

Industrial Additives



| | |
|---|---|
| Gear Oil Packages (GA) | 3 |
| Hydraulic Fluid Packages (HF) | 3 |
| Slideway / Way Oil Packages (WA) and Guide..... | 4 |
| Bar and Chain Oil Packages (BC) | 5 |
| Rock Drill Oil Packages (RD) | 5 |
| Saw Guide Oil Packages (SGP)..... | 5 |
| Pour Point Depressants (PD)..... | 6 |
| Corrosion Inhibitors (CI)..... | 7 |
| Antiwear and Extreme Pressure (AW, EP)..... | 7 |
| Demulsifiers (DM)..... | 7 |
| Defoamers (DF)..... | 7 |
| Guide to Industrial Lubricants..... | 8 |

FUNCTIONAL PRODUCTS INC.

Since 1985, Functional Products Inc. has been a leading supplier of innovative polymer additives for lubricants and grease.

Functional Products Inc. manufactures market general components as well as unique, tailor-made additive solutions through development projects with clients. FPI produces over 300 standard or custom products from one drum to tanker batches.

All clients – from small blenders to multi-national corporations – receive world-class support on the necessary technologies, formulations, and regulations from experts on staff to succeed on their projects.

FPI's headquarters, offices, labs, and production are located in Macedonia, Ohio, USA. For global sales and warehousing, contact sales@functionalproducts.com or refer to page 2 of the **Applications Chart**.

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.”

FPI is proud to maintain an ISO 9001:2015 (with design) quality management system and complies with all REACH and CLP regulations, including the Globally Harmonized System (GHS) for labeling.

Health and Safety

The product descriptions, labels, and datasheets (TDS) are not intended to take the place of a Safety Data Sheet (SDS).

SDS are available online or requested at: sds@functionalproducts.com

Industrial Additives

Industrial additives are general purpose packages and components which provide one or more functions to a lubricant.

Functional Products Inc. offers a broad line of different product functions to suit any and all needs in lubrication. Products can be customized to tune the balance of performance as needed, delivered in different diluent oils, or certified to meet the requires of specialty programs like US NSF HX-1 incidental food contact or European Ecolabel Lubricant Substance Classification list.

Specialty additives are listed in the **Biobased Additives** and **Food Machinery Additives** brochures.

Functional Product Inc. also provides full-service starting point formulations and test results using whichever base oils, packages, additives, and viscosity modifiers are preferred. This includes:

- Rust & oxidation (R&O) oils
- Antiwear (AW) and high VI hydraulic fluids
- Industrial and automotive gear oils
- Forestry oils including bar & chain oil and saw guide oils
- Pneumatic and rock drill oils
- And more

Excellence in Lubrication

Functional Products Inc. is an active member or participant in the following professional technical organizations:

STLE • ILMA • NLGI • ELGI • NLGI-IC • CLGI • K-STLE • AOCS • UEIL • Lube Expo

and supporter of university programs in lubrication and tribology.

Functional Products Inc. has received best technical paper awards at:

ELGI (Paris, 2011)

NLGI (Coeur d'Alene, 2018)

NLGI-IC (Amritsar, 2018)

CLGI (Wuyishan, 2011)

Functional Products Inc. was noted as an 'HPM Valuable Contributor' for the NLGI High Performance Multiuse Grease Specification (2020).

Scientists from FPI authored the chapter “Tackifiers and Antimisting Additives” in *Lubricant Additives: Chemistry and Applications*, 2nd ed. (2009) and 3rd ed. (2017), edited by Leslie R. Rudnick; and helped edit the *NLGI Lubricating Grease Guide*, 7th ed. (2022).

Gear Oil Packages

Gear oils are demanding extreme pressure lubricants that serve in a wide range of conditions from industrial gearboxes to automotive lubricants or even greases.

| Product | wt% | Type | Chemistry | Applications | Add-Ons |
|---------|--------|-----------|-----------|---|----------------|
| GA-307 | 5wt% | Zinc-Free | S/N/Ca | Economic EP industrial gear, automotive gear, R&O | DM-240, DF-110 |
| GA-614 | 3wt% | Ashless | S/P/N | Top tier ashless EP lubricants and greases | None |
| GA-400 | 1.1wt% | Ashless | S/P/N | NSF HX-1 incidental food contact gear | DM-400, DF-400 |

FUNCTIONAL GA-307 is a zinc-free gear oil package which is readily available and offers a secure supply chain in 2022/2023. This product provides high EP loading carrying performance with excellent copper corrosion resistance. Foam and demulsification may require additional additive depending on the base oil viscosity and Group. See TDS for more.

FUNCTIONAL GA-614 is a top-tier ashless sulfur-phosphorus EP gear oil package for industrial and automotive lubricants. Available without defoamers and demulsifiers if needed.

FUNCTIONAL GA-400 is an NSF HX-1 ashless light duty gear oil package which performs at 1.1wt%. **FUNCTIONAL GA-400** requires added defoamer and demulsifier to suit the many different NSF H1 base oil options which may require different levels.

Hydraulic Fluid Packages

Antiwear hydraulic fluids can be easily prepared using **FUNCTIONAL HF** packages and additional components. Higher performance 'high VI' hydraulic oils require viscosity modifiers, see the **Viscosity Modifier** brochure from Functional Products Inc. for more details.

| Product | wt% | Type | Chemistry | Applications | Add-Ons |
|---------|---------|---------|-----------|--|----------------|
| GA-400 | 0.55wt% | Ashless | S/P/N | NSF HX-1 hydraulic and light duty gear package | DF-400, DM-400 |
| HF-580 | 2.0wt% | Ashless | S/P/N | Top tier ashless AW hydraulic package; variable treat rate | None |
| HF-595 | 2.2wt% | Ashless | S/P/N | Ecolabel-listed hydraulic package | DF-500, DM-400 |

FUNCTIONAL GA-400 also performs well as an ashless antiwear (AW) hydraulic fluid package at 0.55wt%.

FUNCTIONAL GA-400 requires added defoamer and demulsifier to suit the many different base oil options available.

FUNCTIONAL HF-580 is a top-tier ashless AW hydraulic fluid package. The product can be dextreated from 2.5wt% to 2.0wt% or 1.5wt% as desired for improved economy. **FUNCTIONAL HF-580** contains high levels of antioxidant to treat and allow vegetable based hydraulic fluids.

FUNCTIONAL HF-595 is an Ecolabel-listed ashless AW hydraulic fluid package. **FUNCTIONAL HF-595** requires added defoamer and demulsifier to suit the many different base oil options available.

Way Oil Packages

FUNCTIONAL WA-64 is a high performance and versatile way oil package for Group I-IV oils and synthetic base oils.

FUNCTIONAL WA-60SF is sulfur-free for reduced color and odor with better copper compatibility

| Product | wt% | Type | Chemistry | isApplications | Add-Ons |
|---------|---------|---------|-----------|--|-------------|
| WA-64 | 1.75wt% | Ashless | S/P/N/B | Slideway lubes, way oils, general purpose machine oils | Tackifier * |
| WA-60SF | 1.5wt% | Ashless | P/N | Sulfur-free way oils in presence of yellow metals | Tackifier * |

*DM-240 demulsifier sometimes used at 0.05-0.10wt% depending on coolant or tramp oil conditions.

Way Oil Formulating Guide

Blending of Way Lubricants

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.

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.

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

Do you need a better way lubricant?

The “bottle test” quickly and easily compares lubricants in any setting. Fill a small bottle half way with coolant. Add ¼” (5-6 mm) of way lubricant, seal the bottle, and invert 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.

Importance of Testing Compatibility of the Way Oil with the Coolant

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 cause 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.

Packages for Industrial Lubricants

Bar & chain, rock drill, and saw guide oils look similar in appearance, viscosity, tack, and the basic approach to formulating. However, these three different applications balance performance in wear, extreme pressure protection, and friction modification based on the specific equipment being lubricated.

Bar & Chain Oil Packages

| Product | wt% | Type | Chemistry | Applications | Add-Ons |
|---------|--------|-----------|-----------|--|-----------|
| BC-10 | 1.5wt% | Ashless | S/P/N | All season bar and chain package for petroleum oil | Tackifier |
| BC-15 | 1.5wt% | Ashless | S/P/N | All season bar and chain package for biobased oils | Tackifier |
| SGP-563 | 1.5wt% | Zinc-Free | Ca | Ecolabel-listed forestry oil package | Tackifier |

Bar & chain oil packages are designed for high speed sliding wear of the chain with mild shock loading. **FUNCTIONAL BC-10** and **BC-15** are low cost, streamlined packages for producing top-tier bar & chain oils. These packages include antiwear, mild EP additives, corrosion inhibitors, and pour point depressant. **FUNCTIONAL SGP-563** is an Ecolabel-listed alternative for environmentally acceptable lubricants using approved chemistry and offers very low coefficient of friction for minimal heat buildup.

Rock Drill Oil Packages

| Product | wt% | Type | Chemistry | Applications | Add-Ons |
|----------|--------|---------|-----------|--|-----------|
| RD-540 | 2.2wt% | Ashless | S/P/N | EP rock drill package – emulsifying (default option) | Tackifier |
| RD-540CP | 2.4wt% | Ashless | S/P/N | EP rock drill package – demulsifying | Tackifier |

Rock drill packages are designed for high shock loads to operate the hammering and drilling functions from heavy duty rock drill equipment down to pneumatic air tools. **FUNCTIONAL RD-540** and **RD-540CP** contain high levels of severe extreme pressure additives, corrosion inhibitors, and either an emulsifying or demulsifying agent. Standard OEM rock drill lubricants tend to be the emulsifying type to allow proper usage with the high amounts of water used to flush out cuttings as the rock drill works.

Saw Guide Oil Packages

| Product | wt% | Type | Chemistry | Applications | Add-Ons |
|---------|--------|---------|-----------|---|-----------|
| SGP-567 | 1.5wt% | Ashless | S/P/N | Multipurpose saw guide and forestry oil package | Tackifier |
| SGP-563 | 1.5wt% | Ashless | Ca | Ecolabel-listed low friction, phosphorus-free package | Tackifier |

Saw guide oil packages are designed for low friction and heat buildup. Saw guides experience high speed and sliding wear as lumber is cut. Low wear is important but heat buildup can cause blades to warp and lose temper before the blade has worn down. **FUNCTIONAL SGP-567** is a versatile package built around ashless friction modifiers. **FUNCTIONAL SGP-563** is an Ecolabel-listed alternative with greatly reduced coefficient of friction for negligible heat generation during use.

Pour Point Depressants

Functional Products Inc. offers a wide range of pour point depressants (PPDs) to improve the low temperature fluidity and cold flow performance of lubricants. The scientists at Functional Products Inc. can evaluate your base oil or formulated product determine the proper additive and treat rate to reduce cost and increase performance.

Pour Point Depressants for Petroleum Oils

FUNCTIONAL PD-6## series pour point depressants (PPDs) are engineered to selectively treat the different types of wax profiles found in API Group I, II, or III type paraffinic oils. Different catalysts, extractions, and hydrogenating conditions in the petroleum refining process produce different species of wax.

FUNCTIONAL PD-610, PD-620, and PD-630 are highly versatile polymethacrylate-based pour point depressants which are notable for their versatility in specific API Groups or viscosity ranges.

| Product | wt% | Chemistry | Application Note |
|---------------|--------|-----------|---|
| PD-610 | 0.3wt% | PMA | Medium to heavy Group I/II paraffinic and naphthenic oils; 220 SUS (ISO 46) and above |
| PD-620 | 0.3wt% | PMA | Light Group I/II/III oils; 150 SUS (ISO 32) and below |
| PD-630 | 0.3wt% | PMA | Light to heavy Group III oils (4/6/8 cSt Group III) |

Exact recommendation may depend on: the base oil manufacturer's production conditions and catalyst; use of viscosity modifiers or heavy base stocks; and the additive package.

Pour Point Depressants for Biobased / Fatty Esters

Pour point depressants (or "cold flow improvers") are critical for improving the low temperature fluidity of fatty esters, especially natural triglycerides like vegetable oil which contain high amounts of waxy fatty acids.

FUNCTIONAL PD-5## series pour point depressants (PPDs) are engineered to target the long chain fatty acids that inhibit the low temperature fluidity of certain biobased esters. Different vegetable oils or fats will respond differently to PPDs depending on the composition of the oil.

| Product | Viscosity, at 100°C | Chemistry | Ecolabel LuSC? | US EPA Cleangredients? | NSF HX-1? |
|----------------|---------------------|-------------|----------------|------------------------|-----------|
| PD-585 | 1200 | PMA | Yes | Yes | No |
| PD-555C | 300 | PMA | No | No | No |
| PD-570 | 400 at 40°C | Proprietary | No | No | No |
| PD-571 | 1100 at 40°C | Proprietary | No | No | No |

FUNCTIONAL PD-585 is a highly concentrated PMA pour point depressant which can also perform as a shear stable viscosity modifier. Listed on both European Ecolabel LuSC list and the US EPA Cleangredients program.

FUNCTIONAL PD-555C is the lowest viscosity, low treat PPD for biobased. This product performs well with blends of vegetable oil with white oil or Group III to improve oxidative stability while retaining biodegradability.

FUNCTIONAL PD-570 and **PD-571** are unique bio-derived pour point depressants which provide second and third supply chain options versus PMA PPDs. Both products are cold flow improvers for methyl esters and biodiesel.

Components and Chemistries

Functional Products Inc. manufactures individual components for delivering the exact performance needed.

Corrosion Inhibitors

| Product | wt% | Chemistry | Applications | Use With |
|---------|--------|-------------|--|----------------------------|
| CI-426 | 0.2wt% | P/N | Amine phosphate corrosion inhibitor with mild antiwear, EP; NSF HX-1 | Petroleum, PAO, Ester, PAG |
| CI-427 | 0.2wt% | P/N | Amine phosphate, replacement for CAS# 80939-62-4; NSF HX-1 | |
| CI-408 | 0.5wt% | Proprietary | Ferrous corrosion inhibitor for glycol/water blends | Glycol/Water |
| CI-498 | 0.2wt% | Proprietary | Ferrous corrosion inhibitor for aqueous lubricants; NSF HX-1 | Water |

FUNCTIONAL CI-426 and **CI-427** are neutral amine phosphate corrosion inhibitors for ferrous rust on iron or steel.

FUNCTIONAL CI-408 is a unique corrosion inhibitor for glycol or water/glycol mixtures.

FUNCTIONAL CI-498 is a corrosion inhibitor for aqueous (predominantly water-based) lubricants with mild antiwear.

Antiwear and Extreme Pressure

| Product | wt% | Chemistry | Applications | Use With |
|----------|--------|-----------|--|----------------------------|
| AW-116 | 0.5wt% | P/N | Amine phosphate balanced for AW/EP performance; NSF HX-1 | Petroleum, PAO, Ester, PAG |
| CI-426EP | 2.0wt% | S/P/N | Enhanced amine phosphate for extra EP protection; NSF HX-1 | |
| CI-446EP | 2.0wt% | P/N | Sulfur-free amine phosphate with extra EP protection; NSF HX-1 | |
| AW-487 | 0.5wt% | Na | Aqueous anti-wear and lubricity additive | Water |

FUNCTIONAL AW-116 is a mildly acidic amine phosphate which adds extra antiwear and EP performance while retaining good ferrous corrosion resistance. **FUNCTIONAL CI-426EP** and **CI-446EP** are amine phosphate blends with higher EP performance using either a sulfur or phosphorus based booster.

FUNCTIONAL AW-487 is an antiwear additive for aqueous lubricants with mild corrosion inhibition.

Demulsifiers

| Product | wt% | Chemistry | Applications | Use With |
|---------|--------|-----------|---|----------------------------|
| DM-240 | 0.1wt% | PAG | Highly effective industrial PAG-based demulsifier | Petroleum, PAO, Ester, PAG |
| DM-400 | 0.1wt% | Sulfonate | Versatile sulfonate-based demulsifier; NSF HX-1 | |

FUNCTIONAL DM-240 and **DM-400** provide two options from two different chemistry types to improve demulsibility in ASTM D1401, ASTM D2711, and steam emulsion number.

Defoamers

| Product | wt% | Chemistry | Applications | Use With |
|---------|--------|-----------|--|----------------------------|
| DF-110 | 0.1wt% | Silicone | Silicone defoamer balanced for synthetic (Group III/IV) oils | Petroleum, PAO, Ester, PAG |
| DF-400 | 0.1wt% | Silicone | Versatile silicone-based defoamer; Ecolabel, NSF HX-1 | |
| DF-500 | 0.1wt% | Acrylate | Acrylate-based defoamer for fatty esters / veg oil; Ecolabel | Fatty Esters / Veg Oil |

FUNCTIONAL DF-110, **DF-400**, and **DF-500** are effective defoamers for a wide range of applications.

FUNCTIONAL DF-500 is best in vegetable oils or TMPTO with long chain fatty acids. Specialty defoamers for more polar synthetic esters (adipates, short chain TMP esters) are available.

Guide to Industrial Additives

The table below is based on the original API GL service categories (GL-1 through GL-5) which are now obsolete but remain as an effective framework for deciding which additives and performance parameters should be used to approach increasingly severe applications. Each successive category includes additives from the previous categories.

| Application | Typical Components and Chemistry | EP Weld Load, ASTM D2783 | FUNCTIONAL Lines/Additives |
|---|---|--------------------------------|--|
| Rust & Oxidation (R&O) Oil GL-1 'Very Mild Duty' Gear Oil | Corrosion Inhibitors, Antioxidant, Defoamer, Demulsifier | ≤ 126 | CI- DM- DF- |
| Lubricants for Yellow Metals (Worm Gear, Specialty Way Oil) GL-2 'Mild Duty' Gear Oil | Sulfur-free antiwear and friction modifiers Fats, esters | 126 – 160 400+ worm gear | WA-60SF AW- |
| Way Oils, Hydraulic Fluid, Engine Oils, Bearing Oil, Circulating Oil, GL-3 'Moderate Duty' Gear Oil | Mild extreme pressure additives Inactive sulfur (1a), phosphorus, ZDDP, sulfonates | 200 – 250 | CI-426EP GA-307 HF-580 SGP-567 WA-64 |
| Industrial Gear (US Steel 224, AGMA 9005) GL-4 Automotive Gear (Diff., Manual Trans.) EP Grease (GC-LB, NLGI HPM) | Medium extreme pressure additives Passivated active sulfur (1b/2a) | 250 – 315 | GA-307 |
| GL-5 Automotive Gear (Hypoid Diff.) Air Tool, Rock Drill, Pneumatic Oil, Wireline | Severe extreme pressure additives Active sulfur (3a) | 315 – 400 | GA-614, RD-540CP |
| MT-1 Automotive Manual Transmission Oil | 'Clean gear' GL-5 accomplished with low corrosion GL-4 chemistry + dispersants + AO | 315 – 400 | GA-307 |
| Severe EP Lubricants Rock Crusher, Sugar Mill | Higher levels of active sulfur and phosphorus; molybdenum complexes | 400 - 620 | GA-614 |
| Open Gear Lubricants | Solid lubricants and low % soap thickener Graphite, molybdenum, boron nitride, metal powders | > 800 | CERAMAX |

The FUNCTIONAL additives listed are suggestions. The total formulation and its performance will determine the suitability for the intended application.