

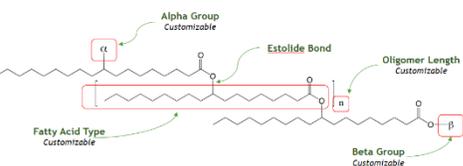
Sustainable Base Oils

Biosynthetic® Technologies manufactures a revolutionary new class of biobased synthetic compounds called Estolides that are made from organic fatty acids found in various bio-derived oils. These highly functional biosynthetic oils have numerous uses in lubricant, automotive, marine, and personal care applications and can be used as the primary base oil of a lubricant formulation, a component of a base oil co-blend, or even as an additive. In addition to their high-performance properties, these oils are *biodegradable*, *sustainable*, *renewable*, *non-bioaccumulative*, and *non-toxic*. In addition, because Biosynthetic Base Oils are compatible with common lubricant base oils and additives, they serve as an easy drop-in for most existing formulations available in the market.

Base oils are used to manufacture products including lubricating greases, motor oil and metal processing fluids. Different products require different compositions and properties in the oil. One of the most important factors is the liquid's viscosity at various temperatures. Base oils are used to make various lubricants and greases across all industries. Base oils can represent from between 70% and 99% of a finished lubricant. These might be automotive engine oil, grease or metal processing fluids.

For the past several years, industry has been quietly looking into and utilizing environmentally safer, readily biodegradable and non-toxic fluids. The benefits of environmental lubricants are well known. Their biodegradable properties allow them to break down in the environment reducing the negative impact from leaks and spills. They can be non-toxic, meaning they won't hurt operators, animals or plants that come in contact with the fluid. Furthermore, they are renewable and reduce dependence on foreign petroleum oil.

Conventional knowledge has focused on the limitations of vegetable oils as base stocks for lubricants. The weaknesses of the oxidative stability, the cold temperature performance and incompatibility with elastomers are well documented. Early generation biobased lubricant formulators utilized performance chemistry similar to those used in petroleum-based fluids, creating lubricant products that did not meet industrial performance requirements. Over the past decade, however, improvements in vegetable and other base stocks, improvements in performance chemistry, and improvements in formulation expertise have allowed the development of biodegradable products with performance similar to or better than conventional petroleum fluids. There are four main classifications of environmentally preferable fluids as defined by ISO 6743/4. They are: HETG-vegetable based; HEPG-glycol based; HEES-ester based; HEPR-PAO (and other synthetic based) and Non-Defined (estolides).



This last classification embodies estolides. These fluids have excellent lubricity as well as a high biobased content (>90%). In addition, they have excellent load carrying characteristic and excellent biodegradability (>70%) and low toxicity (EC50 > 1000 ppm). With stability, seal compatibility and biodegradability at a high-performance level, these fluids also have strong oxidative and hydrolytic stability. Estolides also have a high flash point and excellent pour points with good demulsibility.

Estolides are a class of unique bio-based oils with a variety of uses. Their oligomeric structure contains fatty acid repeat units, with secondary ester linkages on the alkyl backbone. Functional groups denoted as α and β , oligomer length n , and the fatty acid feedstock can all be manipulated in order to achieve desirable performance properties. Relevant

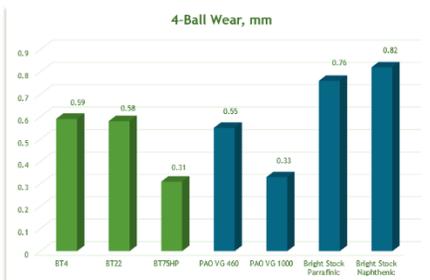
technical performance properties include increasing or decreasing viscosity and polarity, as well as improving cold temperature properties and oxidative stability.

The base oils offered by Biosynthetic Technologies exhibit excellent lubricity and load carrying characteristics, strong oxidative stability, and good demulsibility. In addition, they show high flash point, with closed-cup values ranging from 200°C to 245 °C (ASTM D93) and open-cup values ranging from 240°C to >260 °C (ASTM D92). Biosynthetic Technologies base oils display good cold temperature performance as well, with pour points ranging from -18 °C to -21 °C (ASTM D97).

Biosynthetic® Technologies' estolides provide world class wear protection decreases less friction and improving overall equipment life.

Wear Protection

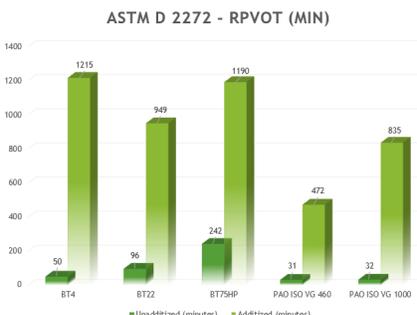
Biosynthetic® Technologies' Estolides provide world class wear protection! Better wear protection decreases less friction and improves equipment life



In addition, estolides provide excellent oxidative stability. High viscosity Estolides achieved better oxidative stability results than similar viscosity PAO products per RPVOT testing. The true life of the Estolide base oil appears to outlast the specified end point of the standard RPVOT testing method; Biosynthetic® Technology estolide Base Oil breaks at 1,821 minutes! RPVOT testing is designed to stop at the point a typical mineral oil would lose its stability and give in to rapid oxidative breakdown. Biosynthetic base oils outlast the standard RPVOT test. Research shows that Biosynthetic® Technology BT75HP lasted

Oxidative Stability

Saturated Estolides have excellent oxidative stability. High viscosity Estolides achieved better oxidative stability results than similar viscosity PAO products per RPVOT testing.



631 minutes longer than the test stopping point. That's 53% longer fluid life!

And finally, saturated Estolides have superior Hydrolytic Stability when even at **3 times** the recommended test duration, the Biosynthetic® Technologies Estolide base oil shows excellent hydrolytic stability!

Test Method: ASTM D2619 Conditions: 99°C (144 hours) modified from (48 hours)	BT22 ISO VG 460	BT75HP ISO VG 460	PAO ISO VG 460	PAO ISO VG 1000	Bright Stock Paraffinic	Bright Stock Naphthenic
Weight Change of Copper Panel, (mg/cm ²)	-0.067	-0.033	-0.092	-0.033	0.00	-0.033
Appearance of Copper	Shiny, 2c	Shiny, 2c	Shiny, 2c	Shiny, 1b-2c	Shiny, 1b-2c	Shiny, 1b
% Change in Viscosity	+0.22	-0.67	-0.41	-0.64	+0.04	+11.3
Change in Acid Number, mg KOH/g	+0.10	+0.17	-0.05	+0.06	-0.01	+0.17
Total Acidity of Water Layer, mg KOH/g	0.07	0.17	3.11	0.89	0.11	0.06

Biosynthetic® Technologies base oils provide superior shear stability numbers compared to other high viscosity base stocks, helping your finished lubricants retain their viscosity, even in severe conditions. Biosynthetic® Technologies base oils are slightly polar and therefore usually slightly swell the seal. This is useful when dealing with formulations that are causing seal shrinkage or hardness. The Biosynthetic oil can be added to the formulation to help balance seal shrinkage and seal swell to develop a formulation that meets a target specification.

Certification is a key strategy in further enhancing Biosynthetic® Technologies into a world class producer of sustainable and high-performance base oils. At Biosynthetic® Technologies we hold the appropriate certifications and registrations to certify our products do not deliver on performance and quality but are also compliant with national and international requirements. Please visit www.biosynthetic.com for more information.



Mr. Miller is a serial entrepreneur with a special emphasis on bio and sustainable technologies. Prior to Biosynthetic Technologies, he cofounded and was CEO of Terresold Technologies, Ltd. An environmentally safe chemical products company. He led the organization from start-up until his exit, creating a multimillion dollar highly profitable, global industry leader. He has engineered, sold and marketed environmentally acceptable lubricants and base oils for over 30 years. Mr. Miller has a B.S. in Chemical Engineering from Tufts University and an M.B.A. from Manhattan College.

WHERE SUSTAINABILITY MEETS PERFORMANCE

Biosynthetic Technology has developed a revolutionary new class of high-performance bio-based esters called Estolides, made from organic fatty acids found in various bio-derived oils. The Estolides deliver:

- High Biodegradability
- Non-Bioaccumulative
- Low Toxicity
- High Bio-Content
- Excellent Hydrolytic Stability
- Superior Oxidative Stability
- Low Volatility
- First-Rate Lubricity
- Superb Wear Protection
- High Viscosity Index
- Remarkable Seal Compatibility
- Natural Detergency



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