Additin® RC 3502
New Organic Friction Modifier Additive

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LANXESS is committed to the long term growth of the global lubricants industry

Objective: To help lubricant formulators extend oil life, protect equipment, conserve energy and resources and grow in their markets

Approach: To be the leading integrated†, full value chain collaborator for industrial applications and a trusted, specialized component provider for automotive applications

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1. Backward integrated into sulfur-, phosphate-, thiophosphate-, diphenyl amine- and sulfonate- chemistries
Automotive Additives – Future Trends and Drivers

- Energy efficiency remains a key driver in Automotive
- E-mobility is changing the nature of the industry and lubricant demand
- Automotive lubricants and Automotive additives will continue to play an important role in the near future

- **Metal, Sulfur and Phosphorus free additives** provide the freedom to formulate new lubricants without impacting limits
- **Durable additives** support longer efficiency and lubricant life
- **Highly compatible and synergistic additives** enable formulation flexibility and optimization

*source: Kline Global Lubricant Additives: Market Analysis and Opportunities 2017*
New Additive Development and Focus – reducing friction and improving efficiency

- Our aim is to focus Additive innovation around **key needs and unique technology** to deliver effective simple solutions..

- **Additive technology can help to reduce friction** to improve fuel economy

- **Friction modifiers**, although a relatively small percentage of the market, are predicted to grow ~6%pa over the next 5 years*

- A number of organic friction modifier solutions exist today, but are not optimized for performance, durability and compatibility

- With this in mind our goal was to develop a **new organic friction modifier technology with multi-functionality** for the development of next generation lubricants
Introducing… ADDITIN® RC 3502

Organic Friction Modifier Additive

- New patented organic technology
- ZERO Metals, Sulfated Ash, Phosphorus or Sulfur
- Clear, non corrosive liquid additive
- Fully compatible with Group I-V based engine oils

- **Greater friction reduction** than glycerol monooleate (GMO), or other amide/amine and ester based chemistries
- **Sustained performance durability** compared to GMO and MoDTC friction modifiers
- **Excellent compatibility and synergy** benefits with other additives, including Magnesium sulfonate detergents
1% addition of Additin® RC 3502 to a range of motor oil viscosities without a friction modifier

% reduction in CoF calculated compared to the oil without a friction modifier

Even at lower temperatures (80°C) Additin® RC 3502 shows greater than 20% reduction in CoF
Excellent durability performance over time

Extended Durability of RC 3502 (1%) in SAE 5W-20 (135 °C)

Extended Durability of RC3502 (1%) in SAE 5W-30 (160C)

Plint TE-77 pin-on-plate line contact 100 N Load
Strong compatibility with MoDTC Friction Modifiers

LXS 0W-20 & RC 3502 + Commercial MoDTC - Durability 160°C

Coefficient of Friction (CoF)

(1%) RC 3502  (1%) MoDTC

(1%) RC 3502 + MoDTC (1:1)

Hours from start of heating

Synergy

Plint TE-77 pin-on-plate line contact 100 N Load
Excellent solubility in mineral and synthetic motor oils

- 2% in SAE 5W-30 (-20°C) remains clear after 6 weeks
- Enhanced solubility acts as a co-solvent to increase additive treat flexibility
- Additin® RC 3502 neat, can be stored for 5 years if kept cool, dry, heat and moisture free

- > 0.5% in SAE 5W-30 insoluble additive gel globule after 8 hrs mixing both room temp and -20°C
- 1.0% in SAE 5W-30 insoluble when stored at -20°C for 24 hrs: Additive suspension-haze formed
Additional Antiwear Benefit

ASTM 4172 Four Ball Wear Scar Optical Profilometry Analysis

SAE 5W30 no AW
D4172 AWS = 895 microns

SAE 5W30 0.06% (P) ZDDP
ASTM D4172 AWS = 505 microns

SAE 5W30 0.06% (P) ZDDP +1% RC 3502
ASTM D4172 AWS = 414 microns

lowest scar 0.414 (mm) and lowest shallow volume
Friction reduction benefit in Automotive Gear Oil

Automotive Gear Oil 75W-140 plus Additin® RC 3502
- Friction reduction impact benefit observed
- Stronger performance benefit observed on continued Striebeck testing after 2.5 hours
Key attributes of Additin® RC 3502

- Demonstrates up to 5% Fuel Economy improvement* and retention in Industry Sequence VI E test (ASTM D8114-17)
- Provides a synergistic boost in antiwear performance with ZDDP
- Excellent resistance to deposit formation at high temperatures (TEOST 33C test)
- Excellent low Cu, Sn, and Pb corrosion resistance (ASTM D6594)
- Full no harm tested - Corrosion, oxidation, thermal & material compatibility

*fuel economy benefit calculated from sequence VIE engine test FEI sum over SAE 20W-30 baseline
Additin® RC 3502 - Freedom to formulate...

- Zero metals, Sulfated Ash, Phosphorus and Sulfur
- Clear light amber liquid, compatible in a range of Group I-V formulations
- Excellent additive compatibility
- Full no harm testing: excellent low Cu, Sn, and Pb corrosion resistance
Customers in the USA are kindly requested to refer to:
LANXESS Solutions US Inc.
Business Unit Additives
2 Armstrong Road
Shelton CT 06484
USA

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