## **FUNCTIONAL PRODUCTS INC.** Innovative Chemistry for Lubricants

# **Industrial Packages**



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

## 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 longrun 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

## **Industrial Packages**

#### FUNCTIONAL PRODUCTS INC.

Industrial Packages are fully formulated concentrates that are added to a base oil at performancespecific amounts to create a finished fluid, hydraulic, gear or way oil, that meets all industry standards for the type of fluid.

#### FUNCTIONAL PRODUCTS INC. offers

industrial packages for mineral and vegetable oil to make finished hydraulic fluids, gear oils and way oils. This catalog presents physical data on these packages and the standards met by the finished fluids. Detailed performance data is available upon request.

## Noteworthy

FUNCTIONAL PRODUCTS was given the "Best Paper Award" at the ELGI Annual Meeting in Paris for their paper on polymer compatibility in mineral and vegetable oils.

**FUNCTIONAL PRODUCTS** received an award for its paper at the National Lubricating Grease Symposium in Wuyishan, China.

#### FUNCTIONAL PRODUCTS

contributed to TLT's article on Viscosity Modifiers and Additives for Grease.

#### FUNCTIONAL PRODUCTS has

authored technical papers and written book chapters (Leslie Rudnick's Lubricant Additives chapter on tackifiers)

### Definitions

**Extreme Pressure Property** — (EP) The ability of a lubricant to reduce scuffing, scoring and the seizure of contacting surfaces when applied loads are high

**Lubricity** — The reduction of friction or wear between two load-bearing surfaces, in relative motion, by the addition of a lubricant

**Demulsibility** — The tendency of an oil to resist emulsification in the sump.

**R&O Package** — Provides protection against rust and oxidation within the hydraulic system pump. Primarily for piston pumps.

AW Package — Provides protection against wear, rust and oxidation within the hydraulic system pump. Also, contains anti-foam agents. Primarily for vane pumps.

**PSSI** — The Shear Stability Index value as determined by a mechanical shear test. The PSSI is used to evaluate the shear stress performance of polymers in real applications. Unless otherwise noted, the PSSI herein is based on ASTM D6278.

## **Viscosity Modifiers**

Viscosity modifiers are high molecular weight polymers used to increase the viscosity of lubricants. Typically these additives improve the viscosity index as viscosity index improvers and greatly reduce the thinning of oil with heat. Blending with viscosity modifiers rather than high viscosity oil allows for better low temperature fluidity, greater VI, and better adherence in applications like engine oil, chain oil, light duty hydraulics, semi-fluid grease and coatings, heavy duty open gear lubes, and more. Options are available in solid form as pellet or bale and as liquids with various viscosities and diluent oils. For NSF HX1/HX2 and biobased viscosity modifiers, refer to the *Food Grade* and *Biobased* guides. Olefin copolymers (OCP) of ethylene-propylene chemistry offer the best economics and thickening efficiencies.

Typical Properties										
	V-290	V-100	V-255	V-135	V-101	V-113	V-201			
Form	Pellet	Bale	Pellet	Bale	Bale	Bale	Bale			
Shear Stability Index, PSSI (ASTM D6278)	0 SSI	22 SSI	25 SSI	33 SSI	45 SSI	50 SSI	60 SSI			
Chemistry	Proprietary OCP	ОСР	OCP	ОСР	OCP	OCP	OCP			
Specific Gravity	0.98 - 1.02	0.86 - 0.88	0.86 - 0.88	0.86 - 0.88	0.86 - 0.88	0.86 - 0.88	0.86 - 0.88			
% Ethylene	Proprietary	45 - 55%	12 - 18%	45 - 55%	45 - 55%	50 - 60%	60 - 70%			
<b>Thickening Efficiency</b> (1wt% in ISO32 Gr. I 100°C)	7.6 cSt (10%wt)	11.0 cSt	10.5 cSt	11.9 cSt	13.o cSt	14.6 cSt	21.0 cSt			
<b>Treat for 1000 cST @ 100°C</b> (100N Gr. II)	N/A	9.8 wt%	13 wt%	8.3 wt%	9.0 wt%	6.6 wt%	5.4 wt%			
<b>Solution Viscosity</b> (1wt% in 100N Gr. II, @ 100°C)	6.2 cSt (10%wt)	9.0 cSt	9.0 cSt	9.7 cSt	10.1 cSt	12.2 cSt	15.0 cSt			

Typical Properties										
	V-160	V-160F	V-160P2	V-166	V-158	V-158F	V-158FN	V-158P2		
Form	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid	Liquid		
Shear Stability Index, PSSI (ASTM D6278)	22 SSI	22 SSI	22 SSI	35 SSI	45 SSI	50 SSI	50 SSI	50 SSI		
Chemistry	OCP	OCP	OCP	OCP	OCP	OCP	OCP	OCP		
Kinematic Viscosity @ 100°C, cSt	1000	3000	1000	1200	1200	1400	1400	1400		
Base Oil	Paraffinic	Paraffinic	PAO	Paraffinic	Paraffinic	Paraffinic	Paraffinic	PAO		
Lbs. per Gallon	7.1	7.1	6.75	7.1	7.1	7.1	7.4	6.75		
<b>Thickening Efficiency, cSt</b> (10wt% in ISO32 Gr. I 100°C)	11.0 cSt	13.7 cSt	12.2 cSt	11.4 cSt	11.9 cSt	12.1 cSt	11.7 cSt	12.3 cSt (PAO6)		

High PSSI (permanent shear stability index) polymers are more effective in modifying oil but more sensitive to mechanical shearing. Low PSSI polymers operate longer under more intense applications but require higher treat levels. Recommended PSSI for various applications is shown below. For industrial gear and hydraulic fluids requiring low PSSI, consider Functional polymethacrylates in the *Polymethacrylate* guide.

PSSI		Industrial Ge	ar and Hydrauli	cs	Automotive				
	Industrial Gear	HVLP HF DIN 51524-3	HL/HLP HF DIN 51524-1,2	Heavy Duty Open Gear	Automotive Gear (75W)	Racing	PCMO/ Diesel	Aftermarket Engine Oil	
0's	х	Х			Х	Х	Х		
10's	х	Х			х	Х	Х		
20's		х	Х	Х		х	х	Х	
30's			Х	х			х	Х	
40's			Х	Х				х	
50's				Х				х	
60's									
Viscosity Grades	ISO 150 - 1000	ISO 32 - 100	ISO 32 - 100	ISO 10k - 100K	SAE 90 - 250	SAE 10 - 50	SAE 10 - 50	SAE 10 - 50	

PSSI	General Purpose Lubricants						ings		Grease	
	Bar & Chain/ Saw Guide	Chain/ Conveyor	Way Oil	Pneumatic/ Rock Drill	Spindle/ Textile	Semi-Fluid Coatings	Cable Fill	Tack, Low Temp	Water Resistance	Wireline Grease
0's										
10's										
20's						х	Х	х		
30's						х	Х	х		
40's	Х	Х	Х	Х	Х	х	Х	х		Х
50's	Х	Х	Х	Х	Х	х	Х	х	Х	Х
60's	Х	Х	Х	Х	Х	х	х	х	х	х
Viscosity Grades	ISO 68 - 220	ISO 22 - 150	ISO 68 - 220	ISO 32 - 460	ISO 10 - 22	ISO 10k - 110k	ISO 100k+	#000 - #3	#000 - #3	ISO 220 - 13k

## **Pour Point Depressants**

Mineral oils from Group I/II/III stocks contain wax species which gel at low temperature to prevent oil from flowing. Pour point depressants (PPDs) inhibit wax formation and allow paraffinic mineral oils to pour at temperatures down to -50°C / -58°F rather than -12°C / 10°F. Other low temperature properties like Brookfield viscosity, MRV, and cold crank are also improved.

containing waxy additives. **FUNCTIONAL PD-630** is optimized for Group III base stocks. Typical treat levels range from 0.1-0.5wt%.

an economical PPD for Group I and naphthenic oils

For vegetable oil PPDs, use 0.3-1.0wt% **FUNCTIONAL PD-585** or consult the Biobased brochure.

**FUNCTIONAL PD-610** is ideal for most Group I/II and bright stock formulations. **FUNCTIONAL PD-620** is

Functional Products offers lab testing to screen for the best PPD and optimal treat level for your formulation.

ASTM D97 Pour Point of Mineral Oil PPDs Benchmarked at 0.05wt% and 0.10wt% in ISO 22 Mineral Oil												
	PD-	610	PD-	620	PD-	630	"E	"	"	5″	"	"
Oil Group	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

### Water Based Products

**FUNCTIONAL V-802P** is a water-based tackifier and thickener (60,000 cSt at 40°C) for water and water-based fluids. It may also act as a binder for powders and an anti-sag agent in paints. Typical treat rates are 0.3-5wt% depending on desired effect and application.

**FUNCTIONAL MW-612** is a concentrated but low viscosity anti-misting emulsion that greatly reduces the formation of coolant mist in metal working applications.

**FUNCTIONAL CI-498** is an NSF HX1 corrosion inhibitor based on phosphate salt for lubricants that may have incidental food contact. Use at 0.3-0.5wt%.

**FUNCTIONAL AW-487** is an anti-wear and lubricity additive for use in water-based lubricants. AW-487 contains no phosphorus, chlorine, or heavy metals. Use at 0.5-2.0wt%.

## **Hydraulic Fluid Packages**

**FUNCTIONAL HF-580** is a non-hazardous light color, low odor hydraulic fluid package which is compatible in a wide range of petroleum oils, biobased esters, PAO, and PAG. **HF-580** at ISO 46 in canola passes the ASTM D7043 Vickers Vane Pump Test (V104C) and exhibits excellent demulsibility, rust and copper inhibition, 4-ball wear performance and hydrolytic and thermal stability. **FUNCTIONAL HF-595** is an Ecolabel/LuSC listed hydraulic fluid package meeting European Ecolabel requirements for biodegradability, renewability, toxicity, and bioaccumulation. HF-595 is designed to meet ISO 15380 performance in HETG, HEES, HEPR, and HEPG hydraulic fluids.

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

## **Industrial Gear Oil Additive Packages**

**FUNCTIONAL GA-614** is a high-performance industrial gear oil package compatible in petroleum oils, esters, and synthetic base oils. **GA-614** is metal-free and uses sulfur-phosphorus chemistry to achieve FZG load stages of 12+, >60 lb Timken load, and up to 620 kg EP weld loads in mineral oil. 2.8wt% meets US Steel 224, DIN 51517-3, and ISO 6743-6. Treat level may be adjusted from 1.5-5.0wt% to achieve different EP weld loads as needed.

Test Results - 2.8wt% GA-614 in ISO 220 Gr. II							
Demulsibility (D-1401, 30min)	39/41/0						
Turbine Oil Rust Test (D665A & B)	Pass						
4-Ball Wear Scar (D4172, 20 kg)	0.33 mm						
4-Ball Weld Load (D2783)	315 kg						
Load Wear Index (LWI)	66						
Timken OK Load (D2782)	>60 lbs						
Foam (D892), Sequence I, II, III	00/00						
Oxidation Test (D2893), Viscosity Change	0.28%						
Precipitation Number	0.02 mL						
FZG A/8.3/90 (D1582), Load Stage	>12						

### **Additives for Mist Inhibition and Worker Safety**

Misting of metalworking fluids is an environmental and health concern in many metal-removal applications such as milling and grinding. Anti-mist additives **FUNCTIONAL MW-612** and **V-162** greatly reduce the formation of mist and are especially in equipment that lacks mist-collecting systems.

**FUNCTIONAL MW-612** is an oil/water emulsion. It is added tank side at a 0.05% treat rate in the finished fluid or at a 0.5% in concentrates.

**FUNCTIONAL V-162** is a clear oil-based solution. Depending on machinery speed and cutting oil viscosity, treatment levels vary from 0.02% to 0.10% (200-1000 ppm).

Typical Properties							
	MW-612	V-162					
Appearance	Milky Liquid	Yellow-orange					
Lbs. per Gallon	8.7	7.1					
Flash Point	None	150°C (300°F)					
Kinematic Viscosity at 40°C	3-8 cSt	600-1100 cSt					
Mist Abatement*	63%	Up to 46%					
Treatment Level	0.05%	0.02-0.10%					

\*Copies of the anti-mist test protocol are available upon request.

## **Way Oil Additive Packages**

Way oil or slide way lubricants are used to lubricate the ways of planers, grinders, horizontal boring machines, shapers, jig borers and milling machines. Functional WA products provide high extreme pressure properties, a substantial friction reduction, excellent wear protection, and corrosion inhibition. WA products are carefully screened for resistance to alkali and removal by coolant. Use with 0.5wt% **FUNCTIONAL V-176** or **V-178** tackifier for excellent adherence to working surfaces.

**FUNCTIONAL WA-24** is a way oil package designed for use in Group I paraffinic oils. Fully formulated fluids will pass Fives Cincinnati P-47 specifications. **FUNCTIONAL WA-64** is a light color, low odor way oil package compatible in a wide array of base fluids including vegetable oils and synthetics. Compatibility in rerefined base oils should be checked. Fully formulated fluids will pass Fives Cincinnati P-47 and GM LS-2 specifications.

**FUNCTIONAL WA-60SF** is a sulfur-free, ashless way oil package designed for use in light duty and biobased applications. **WA-60SF** adds no color to finished lubricants and makes water-white way oils. It is soluble in mineral oils, white oils, synthetics, and oil-soluble PAGs. Passes Fives Cincinnati stick-slip requirements.

Typical Properties									
	WA-24	WA-64	WA-60SF						
Extreme Pressure	High	High	Low						
Corrosion Inhibition	Excellent	Excellent	Excellent						
Demulsibility	Excellent	Excellent	Excellent						
Color	Black	Amber	Amber						
Base Oil Solubility	Group I	Group I/II/III/IV	Biobased						
Treat Level wt%	1.75	1.75	1.4						

#### **Blending of Way Lubricants**

Paraffinic oil is the recommended base fluid for blending way lubricants for the greatly coolant compatibility. Naphthenic base oil typically emulsifies with soluble oil coolants.

Add base oil to the kettle first followed by way oil package and then tackifier. Allow package to disperse completely (10-30 minutes) before adding tackifier. Do not add package and tackifier concentrate at the same time. Do not include tackifier in masterbatches of additives. Concentrated additive packages and tackifier are incompatible and may form separation in the finished lubricant if improperly mixed.

#### Do you need a better way lubricant?

The "bottle test" quickly and easily compares lubricants in any setting. Fill a small bottles half way with coolant. Add 1⁄4" (5-6 mm) of way lubricant, seal the bottle, and invert a ten times. A proper way oil should quickly form a clear coolant layer; an incompatible way oil will emulsify and cause the coolant to turn hazy.

### **Evaluating the Coolant Compatibility of Way Lubricants**

It is critically important to evaluate a way oil with the actual coolant. A way oil must be compatible with the metalworking coolant in order to resist emulsification. If the way oil is not resistant, the fluid will wash off the slide way and contaminate the coolant. If the way oil includes a tackifier, incompatibility can cause the tackifier to come out of solution and accumulate at the top of the sump as a sticky, gummy material.

If the coolant is not available or multiple coolants are used then use a generic aqueous solution matching the coolants pH. Most way oils are resistant to emulsification but some friction modifiers can form detergent upon standing with alkaline coolants. This byproduct can causes emulsions even if the way oil did not emulsify with neutral water. Way oils should separate readily from coolant to allow skimming of the way oil and reuse of the coolant. If emulsion begins to form then the coolant will remove the way lube from the way. An elaborate treatment (such as acidification) is necessary to separate the oil-coolant and the coolant should be disposed of.

#### **Quantitative Evaluation:**

Coolant compatibility can be quantitatively evaluated using ASTM D6553. 40 mLs of coolant and 40 mLs of lubricant are agitated for 5 minutes. The test is observed every 5 minutes and amount of oil, aqueous phase and emulsion are recorded. Way oil should separate within 30 minutes. The Schmidt Koburg test evaluates coolant separation over longer periods.

#### **Qualitative Evaluation:**

Sometimes a qualitative evaluation is sufficient. ASTM D6553 testing can be simulated by placing 40 mL of way oil and 40 mL of coolant in a 100 mL graduated cylinder and inverting ten to twenty times. A persistent emulsion or cloudy coolant layer demonstrates poor compatibility. A good, coolant-compatible way oil will quickly float to the top of the cylinder and leave the coolant clear.

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