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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).

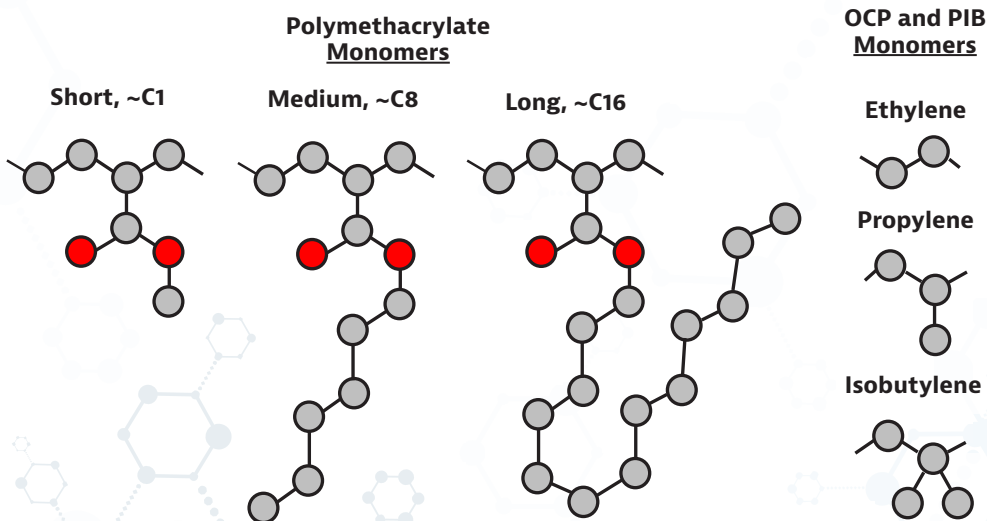
An SDS is provided with each order or sample shipment and can be downloaded from our website:

www.functionalproducts.com
Phone: 1-330-963-3060

Polymethacrylates

Polymethacrylate-based (PMA) viscosity index improvers and pour point depressants offer exceptional shear stabilities, VI improvement, and low temperature fluidity in industrial

and automotive formulations of all types. This is due to the shorter, highly branched structure of PMA versus olefin copolymer (OCP) chemistry.



Gear Oil VI Improvers

FUNCTIONAL MG PMA are for OEM industrial gear/hydraulics and 75W automotive gear oils with stringent shear stability and low temperature requirements. These products allow high viscosity high VI lubes that shear in

grade by KRL 20hr. For best ASTM D2983 results, use **MG-3000** in Gr. III and **MG-1000** in PAO.

Hydraulic and Crankcase VI Improvers

FUNCTIONAL MH are designed to provide high VI high viscosity formulations that shear in grade by

Kurt-Orbahn or sonic methods. High VI low viscosity formulations can be prepared that shear in grade by KRL 20hr.

Measuring Shear Stability of Lubricants

- Bosch Shear (ASTM D6278): Treated oil is cycled 30 times through a Bosch diesel injector pump/nozzle/filter assembly. Also known as Kurt Orbahn. Mild shearing.
- Sonic Shear (ASTM D5621): Treated oil is subjected to 40 min of high intensity vibrations which causes cavitation (microscopic implosions). Moderate shearing, used for HF.
- KRL (CEC L45-A-99): Treated oil is run for 20 hours in a tapered roller bearing under load. Severe shearing, suitable for gear oil testing.

Polymethacrylate (PMA) VI Improvers

	Viscometrics		Shear Stability			Typical Properties											
	KV100 10wt%(cSt*)	Treat Level (wt**)	K-O ¹ D6278	Sonic ² D5621	KRL ³ 20 hr.	OEM Gear and HF, Turbine	Automotive Gear Oil (75W)	ISO 220+ HVI Gear Oil	ISO 100+ HVI Hydraulic	ISO 32-150 HVI Gear Oil	ISO 32-68 HVI Hydraulic	Economy HVI Hydraulic	Suspension Fluid / Shock	Engine / Crankcase	Racing Engine	Tractor / Universal Hydraulic	Automatic Transmission Fluid
Industrial and Automotive Gear PMA																	
MG-1000	8.6	10%	0%	—	15%	•	PAO	•	•	•							
MG-3000	8.0	11%	0%	3%	20%	•	Gr. III	•	•	•	•					•	•
Hydraulic Fluid and Engine PMA																	
MH-2000	9.2	10%	1%	12%	35%	•	80W	•	•	•	•	•				•	•
MH-2500	11.1	8.6%	3%	29%	50%				•	•	•	•				•	•
MH-4000	11.3	7.5%	7%	33%	58%				•	•	•	•					
MH-4500	12.3	6.4%	15%	50%	65%							•	•	•	•		
MH-7000	15.0	3.7%	36%	71%	—							•	•	•	•		
Dispersant PMA																	
MD-8000	16.0	4.8%	40%	74%	—									•	•	•	•
MD-9000	20.0	3.0%	52%	81%	—									•	•	•	DEXIII
Naphthenic PMA																	
MN-3500	12.0	5.7%	9%	—	—			•	•	5606	•	•					

* Kinematic viscosity of 10wt% in ISO 32 Gr. I oil at 100°C

** Suggested treat to increase ISO viscosity grade (22 to 32, 32 to 46, etc)

¹ ASTM D6278 - Shear Stability of Polymer Containing Fluids Using Diesel Injector Apparatus (or "Bosch", "Kurt-Orbahn") 5wt% in ISO 32 Gr. II

² ASTM D5621 - Sonic Shear Stability of Hydraulic Fluids (or D2603) At suggested treat level* in ISO 32 Gr. II to make ISO 46

³ CEC L45-A-99 - 20hr KRL tapered roller bearing test (or DIN 51350-6, ISO 26422) At 5wt% in ISO 32 Gr. II; at 20wt% in all MG- products

Dispersant VI Improvers

FUNCTIONAL MD products include nitrogen functionality for improved varnish and sludge control in applications like tractor hydraulics (**MD-8000**), DEX-III ATF (**MD-9000**), and

racing engine oil. Use approximately 2wt% in combination with **FUNCTIONAL MH** PMA for shear stable formulations.

Naphthenic VI Improvers

FUNCTIONAL MN products are formulated in light naphthenic oil and specially optimized for extra low temperature performance. **MN-3500** is designed for lubricants meeting 5606

aviation hydraulic fluid performance in a variety of applications.

Pour Point Depressants for Petroleum and Bio-based Oils

Petroleum Pour Point Depressants

Pour point depressants (PPD) inhibit the formation of wax crystals in paraffinic oils at low temperature which would prevent the oil from flowing. PPDs work best when chosen for a specific API Group (I / II / III) and can also improve cold flow in test methods like MRV, cold crank (CCS), and ASTM D2983 Brookfield.

Typical treat rate in fully formulated lubricants is 0.1-0.5wt% in petroleum. Recommend PPDs by base oil group are:

- **FUNCTIONAL PD-610** for general purpose PPD use in Group I/II paraffinic oils.
- **FUNCTIONAL PD-620** for use in Group I oils and to treat the effect of waxy additives in naphthenic oil formulas.
- **FUNCTIONAL PD-630** for Group III oils and formulations containing high levels of ethylene-based olefin copolymers.

Oil Group	PD-610		PD-620		PD-630		"E"		"S"		"L"	
	0.05%	0.10%	0.05%	0.10%	0.05%	0.10%	0.05%	0.10%	0.05%	0.10%	0.05%	0.10%
Gr. I	-36	-36	-42	-42	-36	-36	-36	-36	-33	-33	-33	-36
Gr. II	-30	-30	-30	-30	-30	-33	-27	-27	-27	-27	-30	-33
Gr. III	-36	-36	-39	-42	-39	-42	-39	-39	-39	-39	-39	-39

Cold Flow Improvers for Vegetable Oils

Vegetable oils like canola and soybean oil contain higher levels of wax in the form of palmitic and stearic fatty acids than refined petroleum. Typical treat rate of biobased PPDs are 0.5-1.0wt%.

FUNCTIONAL PD-585 is a highly concentrated biobased PPD. It is also used to prepare highly shear stable ISO 46 hydraulic fluids.

FUNCTIONAL PD-555C is a low viscosity biobased PPD for easy handling.

FUNCTIONAL PD-590 is a concentrated PPD that has been registered with both the European Eco-Label Lubricant Substance Classification List (LuSC) and the U.S. EPA Cleangredients (Safer Choice) program. LuSC listing fulfills the Environmentally Acceptable Lubricant (EAL) criteria for Vessel General Permit (VGP).

For details on biobased lubricants, see the Functional Products brochure on **Biobased**.

	FUNCTIONAL PD-585		FUNCTIONAL PD-590		Competitor Biobased PPD	
	Canola Oil	Soybean Oil	Canola Oil	Soybean Oil	Canola Oil	Soybean Oil
0.0wt%	-24°C	-12°C	-24°C	-12°C	-24°C	-12°C
0.5wt%	-33°C	-21°C	-33°C	-18°C	-33°C	-21°C
1.0wt%	-36°C	-24°C	-33°C	-21°C	-33°C	-21°C

