

# FUNCTIONAL PRODUCTS INC.

Innovative Chemistry for Lubricants

## Additives for Biobased Products



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## FUNCTIONAL PRODUCTS INC.

Functional Products Inc. was founded in 1985. We received our ISO 9001:2008 certification in 2010, and we are REACH compliant.

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, the Technical Data Sheets (TDS) and the product labels are not intended to take the place of a Material Safety Data Sheet (MSDS).

An MSDS is provided with each shipment of an order or a sample, or can be downloaded from our website:

[www.functionalproducts.com](http://www.functionalproducts.com)  
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## Additives for Biobased Products

### **Why Convert From Mineral to Vegetable-based fluids?**

As environmental concerns are growing, vegetable oils are finding their way into total-loss lubricants for military applications and in 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 combined with advances in the technology of biobased lubricants are expected to expand the market for such 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.

Hydraulic equipment can experience a hose rupture or fitting leak, releasing oil into the environment. It has been estimated that a hydraulic system can lose as much as three times its sump size each year.

The **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 and even some mineral oil-based lubricants for high-temperature applications.

### **Converting Machinery to use Vegetable-based Lubricants**

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

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

Spent fluids may be recycled through 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 compatible with synthetic esters, as well, although thickeners (page 3) may not be compatible with all synthetic esters. See the Technical Data Sheets for thickeners 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 describes biobased in referring to products, including lubricants and greases, that are made of at least 51% biological materials.

## Thickeners for Biobased Lubricants

### APPLICATION:

Triglyceride oils are sometimes preferred as base stocks for blending hydraulic gear oils, rock drill oils and other fluids and lubricants intended for use in environmentally sensitive applications. A drawback, however, is their light viscosity of only about 40 cSt at 40°C. A thickener may be needed to provide higher viscosity, or a tackifier may be needed to provide tack to the end product.

**FUNCTIONAL V-508, V-510 and V-515** are thickeners for vegetable or animal based oils to blend lubricants of ISO 46, ISO 68 or ISO 100 viscosity grade. **FUNCTIONAL V-516** is a thickener for high oleic vegetable oils used to blend lubricants of ISO 46, ISO 68 or ISO 100 viscosity grade. These thickeners are ideal for use with synthetic esters. **FUNCTIONAL V-508** is best for use with di-octyl adipate, di-tridecyl adipate, C6, C7, C8 polyol ester, trimethylolpropane tricaprilate and trioctyl trimellitate. **FUNCTIONAL V-510** is best for use with 2-ethyl hexyl stearate. **FUNCTIONAL V-515 and V-516** are optimal with tri-isodecyl trimellitate and di-isodecyl phthalate.

**FUNCTIONAL V-508** is also available as **FUNCTIONAL V-508S**, a concentrate in granular form. Typical treatment levels of 1.0 to 2.0% are used in greases. In canola oil, use concentrations of 1.5% for ISO 68 and 3.3% for ISO 220.

### COMPOSITION:

The active additive is a polymer selected for its shear stability and thickening efficiency. The polymer permits the adjustment of the lubricant's viscosity in biobased base oils. When combined with vegetable oil, the polymer produces a biodegradable product under all widely used standards.

Typical Properties				
Property	V-508	V-510	V-515	V-516
Diluent	Canola oil	Canola oil	Canola oil	High-oleic canola oil
Specific Gravity	0.93	0.93	0.93	0.91
Lbs. per Gallon	7.75	7.75	7.75	7.60
Flash Point	150°C (300°F)	150°C (300°F)	150°C (300°F)	>260°C (500°F)
Kinematic Viscosity @100°C	1100 to 1400 cSt	5000 cSt	8000 cSt	6000 cSt
Color (ASTM)	Yellow (<4)	Yellow (<3)	Yellow (<4)	Yellow (<2)

● Note: V-508 is often purchased as V-508S, a solid concentrated polymer in granular form.
 ● The use of these thickeners should not affect the pour point or the water-shedding properties of the finished lubricant.

Treatment Level			
Product	Base Oil (high oleic canola oil)		
	ISO 46	ISO 68	ISO 100
Typical / High Shear Service			
V-508	4.0% / 4.5%	8.5% / 9.5%	12% / 15%
V-510	2.0% / 4.5%	6.5% / 9.5%	12% / 15%
V-515	2.0% / 2.5%	6.0% / 7.0%	15% / 16%
V-516	1.5% / 2.0%	5.0% / 6.0%	12% / 15%

### HANDLING:

Warming **FUNCTIONAL Biobased Additives** to about 65°C (150°F) may facilitate pumping and handling. Extended storage at elevated temperatures is not recommended for any product derived from vegetable oils. Safe handling precautions are the same as those to be taken with vegetable oils; see the current Material Safety Data Sheet for details.

## Cold Flow Improvers for Vegetable Oil Based Lubricants

### APPLICATION:

**FUNCTIONAL PD-551, PD-555 and PD-557** modify the wax crystal performance of lubricants. These products are called either pour point depressants or Cold Flow Improvers. Their primary use is to improve the cold flow properties of vegetable oil based lubricants at temperatures below their cloud points. These products are effective under both rapid-cooling and extended cold storage conditions. Our Cold Flow Improvers are effective in hydraulic fluids, chain saw oils, pneumatic tool lubricants and other lubricants made from canola oil, sunflower oil or other triglycerides. The low viscosity of **PD-555** makes it very easy to handle.

Composition & Typical Properties			
Property	PD-551	PD-555	PD-557
Composition	Proprietary Copolymer	Proprietary Copolymer	Proprietary Copolymer
Diluent	Vegetable Oil	Vegetable Oil	Vegetable Oil
Appearance	Light-colored Liquid	Light-colored Liquid	Light-colored Liquid
Odor	Mild Fatty	Mild Fatty	Mild
Specific Gravity	0.93	0.93	0.92
Lbs. per Gallon	7.75	7.75	7.70
Flash Point	160°C (320°F), min.	160°C (320°F), min.	120°C (249°F)
Kinematic Viscosity	200 cSt at 100°C, 1200 cSt at 40°C	110 cSt at 100°C, 455 cSt at 40°C	790 cSt at 100°C 11,700 cSt at 40°C

### TREATMENT LEVEL:

To reduce the pour point of canola or other low-saturate triglyceride oil to below -10°F, a treatment of 0.3% to 0.5% is usually sufficient. To reduce the pour point to below -20°F, a treatment of 0.5% to 1.0% is usually sufficient. For stability in extended storage at -10°F, a treatment level of 1.0-2.5% is usually necessary. Since the responsiveness of triglyceride to wax-crystal modifiers is extremely variable and may be dependent on the cooling history, the user should determine the treatment level.

## Anti-Oxidants for Biobased Lubricants

Because of their triglyceride structure, vegetable oils generally have poor oxidative stability that may contribute to oil failure. Rapid increase in viscosity, sludge and deposit compromises the performance of the lubricant and contaminates filters. For an economic anti-oxidant for vegetable oils, **FUNCTIONAL** recommends **AO-510** which, at treat rates as low as 0.15% by weight, greatly enhances oxidative stability. For premium performance, **AO-520** may be used. Both products comply with existing toxicology standards OECD 301 and 302.

When comparing the oxidative stability of vegetable oils, the American Oil Chemist Society test Cd 12b compares the hours until failure of vegetable oils. Performance of the antioxidants is similar in canola, soybean, low and high linoleic soybean, cotton seed and sunflower oils. The table below shows the improved oxidation stability of two formulated hydraulic fluids using the AOCS Cd 12 b test methods.

Finished Hydraulic Fluids (see page 6)	Untreated	AO-510 – 0.15%	AO-520 – 0.15%
Mil-Prf-32073	40.4 hrs.	101.8 hrs.	144.1 hrs.
HF-546	120.2 hrs.	174.4 hrs.	218.7 hrs.

## Tackifiers for Biobased Lubricants

### APPLICATION:

Biobased tackifiers are additives that confer a tack or stringiness to lubricants made from vegetable or animal based fatty oils. The tackifiers are applied in environmentally sensitive locations or to prevent product contamination by mineral products. 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 a baking or food processing facility. They may also be used to inhibit stray mists or to provide drip resistance in other products. **FUNCTIONAL V-570** may also be used to provide thickening and tack in oils that contain high levels of fatty additives, such as in cutting oils.



Nonfoods Compounds  
Program Listed

Unlike other tackifiers that are effective in fatty oil, **FUNCTIONAL V-584** has been approved by the NSF as an additive for lubricants with incidental food contact (category HX-1). 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. For tackifying vegetable oil based single use lubricants, **FUNCTIONAL V-584** may be used at lower treatment level.

### Composition and Typical Properties

Property	V-570	V-584
Appearance	Amber	Amber
Composition	Polymer	Polymer
Diluent	Vegetable Oil	Vegetable Oil
Specific Gravity	0.93	0.93
Lbs per Gallon	7.75	7.75
Flash Point	150°C (300°F)	150°C (300°F)
Kinematic Viscosity	8,000 cSt At 100°C	2500 cSt At 40°C
Thickening Efficiency (10% In Canola Oil)	75 cSt @ 40°C	60 cSt @ 40°C
Color	Yellow-orange (<4 ASTM)	Hazy Yellow or Orange

### TREATMENT LEVEL:

A treatment level as low as 1% will provide tackiness in a vegetable oil. The typical treatment level for a chain lube is 3-7%; about 5% will bring a vegetable oil to ISO 46 and 10% to ISO 68. Due to its high viscosity index, a fatty-derived ISO 46 product may actually have a higher viscosity at 100°C than many ISO 100 mineral based products. The slight residual haze in these higher viscosity blends does not affect performance. A treat level of between 0.2% and 1.0% of **FUNCTIONAL PD-551** or **PD-555** can inhibit the freezing of the base oil, extending downward the temperature range of the lubricant. Minimization of hydrocarbon aerosol escape from mist lubricated and pneumatic equipment requires up to about 1%. Since there are no standardized test methods for tackiness or stray-mist inhibition, the treatment level is best determined by experimentation.

### HANDLING:

While warming **FUNCTIONAL V-570** to about 65°C (150°F) or **FUNCTIONAL V-584** to about 50°C (120°F) may facilitate pumping and handling, extended storage of this or any other vegetable oil derived product at elevated temperatures is not recommended. For best tackiness retention, do not warm above about 65°C (150°F). **FUNCTIONAL V-584** has a storage life of six months and **V-570** has a storage life of two years.

Safe handling precautions are the same as those to be taken with vegetable oils; see the current Material Safety Data Sheet. The tackiness of products made from any tackifier may be somewhat lessened by shear, so mechanical shearing during blending and handling should be minimized.

## Additives for Biobased Hydraulic Fluid

### APPLICATION:

**FUNCTIONAL HF-500** is an additive package for making hydraulic fluids based on vegetable oils for situations where the lower environmental impact is important. **FUNCTIONAL HF-500** provides oxidation and corrosion protection, extreme-pressure / anti-wear activity and resistance to water. It contains neither phenols nor substances that give a positive EPA phenol test.

**FUNCTIONAL HF-546** is an additized package for making ISO 46 hydraulic fluids. It is formulated to provide excellent anti-wear and corrosion resistance, oxidative stability, foam resistance, cold flow properties and resistance to water. **HF-546** and **HF-560** are compatible with TMP trioleate diluents for increased thermal and oxidative stability.

**FUNCTIONAL HF-560** is an additive package for making Military Specification MIL-PRF-32073 type hydraulic fluids based on biodegradable esters or vegetable oils. **FUNCTIONAL HF-560** provides oxidation and corrosion protection, extreme-pressure / anti-wear activity, foam resistance and resistance to water. We recommend using refined vegetable oils to pass the Military oxidation requirement. To improve the oxidative stability of the vegetable oil, **FUNCTIONAL AO-510** or **AO-520** may be used at a 0.15-0.25% rate.

### COMPOSITION:

**FUNCTIONAL HF-546** and **HF-560** are mixtures of oxidation, wear, demulsifiers, and ferrous and non-ferrous corrosion inhibitors designed to give optimum performance in biodegradable esters and vegetable oils.

Typical Properties			
Property	HF-500	HF-546	HF-560
Appearance	Dark Liquid	Light Green Hazy Liquid	Amber Hazy Liquid
Odor	Mild Sulfurous	Mild	Mild Sweet
Specific Gravity	0.98	0.92	0.96
Lbs per Gallon	8.2	7.7	8.0
Flash Point	135°C (275°F)	>150°C (302°F)	112°C (234°F)
Kinematic Viscosity	20.0 cSt at 100°C	80.0 cSt at 100°C	7.0 cSt at 100°C
	240 cSt at 40°C	684 cSt at 40°C	131 cSt at 40°C
Treatment Level (by weight)	3.5%	4.4%	1.85%

### HANDLING:

Use normal procedures for handling or blending **FUNCTIONAL HF-500**. Cold storage may lead to slight separation of the product but warming it to 25°C (77°F) will make **FUNCTIONAL HF-500** homogenous again. Review the current Material Safety Data Sheet before using. The service life of the hydraulic fluid is limited by the stability of the vegetable oil, so a maximum temperature of 70°C (160°F) is recommended. Use normal safe procedures for handling or blending **HF-546** or **HF-560**. Heating before blending is not required. Review the current Material Safety Data Sheet before using.

Specifications of Finished Hydraulic Fluid to Meet Mil-PRF-32073			
Formula		Tests Passed	
High Oleic Canola Oil	95.65%	<ul style="list-style-type: none"> <li>● Maximum Pour Point</li> <li>● Oxidation Stability (PDSC)</li> <li>● Swelling of Synthetic Rubber</li> <li>● Evaporation Loss</li> </ul>	<ul style="list-style-type: none"> <li>● Four Ball Test (10 &amp; 40 kg load)</li> <li>● Biodegradability</li> <li>● Foaming Sequences 1, 2 and 3</li> <li>● 1 Year Storage Stability @ 24°C</li> </ul>
<b>FUNCTIONAL HF-560</b>	1.85%		
<b>FUNCTIONAL V-516</b>	1.5%		
<b>FUNCTIONAL PD-557</b>	1.0%		

## Multifunctional Rock Drill or Gear Oil Package

### APPLICATION:

**FUNCTIONAL RD-535** is a high performance oil additive package having EP/Anti-wear, corrosion inhibition, and tackiness properties especially suited for rock drilling or open-gear applications. **FUNCTIONAL RD-535** is readily biodegradable when formulated with vegetable base stocks, and is designed to meet the requirements of pneumatic tools, down-hole, surface drilling and open-gear equipment. It is formulated with a tackifier to allow the lubricant to adhere to tooling surfaces, further reducing corrosion and wear in the presence of compressed air. It is designed to emulsify water in wet conditions for open-gear equipment. The wear reduction performance greatly reduces the incidence of premature bit shanking and lowers operating costs.

### COMPOSITION and SELECTED PROPERTIES

**FUNCTIONAL RD-535** is a proprietary formulation recommended for vegetable oil base stocks. **FUNCTIONAL RD-535** is soluble in oil, insoluble in water, and contains 20% sulfur and 0.9% phosphorous by weight. See the Technical Data Sheet for additional property information.

### TREATMENT LEVEL:

**FUNCTIONAL RD-535** recommended initial treat level is 5% by weight, with the optimum level dependent on the severity of the application. At 5% by weight in canola oil, the Viscosity at 100°C is 8.6 cSt, 33.8 cSt at 40°C, and a VI of 249.

### HANDLING:

**FUNCTIONAL RD-535** is a skin and eye irritant, and should be handled with suitable personal protection. The maximum heating temperature is 140° F. At higher temperatures, fumes could be released which could be an inhalation irritant.

Specifications of Finished Rock Drill or Open Gear Oil		
Formula	Typical Properties	
(by weight in high oleic canola oil)	<b>Flash Point (COC)</b>	> 150° C
<b>FUNCTIONAL RD-535</b> 5%	<b>Kinematic Viscosity at 100°C D445</b>	36.0 cSt
<b>FUNCTIONAL V-508S</b>	<b>Kinematic Viscosity at 40°C D445</b>	224.2 cSt
<b>For ISO 220</b> 4%	<b>Viscosity Index</b>	211
<b>For ISO 320</b> 5%	<b>Performance</b>	
<b>For ISO 460</b> 6%	<b>4-Ball EP Test, D1783, weld load</b>	551 lbs. (250 kg)
See the <b>V-508S</b> Technical Data Sheet for preparation details.	<b>Timken Load Test, D1782, failure point</b>	> 70 lbs. (31 kg)
	<b>Emulsion Stability, D1401</b>	1 / 6 / 73 (30 min.)

## Additives for Biodegradable Grease

### WATER SPRAY-OFF AND EXTREME PRESSURE APPLICATIONS:

With a treatment rate of 10%, **FUNCTIONAL V-508** improves water spray-off to 30.3% when compared to the reference canola-based grease. **V-508** is compatible with most esters and natural vegetable oils. See page 3 for typical properties.

With a treatment rate of 5%, **FUNCTIONAL RD-535** improves water spray-off to 30.0% and 4-ball weld point to 500kg, when compared to the reference canola-based grease.

# Purchasing Information

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#### Lintech International

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#### Midwest

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#### Hall Technologies

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