CESTOIL CHEMICAL INC

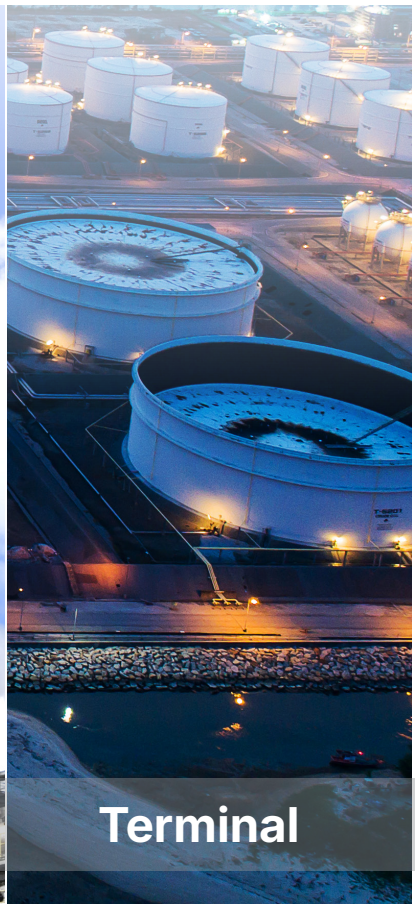
Expanding Possibilities

Fuel Additives > Lubricity Improver

Northshore® Diesel Lubricity Improver Portfolio

For ULSD / EN590 / ASTM D975 | EI 1535 qualified options available

Metal-free | Phosphorus-free | Storage-stable | Package-compatible



COLI9500 | COLI9500E | COLI9500ES | COLI9500H | COLI9510

Northshore® Diesel Lubricity Improver Portfolio

Cestoil offers a comprehensive portfolio of diesel lubricity improvers designed to restore and stabilize boundary lubrication performance in ultra-low sulfur diesel (ULSD) fuels across a wide range of base stocks, operating conditions, and regulatory environments.

The Northshore® lubricity portfolio provides refiners, terminal operators, pipeline systems, and fuel distributors with multiple technology pathways — fatty-acid based, ester-based, and hybrid systems — allowing optimal balancing of lubricity performance, low-temperature handling, regulatory compliance, and cost efficiency.

Product Portfolio at a Glance

Product Name	Product Identity
COLI9500	Premium soybean oil fatty acid–based lubricity improver, EI 1535 qualified
COLI9500E	Economical variant of COLI9500 with comparable lubricity efficiency and slightly higher cold-flow limits, EI 1535 qualified
COLI9500ES	Ester-based lubricity improver designed for enhanced compatibility and stability, EI 1535 qualified
COLI9500H	Advanced acid–ester hybrid lubricity improver delivering significantly higher lubricity efficiency at reduced treat rates
COLI9510	Traditional tall oil fatty acid (TOFA)–based lubricity improver for established market preferences

Application-Oriented Selection Philosophy

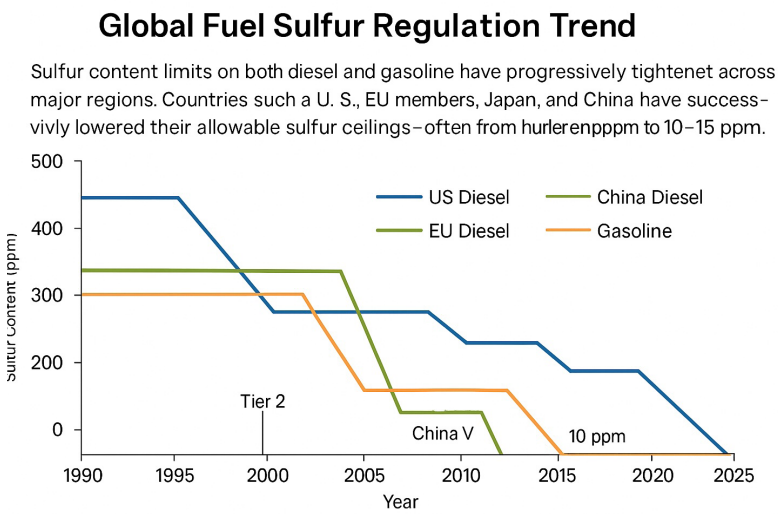
Rather than a one-size-fits-all approach, the Northshore® portfolio enables customers to select the most appropriate product based on:

- Required lubricity target (HFRR performance)
- Low-temperature storage and handling conditions
- Pipeline and multi-product system requirements
- Additive package compatibility
- Commercial optimization objectives

Cestoil's technical team supports product selection and treat-rate optimization based on fuel-specific testing and field experience.

Executive Summary: Why Lubricity Improvers Matter

Restoring Lubricity in Modern ULSD Fuels



Global sulfur reduction regulations have significantly altered the chemical composition of diesel fuels. Deep hydrotreating processes remove not only sulfur compounds but also naturally occurring polar species that contribute to boundary lubrication in fuel injection systems.

As a result, modern ULSD fuels frequently exhibit insufficient lubricity, increasing the risk of wear in high-pressure fuel pumps, injectors, and common-rail systems unless treated with effective lubricity improvers.

Northshore® Lubricity Solutions

The Northshore® diesel lubricity improver portfolio is engineered to restore boundary lubrication by forming durable, polar adsorption films on metal surfaces. These films reduce metal-to-metal contact under high load and low-speed conditions typically encountered in fuel injection equipment.

Across the product range, Northshore® lubricity improvers are designed to:

- Achieve reliable HFRR performance compliance with EN 590 and ASTM D975
- Maintain effectiveness across a wide range of base fuels and blending scenarios
- Exhibit strong compatibility with common diesel additive components
- Support long-term fuel stability during storage and transportation

Designed for Today's Fuel Supply Chain

With increasing use of shared infrastructure such as pipelines and terminals, additive performance consistency and regulatory compatibility have become as critical as lubricity efficiency itself. Selected Northshore® grades are qualified under EI 1535, enabling safe use in multi-product pipeline systems where trace aviation fuel exposure may occur.

Technology Differentiation & Performance Philosophy

Multiple Technology Pathways, One Performance Objective

Diesel lubricity improvers achieve their function through polar surface adsorption. However, the chemical architecture of the additive strongly influences adsorption strength, film durability, low-temperature behavior, and treat-rate efficiency.

Cestoil's portfolio deliberately incorporates multiple chemistries to address diverse operational needs:

- Fatty-acid based systems for robust, proven boundary lubrication
- Ester-based systems for enhanced compatibility and controlled polarity
- Hybrid acid–ester systems for higher adsorption efficiency and reduced dosage

Key Differentiation Versus Conventional Alternatives

Compared with generic fatty-acid lubricity additives or metal-containing alternatives, Northshore® lubricity improvers offer:

- Higher lubricity efficiency at comparable or lower treat rates
- No contribution of metallic ash or phosphorus
- Improved storage stability and reduced risk of fuel degradation
- Verified compatibility with detergents, cetane improvers, corrosion inhibitors, and metal deactivators

Fuel-System Friendly Design

All Northshore® lubricity improvers are formulated to minimize adverse interactions with fuel system materials and downstream equipment. Extensive internal screening includes corrosion behavior, oxidative stability, and additive–additive compatibility evaluations.

Product Spotlight: COLI9500 & COLI9500E

EI 1535 Qualified

COLI9500 – Premium EI 1535 Qualified Lubricity Improver

COLI9500 is a premium soybean oil fatty acid–based diesel lubricity improver designed for reliable performance in ULSD fuels.

Key Features

- High lubricity efficiency at moderate treat rates
- Proven performance across diverse refinery base stocks
- Excellent compatibility with common diesel additive packages
- Qualified under EI 1535 for pipeline and terminal applications

Typical Applications

- Refineries and terminals supplying ULSD via multi-product pipelines
- Fuel distributors requiring consistent lubricity performance
- Applications where EI 1535 compliance is required

EI 1535 Qualified Value Grade

COLI9500E – Economical EI 1535 Qualified Alternative

COLI9500E offers the same core lubricity chemistry as COLI9500 with a formulation optimized for cost efficiency.

Key Features

- Comparable lubricity improvement to COLI9500
- Slightly higher cloud and pour point characteristics
- Optimized for markets where extreme low-temperature handling is not critical
- EI 1535 qualified

Recommended Use

COLI9500E is well suited for customers seeking EI 1535 compliance and reliable lubricity performance while optimizing additive cost.

Product Spotlight: COLI9500ES & COLI9500H

EI 1535 Qualified

COLI9500ES – Ester-Based Lubricity Improver (EI 1535 Qualified)

COLI9500ES is an ester-based lubricity improver engineered for enhanced polarity control and compatibility.

Key Features

- Ester chemistry for controlled surface adsorption
- Improved compatibility in complex additive formulations
- Stable performance during storage and transportation
- Qualified under EI 1535

Typical Applications

- Terminals handling multiple additive components
- Fuels requiring enhanced formulation robustness
- Pipeline systems with strict compliance requirements

Next Generation

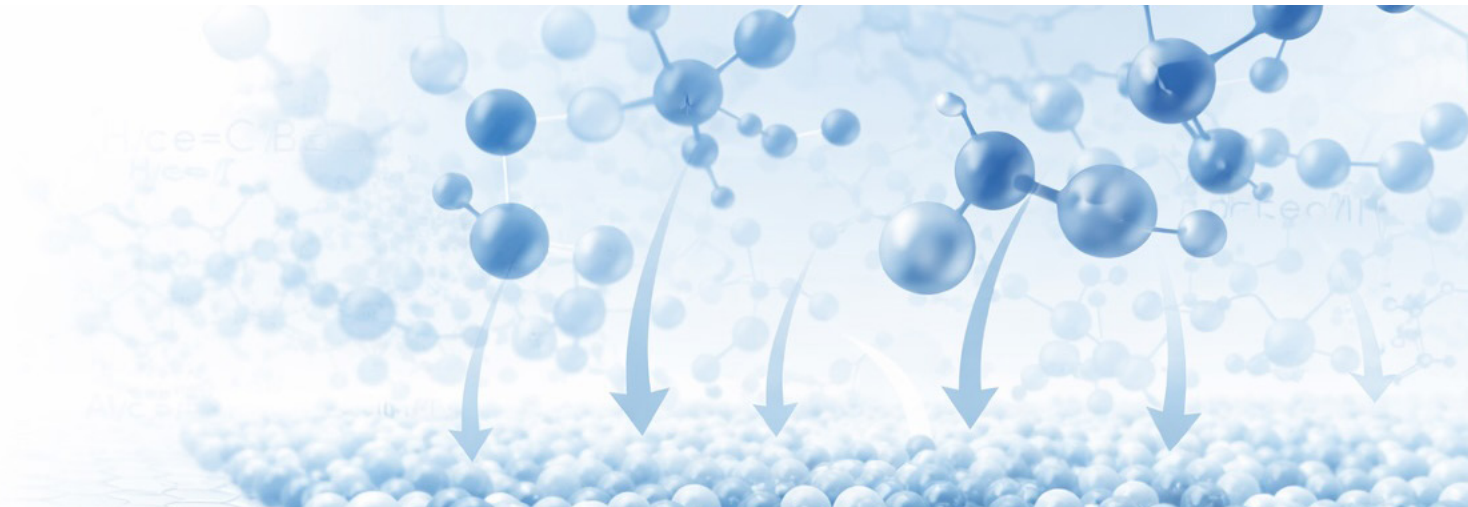
COLI9500H – High-Performance Hybrid Lubricity Improver

COLI9500H represents Cestoil's next-generation lubricity technology, combining fatty-acid and ester functionalities in a hybrid architecture.

Key Features

- Significantly higher lubricity efficiency versus conventional fatty-acid additives*
- Enables reduced treat rates while meeting target HFRR performance
- Particularly effective in challenging base fuels with poor natural lubricity
- Designed for cold-climate operations (Pour Point: -28°C to -30°C)

* Performance improvement is fuel-dependent and based on internal comparative testing using ASTM D6079 methodology.



Conventional

Product Spotlight: COLI9510 (TOFA-Based)

COLI9510 – Traditional Tall Oil Fatty Acid Lubricity Improver

COLI9510 is a tall oil fatty acid–based lubricity improver designed for customers preferring traditional TOFA chemistry.

Key Features

- Established fatty-acid lubricity mechanism
- Broad market acceptance and familiarity
- Suitable for a wide range of ULSD fuels

Typical Applications

- Markets with established TOFA-based additive usage
- Applications prioritizing conventional chemistry and supply flexibility

Product Selection Guide

Application Requirement	9500	9500E	9500ES	9500H	9510
EI 1535 required	✓	✓	✓	—	—
Low treat-rate priority	—	—	✓	✓✓	—
Cold climate handling	✓	—	✓✓	✓✓✓	—
Cost-sensitive blending	✓	✓✓	✓	✓✓	✓
Conventional chemistry preferred	—	—	—	—	✓

✓ = Suitable ✓✓ = Strong fit ✓✓✓ = Best fit

Performance Evaluation

Lubricity Improvement (HFRR Test, ASTM D6079, Reference: COLI9500)

COLI9500 effectively reduces wear scar diameters of various low-sulfur diesel fuels to well below specification limits.

Diesel Type	Dosage (mg/kg)	Average Wear Scar (µm)
Canadian Ultra Low Sulfur Diesel (10ppm S)	200	600->380
Swedish Grade 1	250	650 ->368
Germany ULSD	200	587->366

Retention Test:

After 3 months of ambient storage, the lubricity remained stable (≤ 0.005 mm), confirming long-term durability.

Indicative Treat Rate Guidance (Reference: COLI9500)

Baseline Lubricity	Target (≤ 420 µm)	Indicative Treat Rate Guidance(mg/kg)
460-520	√	80
521-600	√	150
601-700	√	200
>700	√	300

The above treat rates are indicative values based on COLI9500 performance and typical ULSD fuels. Actual dosage requirements depend on base fuel properties, target lubricity, and operating conditions.

Relative Lubricity Performance (HFRR, ASTM D6079)

Product	Relative Lubricity Efficiency*
COLI9500	Reference (100%)
COLI9500E	~100-105%
COLI9510	~100%
COLI9500ES	~90%-125%
COLI9500H	>140%

Relative lubricity efficiency is expressed versus COLI9500 at comparable treat rates. Actual performance is fuel-dependent and based on internal comparative testing in accordance with ASTM D6079.

Compatibility and Harmlessness

Northshore® lubricity improvers have undergone extensive compatibility testing with cetane improvers, multifunctional detergents, and engine oils.

Results Summary:

- No stratification or precipitation observed at –10 °C / 40 °C for 5 days.
- Copper Corrosion (ASTM D130): 1a at 50 °C and 100 °C.
- Oxidation Stability (ASTM D2274): No increase in insolubles.
- Anti-Foam Test (BNPé): No negative effect on foam collapse time.
- Low-Temperature Performance: No change in CFPP or cloud point.
- Engine Oil Interaction: No reaction or gum formation after 20 days at 50 °C.

These results confirm complete blending safety with diesel additive packages and engine oil inertness, enabling Northshore® lubricity improvers to be used as a standalone lubricity improver or a component in multifunctional packages.

Storage & Stability Performance

Condition	Duration	Result
Ambient storage (sealed drum)	12 months	No change in appearance or lubricity; HFRR value remained below 380 µm
High-temperature accelerated aging (40°C)	6 weeks	No significant change in acid value, color, or lubricity performance
Freeze-thaw cycles	5 cycles	No phase separation or precipitation observed

Northshore® lubricity improvers maintain their physical and chemical stability under extreme storage and transport conditions, ensuring consistent lubricity performance and minimizing requalification risk during long-term logistics.

EI 1535 Compliance

Selected Northshore® grades (COLI9500, COLI9500E, COLI9500ES) are qualified under EI 1535, enabling use in multi-product pipeline and terminal systems where aviation fuel contamination risk must be controlled.

About Cestoil Chemical

Cestoil is a specialty chemicals company focused on fuel and lubricant additive technologies for global energy markets. With expertise spanning formulation development, supply-chain execution, and field technical support, Cestoil partners with refiners, terminals, distributors, and additive formulators worldwide.

Our approach combines chemistry-driven design, application-focused testing, and practical operational insight to deliver reliable additive solutions across the fuel value chain.

For product selection, treat-rate recommendations, or EI 1535 documentation, please contact Cestoil technical support.

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