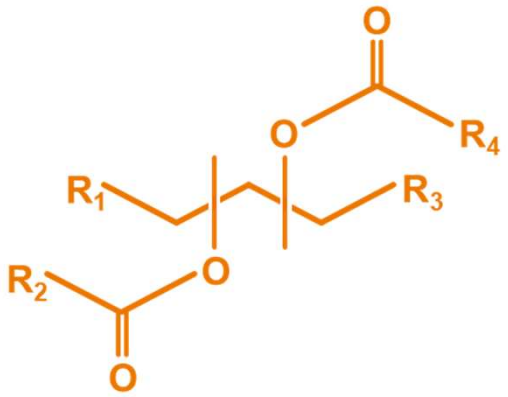
# Fields of application for EsterTec synthetic esters

- 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 Synthetic Ester Product 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




**Vicinal Secondary Polyol Ester**

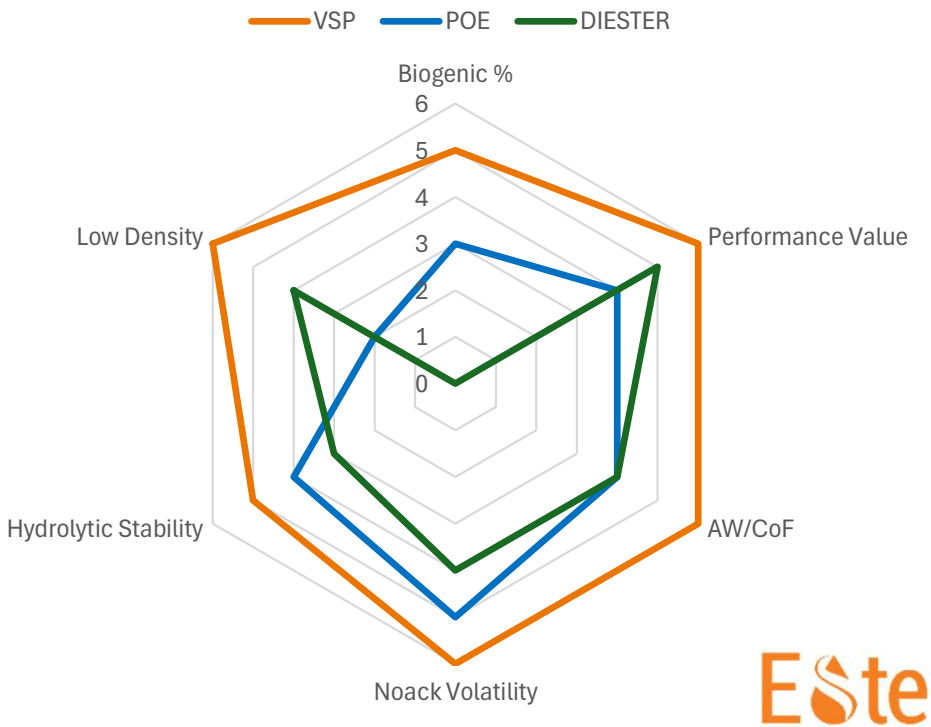
EsterTec
synthetic esters

zslubes.com/estertec

# 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


zslubes.com/estertec

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 | 0.92 | 0.923 | 0.93 | 0.925 | 0.95 | 0.963 | 0.95 |
| 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% |

*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 | *Selling Price, $/lb | Price, $/gallon | $/Gal % Difference |
|---|---|---|---|---|---|---|
| EsterTec 2N-1416 | 0.896 | 7.48 | | 2.00 | 14.96 | |
| Ester Example A | 0.941 | 7.85 | 5.0% | 2.00 | 15.70 | +5% |
| Ester Example B | 0.941 | 7.85 | 5.0% | 2.50 | 19.63 | +31% |
| | | | | | | |
| EsterTec 2G-1432 | 0.890 | 7.43 | | 2.00 | 14.86 | |
| Ester Example A | 0.941 | 7.85 | 5.7% | 2.00 | 15.70 | +6% |
| Ester Example B | 0.941 | 7.85 | 5.7% | 2.50 | 19.63 | +32% |
| | | | | | | |

Formulators sell lubricants to Users by volume. (Gallons/Liters)
Z&S sells VSP Esters to Formulators by weight. (lbs/kg)

*General indication of relative selling prices based on contracted volumes greater than 250MT/year

# How does Density impact Energy Efficiency?

| Product | Specific Gravity | Density, lb/gal | Density Difference | # of lbs in a 55 Gallon Drum | Delta, % | Delta, lbs |
|---|---|---|---|---|---|---|
| EsterTec 2N-1416 | 0.896 | 7.48 | | 411 | 0.0% | 0 |
| DIDA | 0.920 | 7.68 | 2.7% | 422 | 2.7% | 11 |
| Glyceryl C8/10 | 0.949 | 7.92 | 5.9% | 436 | 5.9% | 24 |
| TMP C7 | 0.963 | 8.04 | 7.5% | 442 | 7.5% | 31 |

- Formulators buy drums and totes. EsterTec drums are lighter.
- EsterTec lube systems/sumps are lighter.
- Lower cost to ship.
- Lower energy requirement to pump, circulate, filter.

# 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 |
| Noack Volatility, % | 8% | 15% | 3% | 6% | 12% | 5% | 8% |
| Noack Volatility, % | 8% | 15% | 3% | 6% | 12% | 5% | 8% |

*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 | 33 | 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% |

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

**Considering the Hertzian contact diameter of 0.43mm

# Hydrolytic Stability

- EsterTec demonstrates excellent hydrolytic stability
  - All esters compared with no inhibitor or passivation additives

| ASTM D2619 | EsterTec 2N-1416 | EsterTec 2LN-1418 | EsterTec 2G-1432 | NGDO | DIOA | DTDA/1 | PE C7/9 | TMP C8/10 | Pass/ Fail |
|---|---|---|---|---|---|---|---|---|---|
| Oil Tan Δ, mg KOH/g | 0.03 | 0.02 | 0.01 | 2.90 | 0.16 | 0.05 | 0.10 | 0.05 | <0.2 |
| Water Layer Acidity, mg KOH | 1.00 | 1.00 | 0.80 | 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**


Formulated lubricant typical limits

Lubricants

# COLLABORATION

# Z&S Collaboration with You

- Sampling and Application Lab Testing under CDA
  - Concurrent testing in customer and Z&S labs will accelerate performance assessment
- TSCA / ECHA Test Market Exemption Documentation
  - EPA and ECHA EcoTox testing has been initiated
  - Products can be sampled/used/sold under R&D exemptions
  - Products are Readily Biodegradable and have “clean” Ames test CMR status
- Field Testing
  - Priority access to EsterTec products
  - Commercial production batches have been manufactured and are available
  - Collaboration on formulation design


ZSCHIMMER & SCHWARZ