FUNCTIONAL PRODUCTS INC.

Innovative Chemistry for Lubricants

Additives for **Grease**

QMS Certified to ISO 9001:2015 (With Design) **REACH and GHS Compliant**

8282 Bavaria Road | Macedonia, Ohio 44056 | 330-963-3060 | functionalproducts.com | September 2019

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
Phone: 1-330-963-3060

Additives for **Grease**

Improve your Greases with our Polymer Additives

FUNCTIONAL PRODUCTS INC. offers a variety of polymer additives. Our specialty polymer additives form an interpenetrating physical network with the grease soap to greatly improve the performance of the grease: increased shear stability, enhanced water spray-off and thicker grease.

How do Polymers Improve Grease?

The polymer forms an interpenetrating network with the grease soap matrix by chemical bonding, entanglement or an amorphous crystalline reinforcement. The result is improved functional properties and a robust appearance.

Polymer Additives and Low Temperature Properties

Many of Functional's polymer additives, including **V-207, V-4040P, V-4060, V-4270** and **V-191,** do not adversely impact low temperature flow properties of lithium complex base greases as determined by Lincoln Ventmeter results. Data available upon request.

Improved Shear Stability

- **FUNCTIONAL V-4004A, V-207,** and **V-176** greatly improve Roll Stability (ASTM D1831) performance test results for grease.
- **Enhanced Water Resistance**
  FUNCTIONAL V-4004A, V-4060, V-4040P, V-207, V-4270 and **V-176** reduce water spray-off grease loss by as much as 90% (ASTM D4049).
- **Increased Yield**
  FUNCTIONAL V-4004A, V-4040P, V-207, and **V-176** stiffen greases and increase Cone Penetration (D217) and NLGI grade. To bring the grease back in grade, approximately 10% more oil is added.

What Types of Grease Soap may be Treated with Polymers?

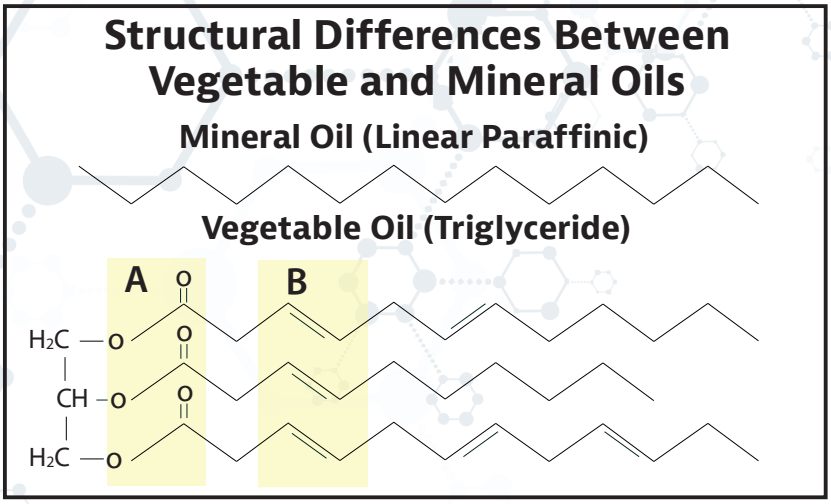
Our specialty polymers are compatible with the following mineral and vegetable oil-based grease soaps: aluminum, lithium, lithium complex and calcium sulfonate systems.

Compatibility with Vegetable and Mineral Greases

Differences between vegetable and mineral oils require the use of compatible polymers when forming greases (see the illustration below). Although both oils are characterized by long hydrocarbon chains, vegetable oils have polar ester groups (A) and unsaturated double bonds (B).

Definitions

Triglyceride — An ester derived from glycerol and fatty acids.



Polymer Additives

For Water Spray-off, Water Washout and Shear Stability

Functional offers a variety of grease polymers to modify the water resistance and mechanical properties of greases. The choice is specific to each grease formulation according to base fluid and thickener type including: lithium, calcium, aluminum, and inorganics like silica and clay.

FUNCTIONAL V-207, FUNCTIONAL V-211 and **FUNCTIONAL V-4040P** are flaked polymers that can be easily added to a kettle and will dissolve faster than bales or pellets.

FUNCTIONAL V-4020 is a grafted copolymer pellet that provides exceptional water resistance at very low treat.

FUNCTIONAL V-4004A is a grafted multifunctional polymer diluted in oil for rapid addition to grease without the extra time needed to dissolve solids.

FUNCTIONAL V-4270 is a proprietary mixture of polymer chemistries to provide excellent water resistance and tack in a single package.

FUNCTIONAL V-4060 is a high MW pellet polymer that provides tack and water resistance but with greatly improved oil bleed and mechanical strength.

V-4060

FUNCTIONAL V-4051 is a highly concentrated liquid product formulated in biobased ester for environmentally acceptable lubricant (EAL) greases.

For NSF H1 and H2 greases, **FUNCTIONAL V-211** flake improves water resistance while **FUNCTIONAL V-4064** flake improves mechanical stability and oil bleed. **FUNCTIONAL V-425** tackifier can added for additional adhesion.

	Composition	Form	Water Spray-off*	Water Washout**	Roll Stability*	Treat Rate†
V-207	Ethylene/propylene copolymer	White Flake	24%	10.8%	4.4%	1%
V-211	HX-1 Styrene Copolymer	White Flake	9%	11.5%	4.8%	1%
V-4004A	Hydrocarbon polymer in naphthenic oil	Orange liquid	23%	14.3%	1.4%	4%
V-4020	Grafted Polymer	White Pellet	20%	—	—	0.25%
V-4040P	Grafted Ethylene/Propylene copolymer	White Flake	25%	—	—	0.25%
V-4051	Grafted Copolymer in Ester	Orange Liquid	23%	—	—	1.5%
V-4060	Hydrocarbon Polymer	White Pellet	15%	—	0.5%	1%
V-4064	HX-1 Hydrocarbon Polymer	White Flake	20%	—	—	2%
V-4270	Proprietary mixture of polymers	Brown Liquid	7%	1.8%	—	4%

*Reference is a lithium complex grease with ASTM D4049 water spray-off of 52% and ASTM D1831 roll stability of 11.0%
**Reference is a lithium complex grease with ASTM D1264 water washout of 23% at 79°C (175°F)
† Treat rates may be optimized for a specific grease, usually within ± 0.5% by weight

Tackifiers

Greases with certain thickeners or stiffer consistencies tend to have difficultly adequately spreading to the needed areas of lubrication. **Functional Products** tackifiers are used as a top-treat to easily improve the tackiness of grease so it spreads and transfers more efficiently.

FUNCTIONAL V-188 is a highly shear stable olefin copolymer (OCP) tackifier that confers tack or stringiness to grease and may be used to improve adhesion. **FUNCTIONAL V-425** is an HX1 alternative in NSF H1 greases for incidental food contact use.

FUNCTIONAL V-191M is a very concentrated emulsion of high molecular weight polymer for easy handling. This adds high tack but also improves water resistance and mechanical stability like a grease polymer.

FUNCTIONAL V-515 and **V-572** are used to tackify biobased greases. 5-15wt% will also help to thicken the fatty base oil to a more appropriate ISO 100-220. Both are ~90% biodegradable.

FUNCTIONAL V-584 (NSF HX-1, HX-2), may be used where incidental food contact may occur.

	Composition	Kinematic Viscosity	Color (ASTM D1500)	Flash Point	Treatment Level
V-188	Olefin Copolymer	3000-5000cSt @ 100°C	Pale Yellow, <3	>135°C	0.5 - 2%
V-425	HX1 Olefin Copolymer	2000-4000cSt @ 100°C	Water White, <1	>150°C	0.5 - 2%
V-191	Emulsion	—	Opaque	—	0.5 - 2%
V-515	Biobased	7000-9000cSt @ 100°C	<4	150°C	5 - 15%
V-572	Biobased	6000-9000cSt @ 100°C	<4	150°C	5 - 15%
V-584	Biobased	2000-3000cSt @ 40°C	<3	150°C	5%

VI Improver and Wireline Grease Base - Functional V158FN

FUNCTIONAL V-158FN is a concentrated viscosity modifier (ISO 17,000) intended for making wireline greases or other polymer greases with excellent viscosity index, pour point, and tackiness at up to ISO 13,000 in light naphthenic oil.

Add 0.2wt% **FUNCTIONAL CI-426** for passing ASTM D665B as a rust preventative or 4wt% F**UNCTIONAL GA-614** for advanced AW/EP protection.

ISO VG	Treat Level (wt%)	VI (ASTM D2270)	Pour Point (ASTM D97)
220	25%	171	-48°C/-54°F
460	33%	182	-45°C/-49°F
1,500	50%	203	-36°C/-33°F
5,000	75%	291	-27°C/-17°F
7,500	80%	294	-24°C/-11°F
10,000	90%	322	-24°C/-11°F

Food Grade and Biobased Extreme Pressure Additives

NSF
Nonfoods Compounds Program Listed

FUNCTIONAL CERAMAX and **CERAMAX PASTE** deliver micronized boron nitride particles to protect against extreme pressure and metal-to-metal contact in heavily loaded NSF H1/H2 greases. This chemistry offers NSF HX-1 status, exceptional temperature resistance, wear protection, and very low color versus graphite, MoS2, and PTFE alternatives.

FUNCTIONAL CERAMAX is 100% powder typically used at 1wt% while **FUNCTIONAL CERAMAX PASTE** is a convenient dispersion used at 5wt%. Both are NSF HX-1/HX-2 additives.

Fully formulated liquid industrial additive packages **FUNCTIONAL GA-614** (industrial gear) and **FUNCTIONAL RD-535** (biobased rock drill) are effective in improving the extreme pressure and anti-wear performances of grease and biobased grease at 5wt%.

Four Ball Extreme Pressure Test Results

	Wear Scar 40kg (mm)	Extreme Pressure Weld (kg)
#2 Lithium Complex	1.060	126
+1% PFTE	0.890	200
+ 1% MoS_2	0.805	250
+1% Ceramax	0.760	250
+5% RD-535	0.820	500