Industrial Packages

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FUNCTIONAL PRODUCTS INC.

Functional Products Inc. was founded in 1985. The Quality Management System is certified to ISO 9001:2008 (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.

Industrial Packages

FUNCTIONAL PRODUCTS INC.

Industrial Packages are fully formulated concentrates that are added to a base oil at performance-specific 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.

Noteworth

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.

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
Our Viscosity Modifier packages are high molecular weight polymers which change the temperature dependence of a liquid lubricants’ viscosity. These polymeric additives reduce mineral oil thinning as temperature increases. Polymers used as viscosity modifiers in oil have three critical attributes: improved viscosity index, enhanced thickening efficiency, and appropriate shear stability.

Liquid viscosity modifiers are used for ease of handling when preparing industrial fluids and lubricants. **FUNCTIONAL V-158, V-158F and V-160** may be used in preparing industrial fluids and lubricants.

**FUNCTIONAL V-460** is a clear and colorless NSF HX-1 approved (142396) shear-stable viscosity modifier that may be used in lubricants that may have incidental contact with food.

Solid viscosity modifiers are more convenient and economical when large quantities of additives are required and the equipment necessary to granulate the solid form of the product is available. **FUNCTIONAL V-100, V-101, and V-255** are OCP viscosity index improver polymers in concentrated form. When dissolved in oil, they are economical oil treatment additives.

The active thickeners in our viscosity modifiers are ethylene/propylene copolymers or proprietary polymers.

Due to the viscosity of **V-158** and **V-158F**, elevated temperatures of 50-90°C (122-200°F) can facilitate handling.

### Typical Properties

<table>
<thead>
<tr>
<th>Appearance</th>
<th>Liquid Form</th>
<th>Solid Form</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V-158</td>
<td>V-158F</td>
</tr>
<tr>
<td>Clear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flash Point (PMMC)</td>
<td>175°C (350°F)</td>
<td>150°C (300°F)</td>
</tr>
<tr>
<td>Kinematic Viscosity</td>
<td>1,000</td>
<td>1,600</td>
</tr>
<tr>
<td>cSt at 100°C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thickening Efficiency in ISO 32 at 100°C</td>
<td>6 cSt</td>
<td>14 cSt</td>
</tr>
<tr>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>PSSI (ASTM D627B)</td>
<td>45%</td>
<td>45%</td>
</tr>
<tr>
<td>Treatment Levels</td>
<td>See Below</td>
<td>5 - 20%</td>
</tr>
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</table>

### Liquid Viscosity Modifier Percent Treat in ISO 32 Base Oil

<table>
<thead>
<tr>
<th></th>
<th>V-158</th>
<th>V-158F</th>
<th>V-160</th>
<th>V-160F</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAE 20</td>
<td>10 - 11</td>
<td>3 - 5</td>
<td>5 - 7</td>
<td>3 - 5</td>
</tr>
<tr>
<td>SAE 30/600N</td>
<td>9 - 11</td>
<td>8 - 10</td>
<td>10 - 11</td>
<td>8 - 9</td>
</tr>
<tr>
<td>SAE 40</td>
<td>12 - 14</td>
<td>11 - 13</td>
<td>12 - 14</td>
<td>9 - 11</td>
</tr>
<tr>
<td>SAE 50</td>
<td>17 - 19</td>
<td>15 - 17</td>
<td>18 - 20</td>
<td>15 - 17</td>
</tr>
<tr>
<td>Bright Stock 150</td>
<td>25 - 27</td>
<td>23 - 25</td>
<td>22 - 24</td>
<td>19 - 21</td>
</tr>
</tbody>
</table>

The treat rates are given as reference values only. Treat rates are heavily dependent on the base oil and other additives used in the final formulation. It is up to the user to determine the proper treat rate.
FUNCTIONAL PRODUCTS offers low molecular weight polyisobutylene that perform similarly to polybutenes, but are more economical when preparing industrial fluids, lubricants and greases. FUNCTIONAL PIB-350 may be used as a replacement for polybutenes with a MW of 350. PIB-510 may be used to replace polybutenes with a MW of 510. Both products utilize a low MW polyisobutylene active thickener that has a single, uniform polymer repeat unit as compared to the copolymer polybutenes. The diluent is a paraffinic mineral oil.

**Cold Flow Improvers**

Cold flow improvers impede crystal formation in mineral and vegetable lubricants to improve performance at low temperatures. FUNCTIONAL PRODUCTS offers PD-555C for vegetable oils and esters and PD-600 and PD-610 for mineral oils. PD-555C is effective under both rapid cooling and extended storage for use in canola, rapeseed, soybean oils and certain esters. A 0.5% treat rate typically improves the cold flow properties by 10°C to 25°C.

FUNCTIONAL PD-600 and FUNCTIONAL PD-610 are wax-crystal modifiers used in mineral oils with applications in hydraulic fluids, gear oils, chain stays, pneumatic tools and motor oils. The selection between PD-600 and PD-610 depends on the compatibility between the cold flow improver and specific chain structure of the base oil. A treat rate of 0.1% may reduce the base oil cold flow properties by 20°C. FUNCTIONAL PRODUCTS will test our cold flow improvers in your base oils and report the results to you.

**Water Based Products**

FUNCTIONAL AW-487 is an anti-wear and lubricity additive for use in lubricants containing a significant amount of water. AW-487 contains no phosphorus, chlorine or heavy metals and can be used in environmentally sensitive applications.

FUNCTIONAL MW-612 is a low viscosity (3-8 cSt at 40°C) anti-mist additive that greatly reduces the formation of coolant mist in metal working applications.

FUNCTIONAL V-801 is an environmentally friendly, non-hazardous viscous liquid additive (40,000 cSt at 40°C) that thickens and adds tack to fluids made from water or emulsions of water and soluble oils. It may be blended to increase adherence and drip resistance to a liquid or colloidal suspension used in aqueous bar and chain oils or wire rope lubricants. It may also act as a binder for powders and an anti-sag agent in paints. Typical treat rates are 0.3% to 5%, depending on the application.

FUNCTIONAL CI-498 is a food-grade corrosion inhibitor composed of an aqueous solution of a phosphate salt for use in lubricants and hydraulic fluids that may have incidental food contact. Treat rates are generally 0.3% to 0.5%, dependent on other components of the formulation. CI-498 may be used with antioxidants, thickeners or other additives commonly found in relevant applications.
FUNCTIONAL HF-750 is a fully formulated rust and oxidation inhibitor additive package engineered for high-performance turbine grade R&O hydraulic fluids that provides excellent rust and oxidation protection. FUNCTIONAL HF-750 is a robust formulation designed to cope with moderate water contamination and provide superior filterability for longer life and reduced system maintenance.

FUNCTIONAL HF-750 is optimized to meet the following industry specifications:
- Cincinnati Milacron P-38, P-55, P-54, and P-57
- General Electric GEK-32568
- Solar Turbines ES9-224
- U.S. Military MIL-H-17672D
- DIN 51524, Part 1
- Hagglunds Denison, HF-1
- Hagglunds Denison, HF-0 Bench tests

In its concentrated form, FUNCTIONAL HF-750 may cause skin or eye irritation and should be handled with suitable personal protection. The concentrated form should not be heated unnecessarily, as heating could release fumes which may cause respiratory irritation. See the Safety Data Sheet. The oils made with FUNCTIONAL HF-750 are not hazardous.

**Typical Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Clear Brown Liquid</td>
</tr>
<tr>
<td>Lbs. Per Gallon</td>
<td>8.2</td>
</tr>
<tr>
<td>Flash Point</td>
<td>95°C (200°F) (PMMC)</td>
</tr>
<tr>
<td>Kinematic Viscosity</td>
<td>2.3 cSt at 100°C</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>1.89%</td>
</tr>
<tr>
<td>Solubility in Oil</td>
<td>Soluble</td>
</tr>
<tr>
<td>Solubility in Water</td>
<td>Insoluble</td>
</tr>
<tr>
<td>Treatment Level</td>
<td>0.8% by weight (0.75% by volume)</td>
</tr>
</tbody>
</table>

Additive for Biobased Hydraulic Fluid

FUNCTIONAL HF-580 is a non-hazardous light color, low odor additive package which is compatible in a wide variety of base oils including vegetable oils, high oleic algal oils, modified castor oils and synthetic esters including TMP and pentaerythritol esters. It also has outstanding solubility in Groups III and IV oils (PAOs) as well as OSP fluids. HF-580 can be formulated in high oleic canola oil to ISO 46 grade using approximately 2.5% FUNCTIONAL PD-551 as a highly shear stable thickener. The ISO 46 grade passes the V104C Vane Pump Test (ASTM D7043) and exhibits excellent demulsibility, rust and copper inhibition, 4-ball wear performance and hydrolytic and thermal stability. FUNCTIONAL HF-580 shows exceptional RPVOT oxidative stability, especially when used in base fluids with high oleic, high saturate and low polyunsaturate content such as very high oleic algal oils, modified castor oils and OSPs.

**Typical Properties**

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Clear Amber Liquid</td>
</tr>
<tr>
<td>Odor</td>
<td>Mild</td>
</tr>
<tr>
<td>Specific Gravity</td>
<td>0.98</td>
</tr>
<tr>
<td>Lbs. per Gallon</td>
<td>8.2</td>
</tr>
<tr>
<td>Flash Point</td>
<td>&gt;230°C (450°F)</td>
</tr>
<tr>
<td>Kinematic Viscosity</td>
<td>50 cSt at 40°C</td>
</tr>
<tr>
<td>Treatment Level (by weight)</td>
<td>2.5%</td>
</tr>
</tbody>
</table>

Use normal safe procedures for handling and blending FUNCTIONAL HF-580. Heating before blending is not required. Review the current Safety Data Sheet before using.

Industrial Gear Oil Additive Packages

**Open Gears and Enclosed Gears**

FUNCTIONAL GA-604 is a high-performance oil additive package for open and closed industrial gears. It may be blended into mineral oil or vegetable oils and esters. The GA-604 has EP/antiwear, copper/steel corrosion inhibition, pour point depressant, and oxidation inhibition especially suited for mineral oil and vegetable oil for open and enclosed gear lubricants. Gear oils formulated with FUNCTIONAL GA-604 may require an added demulsifier, foam inhibitor, or tackifier depending on the base oil application. The typical treat rate is 2.3% by weight.
Slide Way Additive Packages

Slide way lubricants are used to lubricate the ways of planers, grinders, horizontal boring machines, shapers, jig borers and milling machines. Our additive packages are formulated to provide high extreme pressure properties, a substantial reduction of friction, excellent wear protection and corrosion inhibition. Our additives are designed to make full-performance way lubricants that have excellent friction properties, are insensitive to alkalinity and are, therefore, resistant to removal by coolants.

FUNCTIONAL WA-24 is a way oil additive designed for use in Group I paraffinic oils. The additive package contains 7% inactive sulfur to provide EP and antiwear performance. The package also includes demulsifiers and ferrous and non-ferrous corrosion inhibitors. Fully formulated fluids will pass Fives Cincinnati P-47 specifications.

FUNCTIONAL WA-64 is a light color way oil additive compatible in a wide array of base fluids including mineral and vegetable oils, PAOs and PAGs. Compatibility in re-refined base oils should be checked. The additive package contains 12% active sulfur to provide EP and antiwear performance. The package also includes demulsifiers and ferrous and non-ferrous corrosion inhibitors. Fully formulated fluids in suitable base stocks will pass Fives Cincinnati P-47 and GM LS-2 specifications.

FUNCTIONAL WA-60SF is a non-hazardous, light color, ashless sulfur-free way oil additive designed for use in biobased fluids used in light duty applications. It is soluble in a range of base fluids including synthetic esters, algal oils and oil-soluble PAGs. FUNCTIONAL WA-60SF passes Fives Cincinnati stick-slip requirements and contains 2.2% phosphorous antiwear additives, demulsifiers and ferrous corrosion inhibitors.

### Typical Properties

<table>
<thead>
<tr>
<th></th>
<th>WA-24</th>
<th>WA-64</th>
<th>WA-60SF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extreme Pressure</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Corrosion Inhibition</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Demulsibility</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Color</td>
<td>Black</td>
<td>Amber</td>
<td>Amber</td>
</tr>
<tr>
<td>Base Oil Solubility</td>
<td>Group I</td>
<td>Group I/II/III/IV</td>
<td>Biobased</td>
</tr>
<tr>
<td>Treat Level wt%</td>
<td>1.75</td>
<td>1.75</td>
<td>1.4</td>
</tr>
</tbody>
</table>

Blending of Way Lubricants

We recommend using paraffinic oils in blending way lubricants. Soluble oil coolants are typically designed to effectively and efficiently emulsify naphthenic oil. These emulsifiers are not as effective with paraffinic oils, so paraffinic-based way lubricants will be more resistant to most soluble oils.

Way lubricant packages and tackifiers are compatible in a finished lubricant, however they are not compatible in the absence of the diluent oil. When blending a way lubricant, ensure that the way lubricant package or the tackifier is completely dispersed and dissolved before adding the other.

Do you need a better way lubricant?

A bottle test is useful for comparing way lubricants in an office or other non-laboratory environment. Fill two glass bottles half way with coolant. Using bottles taller than 4 inches (10 cm) will give results that are easier to see. Add \( \frac{1}{4} \)" (5-6 mm) of way lubricant, seal the bottles and invert a few times. Coolant compatibility is demonstrated by the quick appearance of a clear coolant layer; a coolant-incompatible way lubricant will emulsify into the coolant.
Evaluating the Coolant Compatibility of Way Lubricants

A way lubricant must be compatible with the metalworking coolant in order to resist emulsification. If the way lubricant is not resistant, the fluid will wash off the slide way and contaminate the coolant. If the way lubricant 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. It is critically important to evaluate a way lubricant with the actual coolant. If the coolant is not available, or if the way lubricant is to be used with several coolants, use an aqueous solution matching the coolant’s pH. While most way lubricants are resistant to emulsification in neutral water, the friction modifier additive of many way lubricants forms a salt when it is exposed to the alkalinity of many coolants. The salt can act as an emulsifier, and these way lubricants can therefore emulsify into the coolant, even though they are resistant to neutral water.

The ready separation of coolant from FUNCTIONAL PRODUCTS derived lubricants shows that the way lubricant is resistant to the coolant. When it is otherwise still serviceable, the coolant may be returned to use after merely skimming the tramp way oil. An emulsion from another way lubricant implies that the coolant will remove the way lube from the way, and shows that a more elaborate treatment (such as acidification) would be necessary to separate the oil, a treatment that will prepare the coolant for disposal rather than reuse.

Quantitative Evaluation:
Coolant compatibility can be quantitatively evaluated using ASTM D6553. In this test, 40 mLs of coolant and 40 mLs of lubricant are agitated for 5 minutes under standardized conditions. The test is observed every 5 minutes and amount of oil, aqueous phase and emulsion are recorded. The aqueous phase should be either the actual coolant or an alkaline buffer of pH 9.0 rather than distilled water. Separation from neutral pH water, whether tap or distilled, is not predictive of separation from coolants. A good way lubricant will separate within 30 minutes. The Schmidt-Koburg test evaluates similar separation from a variety of coolants over a period of a week.

Qualitative Evaluation:
Sometimes a qualitative evaluation is sufficient. ASTM D6553 testing can be simulated by placing 40 mLs of the candidate way lube and 40 mLs of the buffer or coolant in a 100 mL graduated cylinder and inverting ten to twenty times. A persistent emulsion or a coolant layer that stays cloudy with tramp oil demonstrates poor compatibility. A good coolant-compatible way lubricant will quickly float to the top of the cylinder and the coolant will become clear.

Additives for Mist Inhibition and Worker Safety

Misting of metalworking coolants is an environmental and health concern in many metal-removal applications such as milling and grinding. Conventional control technologies frequently involve high capital expenditures and maintenance cost. FUNCTIONAL MW-612 and V-162 are additives that greatly reduce the formation of coolant mists, and are especially valuable in equipment that lacks mist-collecting systems.

FUNCTIONAL MW-612 is for soluble oils, semi-synthetics and full synthetic coolants. It is added tank side at a 0.05% treat rate in the finished fluid, or at a 0.5% in an additive package. MW-612 reduces misting by 63% at a 0.05% treat rate.

FUNCTIONAL V-162 is formulated into an oil-based cutting oil to reduces the oil mist during use. Depending on the speed of machining and the viscosity of the cutting oil, treatment levels vary from 0.02% to 0.10% (200 - 1000 ppm). For tank-side additions, a weekly replenishment is appropriate, but high-shear applications such as deep boring may require daily replenishment. V-162 reduces oil mist by 46% at a 0.1% treat rate.

<table>
<thead>
<tr>
<th>Typical Properties</th>
<th>MW-612</th>
<th>V-162</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appearance</td>
<td>Milky Liquid</td>
<td>Yellow-orange</td>
</tr>
<tr>
<td>Lbs. per Gallon</td>
<td>8.7</td>
<td>7.1</td>
</tr>
<tr>
<td>Flash Point</td>
<td>None</td>
<td>150ºC (300ºF)</td>
</tr>
<tr>
<td>Kinematic Viscosity at 40ºC</td>
<td>3-8 cSt</td>
<td>600-1100 cSt</td>
</tr>
<tr>
<td>Mist Abatement*</td>
<td>63%</td>
<td>Up to 46%</td>
</tr>
<tr>
<td>Treatment Level</td>
<td>0.05%</td>
<td>0.02-0.10%</td>
</tr>
</tbody>
</table>

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

FUNCTIONAL PRODUCTS INC.
8282 Bavaria Road
Macedonia, OH 44056
Phone: 330-963-3060
Fax:330-963-3322
sales@functionalproducts.com
sds@functionalproducts.com
www.functionalproducts.com

North America

United States

Midwest
Hall Technologies
St. Louis, MO
Phone: 314-725-2600
www.halltechinc.com

East Coast
Ivanhoe Industries, INC.
Tullytown, PA
Phone: 215-547-1200
j.snyder@ivanhoeindustries.com
www.ivanhoeindustries.com

West Coast
Tri-iso Tryline, LLC
Cardiff By The Sea, CA
Phone: 909-626-4855
www.tri-isocom

Canada
MCD Canada Limited
Brampton, Ontario
Phone: 800-575-3382
www.imcdca.com

Mexico
Proaindsa
Mexico City DF, Mexico
Phone: 011-52-556-696-5551
jgarduno@proaindsa.com

Australia

A. S. Harrison & Co Pty Ltd.
Brookvale, Australia
Phone: +61 2 8978 1000
www.asharrison.com.au

Europe

France
Lunar France
Carrières sur Seine, France
Phone: +33 (0) 80 83 50 40
contact@lumarfrance.com
www.lumarfrance.com

Germany
Lunar Deutschland
Stuttgart, Germany
Phone: +49 (0)711-18-56-27-13
info@lumardeutschland.com
www.lumardeutschland.com

Italy
Lunar Italia Srl
Assago, Italy
informazioni@lumaritalia.com
www.lumaritalia.com

Spain, Turkey
Lumar Quimica, S.L.U.
Barcelona, Spain
lumar@lumarquimica.com
www.lumarquimica.com

Sweden, Finland, Norway, Denmark, Estonia, Latvia, Lithuania
PEMCO Additives
Hisings Backa, Sweden
Phone: +46 31 775 67 80
lars-erik.lijherd@pemco.org
www.pemco.org

United Kingdom
Lunar UK
London, England
Phone: +0203 318 5698
axel.fahri@lumar-uk.com
www.lumar-uk.com

Middle East

United Arab Emirates
Environ Speciality Chemicals Gulf FZE
Ras Al Khaimah, UAE
Phone: +971 52548 5751
ravi@environchemfze.com
www.environchemfze.com

Asia

China
Smart Oil & Chemical Limited
Hong Kong
www.smart-oil.com

Greenbase Industries, Inc.
Shanghai
Phone: 86-186-2158-0862

Japan
Nippon Chemicals Sales Co., Ltd.
Tokyo, Japan
Phone: 03-3719-0366
info@ncstokyo.co.jp
www.ncstokyo.co.jp

Thailand
Connell Brothers Company Ltd.
Bangkok
Phone: 66-0-2259-8500
Cell: 66-8-1755-1021
Wut.C@wecocbc.com
www.connellbrothers.com

Korea
Inwoo Corp.
Seoul
Phone: 82-2-2202-7028
inwoo@inwoocorp.co.kr
www.inwoocorp.co.kr

Singapore
Eweka International Pte. Ltd.
Singapore
Phone: 65-6348-7279
rianto@ewekainternational.com
www.ewekainternational.com

Taiwan, ROC
Shiony Chemical Co. Ltd.
Taipei
Phone: 886-2-2356-0258
shiony@ms31.hinet.net
shiony.taipei@msa.hinet.net
www.shiony.com