

# Additives for **Biobased Products**



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# FUNCTIONAL PRODUCTS INC.

Functional Products Inc. was founded in 1985. The Quality Management System is certified to ISO 9001:2015 (with design). Functional Products is committed to compliance with current REACH and CLP regulations, including the Globally Harmonized System (GHS) for classification and labeling standard.

Functional Products is an active member or participant in the following professional technical associations: **NLGI, ELGI, NLGI India, STLE, KSTLE, AOCS, NSF, UEIL and ILMA.**

Functional Products formulates and blends over 200 active products and also provides custom formulary capability for short- and long-run needs.

Headquarters, general offices and manufacturing plant are located in Macedonia, Ohio. Sales offices and stocking points are located throughout the United States and Canada, as well as Latin America, Europe, Australia, India and Asia.

## Mission Statement:

Functional Products Inc. is committed to providing our customers with quality products and services that meet or exceed their expectations through the use of continuous improvement.

## Health and Safety:

The product descriptions here, in Technical Data Sheets (TDSs) and on product labels are not intended to take the place of a Safety Data Sheet (SDS).

An SDS is provided with each order or sample shipment and can be downloaded from our website:

www.functionalproducts.com  
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# Additives for Biobased Lubricants

## Why Convert from Mineral to Biobased Fluids?

As environmental concerns are growing, vegetable oils are finding their way into total-loss lubricants for military applications and outdoor activities such as forestry, mining, railroads, dredging, fishing and agricultural hydraulic systems. Lubricants based on vegetable oils offer significant environmental benefits as well as providing satisfactory performance in a wide array of applications. Government initiatives and advances in biobased lubricant technology are expanding the market for environmentally friendly products.

Shortcomings of vegetable oils, such as low thermo-oxidative stability and poor cold flow behavior, may be improved through the use of additives that enhance oxidative stability, improve low temperature properties (pour points) and confer better wear properties.

**FUNCTIONAL PRODUCTS'** additives in this catalog improve the performance of commercially available biobased industrial oils such as hydraulic fluids, biodegradable oils for heavy equipment, biobased drip fluid for agricultural equipment including mineral oil-based lubricants for high-temperature applications.

## Converting Machinery to Biobased Lubricants

When switching from a mineral oil-based rock drill, bar and chain, gear oil or hydraulic fluid to a biobased system, certain care should be exercised:

- Warm up the machinery to reduce the viscosity.
- Flush the sump and/or system with vegetable oil, circulate and drain.
- Fill with biobased fluids.
- Note the clarity and color of the oil.
- Inspect the machinery fluids frequently in order to learn how the fluid behaves.

Spent fluids may be recycled with filtration and in some cases may be revived with booster additives.

## Compatibility

All **FUNCTIONAL PRODUCTS'** biobased additives are compatible with vegetable oils. Most additives are also compatible with some synthetic esters. See the Technical Data Sheets for specific information regarding ester compatibility.

## Definitions

**Biobased** — According to the Office of the Federal Environmental Executive, biobased products are commercial or industrial products (other than food or feed) that are composed in whole or in significant part of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials. In the past, The United States Department of Agriculture (USDA) generally described biobased in reference to products, including lubricants and greases, that were made of at least 51% biological materials.

# Thickeners for Biobased Lubricants and Synthetic Esters

Renewable and biodegradable triglyceride esters are the preferred base stocks for blending economical lubricants and greases for environmentally sensitive applications. Synthetic esters like TMP and adipates are alternatively used for low temperature operation and high oxidative stability. Thickeners are used to raise the low viscosity of these esters (vegetable oil, 30-40 cSt@40°C; synthetics, 5-46 cSt@40°C) to the necessary ISO viscosity grades.

Functional Products provides viscosity modifiers (VM) to thicken biobased and synthetic ester base fluids depending on the target performance and application. These products are typically high molecular weight polymers dissolved in highly biodegradable ester.

**FUNCTIONAL V-515** is an economical VM for thickening bar & chain and saw guide oils for forestry. The high SSI polymer enables a lower treat rate and more biodegradable lubricant.

**FUNCTIONAL V-508F** is the most versatile VM for effectively treating many esters and PAG. This chemistry offers excellent high temperature and oxidative stability. Low temperature fluidity is poor below -30°C. HX1/HX2 listed for incidental food contact.

**FUNCTIONAL V-521** provides excellent low temperature fluidity and is the best complement to synthetic esters with low pour points. **FUNCTIONAL V-505** provides similar low temperature performance with improved shear stability.

**FUNCTIONAL PD-585** is a concentrated polymethacrylate PPD for vegetable oils. 1wt% = -27°C pour point in soybean oil, -36°C pour point in canola oil. 2wt% is sufficient for ISO 46 in vegetable oil.

LuSC listed products are suitable for use Ecolabel environmentally acceptable lubricants (EAL) and Vessel General Permit (VGP) applications.

Typical Properties					
	V-515	V-508F	V-521	V-505	PD-585
Specific Gravity	0.91	0.91	0.91	0.91	0.95
Lbs. per Gallon	7.6	7.6	7.6	7.6	7.9
Flash Point, D92	150°C (300°F)	150°C (300°F)	150°C (300°F)	150°C (300°F)	135°C (275°F)
Shear Stability index, PSSI	51%	29%	30%	15%	7%
Kinematic Viscosity @ 100°C	8000	7000	5000	8000	1500
Color, ASTM D1500	Yellow (<4)	Yellow (<4)	Yellow (<4)	Yellow (<4)	Yellow (<4)
Biodegradation (CEC L-33-T-82)	90%	70%	83%	83%	N/A
Ecolabel/LuSC	Yes	Yes	Yes	No	Yes
Thickening Efficiency, 10%wt in canola (ISO 36)					
KV40=	83.6	124.1	76.8	91.2	80.3
KV100=	18.4	22.9	16.4	19.6	16.7
Viscosity Index	242	216	230	238	225



Typical Treat Levels (wt%)			
	ISO 46	ISO 68	ISO 100
<b>V-515</b>	2.0% – 2.5%	6.0% – 7.0%	15% – 16%
<b>V-508F</b>	2.0% – 2.5%	4.5% – 5.0%	8.0% – 9.0%
<b>V-521</b>	3.0% – 4.0%	8.5% – 9.5%	13.5% – 14.5%
<b>V-505</b>	1.0% – 3.0%	5.5% – 7.5%	5.5% – 7.5%
<b>PD-585</b>	2.0% – 3.0%	7.0% – 8.0%	12.0% – 14.0%

## Pour Point Depressants for Vegetable Oils

Pour point depressants are used to both lower the pour point and improve the general cold flow properties of vegetable oil-based lubricants. 1wt% is typically ideal to minimize pour point (-27°C/-17°F in soybean oil, -36°C/-33°F in canola oil) but performance varies based on fatty acid distribution.

**FUNCTIONAL PD-555C** is specially formulated for easy handling and transfer.

**FUNCTIONAL PD-585** is concentrated to provide low treat rates and may be used as a shear stable thickener.

**FUNCTIONAL PD-590** is Ecolabel/LuSC listed and meets EPA Safer Choice and CleanGredients criteria.

ASTM D97 Pour Point of Biobased PPDs in Vegetable Oil						
	FUNCTIONAL PD-585		FUNCTIONAL PD-590		Competitor Biobased PPD	
	Canola Oil	Soybean Oil	Canola Oil	Soybean Oil	Canola Oil	Soybean Oil
<b>0.0wt%</b>	-24°C	-12°C	-24°C	-12°C	-24°C	-12°C
<b>0.5wt%</b>	-33°C	-21°C	-33°C	-18°C	-18°C	-21°C
<b>1.0wt%</b>	-36°C	-24°C	-33°C	-21°C	-33°C	-21°C

## Additives for Biobased Hydraulic Fluids

Functional Products hydraulic fluid packages offer excellent demulsibility, rust and copper inhibition, 4-ball wear performance and hydrolytic and thermal stability for ecofriendly and LuSC listed hydraulic fluids.

**FUNCTIONAL HF-580** is a non-hazardous light color, low odor hydraulic fluid package compatible in a wide variety of esters including vegetable oils and synthetic esters (TMP, adipates, PE). It also has outstanding solubility in Group I/II/III petroleum

oils and PAO. **FUNCTIONAL HF-580** passed Eaton Vickers V104C ASTM D7043.

**FUNCTIONAL HF-595** is an Ecolabel/LuSC listed hydraulic fluid package for environmentally acceptable lubricants (EAL) and Vessel General Permit (VGP). **FUNCTIONAL HF-595** is compatible in most EAL base stocks to produce HETG / HEES / HEPR / HEPG hydraulic fluids per ISO 15380.

Typical Properties		
	HF-580	HF-595
<b>Appearance</b>	Clear, Amber Liquid	Clear, Amber Liquid
<b>Odor</b>	Mild	Mild
<b>Specific Gravity</b>	0.98	0.99
<b>Lbs. per Gallon</b>	8.2	8.26
<b>Flash Point, D92</b>	>230°C (450°F)	>150°C (300°F)
<b>Kinematic Viscosity @ 40°C</b>	50 cSt	145 cSt
<b>wt% Sulfur/Phosphorus/Calcium</b>	3.5%/1.1%/0%	11.9%/0%/0.2%
<b>Ecolab/LuSC</b>	No	Yes
<b>Treat Level, wt%</b>	2.5%	2.2%

# Tackifiers for Biobased and Synthetic Esters



Nonfoods Compounds  
Program Listed

Biobased tackifiers are additives that confer tack or stringiness to lubricants made from vegetable or animal based fatty oils. They are principally used to provide adherence in chain oils, saw guide oils, down hole drilling oils, open gear oils or oils used to lubricate in baking or food processing facilities. They may also be used to inhibit stray mists or to provide drip

resistance in other products. They may also be used to provide thickening and tack in oils that contain high levels of fatty additives, such as cutting oils.

**FUNCTIONAL V-584** has been approved by the NSF as an additive for lubricants with incidental food contact (#120913, category HX-1, HX-2) and is LuSC listed for EU Ecolabel formulations and suitable for use in Vessel General Permit (VGP) applications. It is principally used to provide adherence in chain oils in environmentally sensitive or food-processing locations. It will also inhibit stray mists and provide drip resistance. In order to add tack to vegetable oil based single use lubricants, **FUNCTIONAL V-584** may be used at a lower treatment level.

**FUNCTIONAL V-592** is recommended for use with synthetic esters and blown or polymerized vegetable oils that can be difficult to additize. A unique blend of synergistic polymers, **FUNCTIONAL V-592** imparts tackiness and adhesion to synthetic esters.

## Typical Properties

	V-584	V-572	V-592
<b>Specific Gravity</b>	0.93	0.92	0.96
<b>Lbs. per Gallon</b>	7.8	7.7	8.0
<b>Flash Point, D92</b>	150°C (300°F)	150°C (300°F)	150°C (300°F)
<b>Shear Stability index, PSSI</b>	Very High	Very High	Very High
<b>Kinematic Viscosity @ 100°C</b>	2500 @ 40°C	7500	900
<b>Color, ASTM D1500</b>	Yellow (<4)	Yellow (<4)	Yellow (<4)
<b>Biodegradation (CEC L-33-T-82)</b>	95%	90%	86%

## Thickening Efficiency, 10%wt in canola (ISO 36)

<b>KV40=</b>	55.5	74.8	69.5
<b>KV100=</b>	13.1	16.9	14.0
<b>Viscosity Index</b>	245	244	210

A treatment level as low as 1wt% will provide tackiness in a vegetable oil. The typical treatment level for a chain lube is 3-7wt%. Minimization of hydrocarbon aerosol escape from mist lubricated and pneumatic equipment requires about 1wt%.

Since there are no standardized test methods for tackiness or stray-mist inhibition, the appropriate treatment level is best determined by the user.

## Industrial Gear Additive Package

**FUNCTIONAL GA-614** is a metal-free industrial gear oil package based on sulfur-phosphorus chemistry that delivers up to 620 kg EP weld loads in ISO 220+ gear oils. 2.8wt% meets US Steel 224 and DIN 51517-3 standards with 315 kg EP weld load. Treat level can be varied from 1.5 5.0wt% to tailor the extreme pressure performance as needed. Consult the *Industrial Additives* brochure for more details.

## Saw Guide Oil Additive Package

**FUNCTIONAL SGP-567** is designed for formulating saw guide oils in either biobased or conventional base stock formulations.

**FUNCTIONAL SGP-567** is a robust, non-hazardous, multifunctional additive that provides antiwear, mild EP, rust protection and enhanced lubricity. **FUNCTIONAL SGP-567** is recommended for multi-blade, gang saws and trimmers commonly used in lumber production.

**FUNCTIONAL SGP-567** should be used at 1.5% by weight in vegetable oil. The addition of a thickener, **FUNCTIONAL V-515**, will increase the viscosity to the higher ISO grades required for this application. **FUNCTIONAL V-584** may also be added to increase adherence of the oil to the saw guides and blades. For continuous saw operation in climates below -20°C, a pour point depressant such as **FUNCTIONAL PD-555C** is recommended for biobased formulations.

## Multifunctional Rock Drill Package

**FUNCTIONAL RD-540** is a high performance emulsifying rock drill additive package having EP/antiwear, corrosion inhibition, and emulsifier. **FUNCTIONAL RD-540** is readily biodegradable in vegetable base stocks and is designed to meet the requirements of pneumatic tools, down-hole and surface drilling equipment. Use **FUNCTIONAL V-515** thickener for fluids that adhere to tooling surfaces, further reducing corrosion and

wear in the presence of compressed air or water. Improved wear reduction performance greatly reduces the incidence of premature bit shanking and reduces operating costs.

**FUNCTIONAL RD-540CP** is a demulsifying version of RD-540 intended to provide efficient water separation where needed.

### Typical Properties

	RD-540	RD-540CP
<b>Water Separability</b>	Emulsifies	Demulsifies
<b>Appearance</b>	Amber Liquid	Amber Liquid
<b>Odor</b>	Mild	Mild
<b>Specific Gravity</b>	0.99	1.00
<b>Lbs. per Gallon</b>	8.26	8.4
<b>Flash Point, D92</b>	150°C (300°F)	150°C (300°F)
<b>Kinematic Viscosity @ 40°C</b>	31 cSt	65 cSt
<b>wt% Sulfur/Phosphorus</b>	16.1%/0.8%	16.1%/0.8%
<b>Treat Level, wt%</b>	2.2%	2.4%

### Performance at ISO VG 100 in canola with FUNCTIONAL V-515

<b>4-Ball EP Weld Load (D2783)</b>	315 kg	250 kg
<b>Load Wear Index (D2783)</b>	65	53
<b>Timken OK Load (D2782)</b>	>60	>60
<b>FZG Load Stage (D5182)</b>	>12	>12
<b>Demulsibility, 30 min (D1401)</b>	1/6/73	39/41/0

	Thickeners				Pour Point Depressants				Tackifiers				Additive Packages				
	V-515	V-508F	V-521	V-505	PD-555C	PD-585	PD-590	V-584	V-592	V-572	HF-580	HF-595	GA-614	SGP-567	RD-540	RD-540CP	
Treat Level, wt%	1 – 15	1 – 15	1 – 15	1 – 15	0.3 – 1.0	0.3 – 1.0	0.3 – 1.0	1 – 10	1 – 10	1 – 10	2.5	2.2	1.5 – 5.0	1.5	2.2	2.4	
Ecolabel/LuSC	Yes	Yes	Yes		Yes	Yes	Yes	Yes				Yes					
NSF HX1/HX2	Yes	Yes						Yes									
Application																	
Bar & Chain	•				•	•	•	•	•					•			
Saw Guide	•				•	•	•	•	•					•			
Chain and Conveyor Oil	•	•			•	•	•	•	•	•				•			
Grease	•	•			•	•	•	•	•	•				•		•	
Pneumatic Tool	•	•			•	•	•	•	•						•	•	
Rock Drill	•	•			•	•	•	•	•						•	•	
Anti-Mist	•							•	•	•							
Hydraulic Fluid		•	•	•	•	•	•				•	•					
Open Gear Oil	•	•						•		•			•				
Industrial Gear				•		•							•		•	•	
Base Fluid Compatibility (10wt% VM, PPD, or tackifier in pure fluid; additive packages at treat wt%)																	
Petroleum Oils																	
Group I/II/III	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
HETG - Vegetable Oils and Triglycerides																	
Vegetable Oil	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Castor Oil																	
HEES - Saturated and Unsaturated Synthetic Esters																	
TMPTO	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Adipate, Long (C13)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Adipate, Short (C8)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Polyol Ester (C18)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Polyol Ester (C9)	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	
Complex Ester (ISO 460+)					•	•	•		•		•	•	•	•	•	•	
HEPR - PAO and Related																	
Low Viscosity PAO	•				•	•	•			•	•	•	•	•	•	•	
High Viscosity PAO										•	•	•	•	•	•	•	
Biobased PAO							•				•	•	•	•	•	•	
Alkylated Naphthalene	•		•	•						•	•	•	•	•	•	•	
HEPG - Polyalkylene Glycols																	
Water Soluble PAG													•		•	•	
WSPAG + Water (50/50)														•	•	•	
Water Insoluble		•							•		•	•	•	•	•	•	
Oil Soluble PAG		•				•	•				•	•	•	•	•	•	

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