Bio-SynXtra™ Booster Pak
For High Performance Engines

Formulated to Improve Engine and Oil Life in High Performance Machines

"Because nobody knows your machine and its application like you"

Bio-SynXtra Booster Pak is a patented biobased concentrate that can be added to any engine oil to improve lubrication performance and increase the life of high performance engines. Bio-SynXtra Booster Pak contains the most advanced additive technology available for high performance, heavy-duty turbo-charged and supercharged gas and diesel engines. In addition, this technology, at the lower treat rates, has shown superior performance in light duty trucks and passenger cars to reduce friction and provide additional fuel economy benefits over formulas without this proven chemistry.

HIGH PERFORMANCE BENEFITS OF STABILIZED HOBS FORMULATIONS:

- Super High Viscosity Index
- Improved fuel economy
- Superior viscosity stability
- Excellent oxidation stability
- Tested by the USDA as Biobased
- Superior antiwear & extreme pressure performance
- Superior low volatility reduces emissions
- Excellent low temperature pumpability
- Superior low foam tendency
- Improved biodegradability

Now more than ever, there is an increased need for a high performance lubricant that is designed to out perform the conventional petroleum API SM/SN formulas. Bio-SynXtra Booster Pak is formulated with Stabilized HOBS* that provides a Super High Viscosity Index (VI) to improve performance in high stress engines without the use of polymers to improve the VI. This concentrated formulation offers a variety of advantages over mineral oil-based additives.

The use of biobased (HOBS) and synthetic oils with RLI's additive technology improves power and performance through a reduction in friction and wear. It provides excellent high-temperature stability for assured performance and superior oil quality in high RPM engines. This patented technology improves lubricity and ensures excellent anti-wear performance in all areas, particularly in respect to multi-valve, high-lift camshafts and other heavily loaded valve train components.

At higher RPM and operating temperatures, this Bio-SynXtra Booster Pak added to motor oils will help resist high temperature and mechanical shear effects for a much longer time than conventional petroleum motor oils. This allows the formulated motor oil to stay in the specified viscosity grade much longer. The natural lubricity of HOBS and the super high VI is key to reduced fuel dilution, reduced wear, and improved fuel economy.

STABILIZED by Renewable Lubricants * is RLI's trademark on their proprietary and patented anti-oxidant, anti-wear, and cold flow technology. High Oleic Base Stock (HOBS) are agricultural vegetable oils. This Stabilized technology allows the HOBS to perform as a high performance formula in high and low temperature applications, reducing oil thickening and deposits.
US Patents: 5,990,055, 6,383,992, 6,534,454 with additional pending and Foreign Patents

* Trademark of Renewable Lubricants, Inc.

Availability F.O.B. :Hartville, Ohio, USA	8 oz Bottle	1 Gallon	5 Gallon Pail	Drum	Totes	Bulk
RLI Product Item #	85901	85903	85904	85906	85907	85909

Renewable Lubricants, Inc.✦476 Griggy Rd✦PO Box 474✦Hartville, Ohio 44632-0474
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Bio-SynXtra Booster Pak Typical Data

Specific Gravity @ 60ºF	ASTM D-4050	.94	Sulfated Ash	1.18%
Viscosity @ 100ºF	ASTM D-445	15 cSt	Calcium	2912 ppm
Viscosity @ 40ºF	ASTM D-445	89 cSt	Sulfur	4200 ppm
Viscosity Index	ASTM D-2270	179	Nitrogen	850 ppm
Pour Point	ASTM D-97	-30ºC	Phosphorus	1144 ppm
Flash Point (PMCC)	ASTM D-93	228ºC	Zinc	1274 ppm
			Antimony	8400 ppm

Direction For Use In Bio-SynXtra Motor Oils

Add to fully formulated Bio-SynXtra Motor Oils for increased performance in super higher performance racing or other motor sport engines: Bio-SynXtra Booster Pak's additives are a balanced concentrated version of the chemistry used in the fully formulated Super High Performance, Bio-SynXtra Motor Oils, with the exception that the *patented* antioxidants, extreme pressure (EP), antiwear, and friction modifier additives are highly boosted *(not all of these Bio-SynXtra Booster Pak patented components are shown in ppm oil analysis above).* Adding Bio-SynXtra Booster Pak to any Bio-SynXtra Motor Oil formula will boost the EP, antiwear, and anti-friction properties, while allowing a proper balance in other necessary performance functions.

For Bio-SynXtra Motor Oils: already containing 420 ppm of antimony (Sb): Add 5% to high performance racing engines (average 500 to 1000 HP range) will boost an additional 420 ppm Sb for an *approximate* total 840 ppm of Sb in universal oil analysis (UOA). Add 10% to 15% by volume of Booster Pak for higher horsepower engines and/or more sever conditions (example: Alcohol Funny Cars or Top-Fuel). Adding 10% will boost an additional 840 ppm Sb for an *approximate* total 1260 ppm of Sb in UOA.

The Sb is used as direct replacement and/or improvement to ZDP. In addition, Sb works synergistically with ZDP and triglycerides or RLI's patented copper with triglycerides, and other components to reduce blow-by, wear, high temperature deposits and improve performance in high performance engines.

Although Bio-SynXtra Booster Pak can improve any motor oil formulation, the percentages used above to increase performance are to be used as approximate guidelines and keep in mind that performance can vary because of high performance engine design and the different variables in the motor sport industry. The main purpose of this product is for the motor sport enthusiast to be able to cost effectively evaluate their application and directly improve the performance in their own machines.

"*Because nobody knows your machine and its application like you".*

General Directions For Use In Conventional Motor Oils

Bio-SynXtra Booster Pak may be added to ***conventional*** engine oil at each OEM recommended oil change.

(Add 5% by volume) = 8 oz. of Booster Pak per 5 qts. of engine oil or 1 qt. of Booster Pak per 20 qts.

(Add 10% by volume) of Booster Pak for high performance racing engines (average 500 to 1000 HP range)

(Add 15% to 20% by volume) of Booster Pak for higher horsepower engines and/or more sever conditions

Exceeding the higher recommended amounts may not improve performance and is not cost effective or recommended by RLI. The benefits listed above **will not** be achieved in equipment or machines, which are damaged or in need of repair due to mechanical failures.

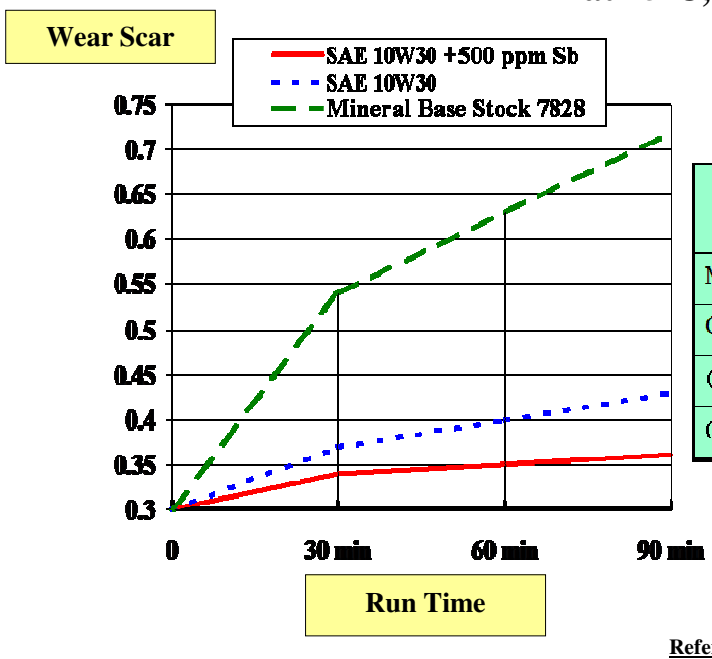
Extreme Pressure and Anti-Wear Performance of RLI's Booster Pak Technology
In the Four-Ball Assembly

In 1993, RLI's William Garmier was contracted by the USDA/DOD to Research and Develop specialty lubricants for engine and hydraulic applications. Penn State University Chemical Engineering Department, world renowned for its lubricant testing laboratory, was chosen for independent testing. This department has developed a large database on the evaluation of transportation lubricants for spark ignition, diesel, and gas turbine engines. This database includes laboratory test data that shows excellent correlation with these engines in lubricant stability and lubricity. Many SAE and STLE papers have been published on the Four-Ball Test and how this test can be run in appropriate load range that compares well with loads found in operating engines, hydraulic systems, transmissions and gear boxes. (1) (2) (3) (4) (5)

A modified Four-Ball Wear Test using a sequential method to obtain a "run-in" wear and a "steady-state" rate of wear has also been developed for use with heavy-duty hydraulic systems using a large Caterpillar data base. (6) (7) In many cases, such as transmission fluids for heavy loaded gearboxes, the lubricants are required to have superior extreme pressure (EP) properties. The properties can be screened using the Four Ball Wear Tester assembly. This test can be supplemented with a scuffing evaluation of lubricants by increasing the load until scuffing occurs.(8)

During this research and development project, the E.P. and anti-wear properties of RLI's patented Sb chemistry in natural ester triglycerides (Booster Pak Technology) was evaluated in the Four-Ball Wear and Extreme Pressure Tests. Here are typical results with base oil (no additives) and SAE 10W30 SG/SH commercial engine oil, with Booster Pak and SAE 10W30 SG/SH without Booster Pak. In these tests, the addition of 500 ppm Sb in Booster Pak showed a considerable reduction of 50% less wear over the commercial SAE 10W30. The tests also confirmed a much higher load carrying capability, at different treat rates of 200 ppm and 500 ppm, before scuffing in the extreme pressure test. (see below)

Comparison of Four-Ball Wear Properties with Booster Pak Steel-on-steel, 40 kg load at 75˚C, 600 rpm



Lubricant	Scuffing Load, kg
Mineral Base Stock 7828	40
Commercial SAE 10W30	60-80
Commercial SAE 10W30 + 200 ppm Sb	100-110
Commercial SAE 10W30 + 500 ppm Sb	>150

References

(1) J. M. Perez, Pennsylvania State University and W. W. Garmier, Renewable Lubricants Inc., "A Vegetable Base Lubricants for Transportation Applications", 47th SAE Earthmoving Industry Conference & Exposition, April 16-17, 1996.

(2) E.E. Klaus, J.L. Duda, and G.S. Jeng, Pennsylvania State University and N. S. Hakim, M.A. Groeneweg, and M.A. Balnaves, Detroit Diesel Corporation, "Vapor Phase Tribology for Advanced Diesel Engines".

(3) E. E. Klaus, Department of Chemical Engineering, The Pennsylvania State University, "Vapor Delivery - A Technique Designed for High-Temperature Lubrication", Department of Energy; Energy Conservation Utilization Technologies, DOE/EC-88/3,

(4) S.M. HSU, National Bureau of Standards, E.E. Klaus, Pennsylvania State University, H.S. Cheng, Northwestern University, "A Mechano-Chemical Descriptive Model for Wear Under Mixed Lubrication Conditions", *Wear*, 128 (1988) 307-323, July 1988.

(5) J.M. Perez and E.E. Klaus, Co-authors, Chapter 3 Handbook of Tribology and Lubrication, VOL III - Monitoring, Materials, Synthetic Lubricants and Applications, CRC Publications, Published 1994.

(6) Klaus, E.E. and J.M. Perez, "Comparative Evaluation of Several Hydraulic Fluids in Operational Equipment, a Full-Scale Pump Test Stand and The Four-Ball Wear Tester,"SAE SP No 558, pp. 25-35 (1983). 831680

(7) J.M. Perez., R.C. Hansen and E.E. Klaus, "Comparative Evaluation of Several Hydraulic Fluids in Operational Equipment, A Full-Scale Pump Test Stand and The Four-Ball Wear Tester," Part II, Vol. 46-4, Lubrication Engr., pp. 249-55 (1990).

(8) J.M. Perez, R.C. Hansen, and E.E. Klaus, Comparative Evaluation of Several Hydraulic Fluids in Operational Equipment, A Full-Scale Pump Test Stand and the Four-Ball Wear Tester. Part III New and Used Hydraulic Fluids.

The following independent test data (pages 5 and 6) confirms the performance specifications of the Bio-SynXtra Booster Pak added at 5% by volume to commercial brand engine oil specifications SAE 10W30 SL, SM. This data is typical of how the Bio-SynXtra Booster Pak performs in other commercial engine lubricants. The data shows that the additional chemistry in the Engine Booster Pak does not take away from the other important chemical and physical properties of the commercial lubricant.

The ICP test shows a slight increase in anti-wear, extreme pressure, and antioxidant chemistry (Phosphorous, Zinc, Sulfur, etc.), reducing wear and increasing oil life (See E.P. and anti-wear tests on Bio-SynXtra Booster Pak additive). The detergency chemistry (Calcium) also shows a slight increase in detergency keeping the engine running clean and preventing rust and corrosive attack on engine parts.

The ball rust test and the L-38 copper and lead bearing corrosion tests support the excellent performance of the Bio-SynXtra Booster Pak added to the engine oil to prevent corrosion and rust. The RLI formula almost hit a perfect 133.8 out of 135=cleanest score on the ball rust test and an excellent weight loss rating of 21.7 mg, well under the baseline average of 49, and under the lower limit of 33 mg on the L-38 Cu/Pb corrosion test.

Copper corrosion D-130 @ 149ºC has no set specification, so the results of the base reference oil was run to give a base line. The test data confirms a slight improvement with the RLI Engine Booster Pak formula over the SAE 10W30 SM without Booster Pak. The lower the number on the Copper Corrosion test correlates to better results.

Shown on page 6, RLI's products provide excellent oxidation stability in preventing deposits measured via TEOST, as well as preventing oxygen uptake in TFOUT.

Prior Art on Copper and Antimony Chemistry

(Preventing oxidation and deposits)

Copper and Antimony additives have been used extensively in many lubricants including: engine, hydraulic, transmission, gear, and grease applications, etc. Many publications and reference patents are available to verify the value of this technology in mineral and synthetic base oils, but the performance of RLI's chemistry in vegetable oil was not discovered nor was it obvious to those skilled in the art. Before RLI's research, vegetable oils were known to be unstable and limited in use for high temperature engine and hydraulic applications. In RLI's patent searches we reference many patents but one filed by Exxon in 1989, patent number 4,867,890, identifies the enhanced antioxidant results by the addition of a small amount of copper to a mineral and/or synthetic based engine oil formula. This patent also emphasized the beneficial synergistic effects caused by the added copper when in the presence of other additives. The power of this copper chemistry was also identified when the number one and number two additive producers, Lubrizol and Exxon, battled for most of the last decade as a result of Exxon filing a patent infringement against Lubrizol for violating Exxon's copper patent 4,867,890. During litigation and before Lubrizol's appeal in February 1993, the records disclosed that both companies used copper in the vast majority of their motor oil formulations.

Another patent filed by Esso Research and Engineering in 1952, patent 2,716,089, describes the problem of oil oxidation creating formulations of sludge and lacquers that deposit on engine parts. The patent explains the problem areas of extremely severe high temperature conditions and gives examples of high-powered reciprocating and turbo-jet engines operating in excess of 450^0 to 500^0 F. The patent also goes into detail of many additives tested and used, but the antimony dibutyldithiocarbamate was the best in reducing coke deposits. In this patent, copper was not identified and, of course, vegetable oils (triglycerides) were not mentioned as base oils in the claims of any of these patents. The patent references that do list vegetable oils have temperature limits of less than 90^0 C.

Along with being an excellent antioxidant and deposit prevention in RLI products, the reference patents list anti-wear, anti-corrosion, extreme pressure, and anti-friction fuel economy benefits of the copper and antimony additives.

TYPICAL PROPERTIES & SPECIFICATIONS	METHOD	SAE 10W30 Plus Booster Pak	Reference API-SM 10W30	Specifications
Viscosity @ 40°C	ASTM D-445	70.56	69.7	
Viscosity @ 100°C	ASTM D-445	11.46	11.03	Min. 9.3 Max. 12.5
Viscosity @ -35°C MRV TP1	ASTM D-4684	19,690 cP	19,746 cP	<60,000 cP at °C
Viscosity Index	ASTM D-2270	156	149	
Flash Point (COC)	ASTM D-92	217°C	215°C	200°C
ICP Analysis				
Calcium		0.2250	0.2105	
Sulfated Ash		0.8918	0.8327	
Phosphorus		0.0812	0.0761	
Sulfur		0.2330	0.2116	
Zinc		0.0898	0.0835	
ACCELERATED BENCH TESTS				
ASTM Foam D892A	ASTM D-892	0/0	0/0	10.0/0
Sequence 1	Lubrizol	0/0	0/0	50.0/0
Sequence 2		0/0	0/0	10.0/0
Sequence 3		20/0	20/0	(GF-4 100/0)
Sequence 4 D6082				
NOACK Volatility % max 1h at 250°C	Lubrizol	15	15	GF-4 15 (max)
L-38 CU-PB Corrosion LZ #1210Y	Lubrizol			
Weight change CU + PB, mg		21.7		Baseline Avg. 49
Weight change CU, mg		11		(upper limit 65-lower 33)
Weight change PB, mg		10.7		The lower the # the better the result
Copper Corrosion (149°C)	ASTM D-130	2-D	2-E	
Ball Rust Test LZ #1319 (GF-3)	Lubrizol	133.8		
Rust Rating avg.		1.1		0-135 (135=cleanest) <100 Fail
% Variability				Strive for <30% variability between two runs

Tests performance at Southwest Research: RLI's products meets and exceeds GF-5 performance during GF-4 Testing.
ILSAC GF-4 Test Results on RLI Bio-Synthetic 5W30 (lot 1027B-072607) with Booster Pak Technology

Test Name	Test ID	GF-4 requirement	result	retest
Ball Rust Test	ASTM D6557	100 minimum	128	
Phosphorus Content	ASTM D4951	0.08% wt max	0.086%	0.08%
Sulfur Content	ASTM D4951	0.50% wt max	0.34%	
NOACK Volatility	ASTM D5800	15% max	11.9%	
Simulated Distillation	ASTM D6417	10% max (371C)	6%	
High Temp Deposits (TEOST)	ASTM D7097	35 mg max	7.2 mg	
Filterability(EOWTT)	ASTM D6794	50% loss max(0.6% water) 50% loss max(1.0% water) 50% loss max(2.0% water) 50% loss max(3.0% water)	27.75% 27.50% 24.43% 21.24%	
Foaming Characteristics	ASTM D892	**Sequence I** tendency 10 ml max Stability 0ml max **Sequence II** tendency 50 ml max Stability 0ml max **Sequence III** tendency 10 ml max Stability 0ml max	 0 0 0 0 0 0	
High Temperature Foaming	ASTM 6082	tendency 100 ml max stability 0 ml max	10 0	
Homogeneity and Miscibility	ASTM 6922	homogeneous and miscible	pass	
Other Testing Performed				
TFOUT (Oxygen Uptake) TEOST (measures deposits, mg) (GF-2 version of test)	 ASTM D4742A ASTM D6335	**Mobil 1 5W30 (X2667 5371)** 187 minutes	**RLI 5W30** 223 minutes 3.6 mg	**(COA427539/08017)** **Quaker State 5W30** 62 minutes 28.6 mg

For additional technical information, see Society of Tribologist and Lubrication Engineers (STLE on renewable.com/aboutus.html under publications)