

# Viscosity Modifiers



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# Viscosity Modifier Selection

Viscosity modifiers, or “VM”, are a diverse range of different polymers which allow formulators to control the viscosity behavior of lubricants. This brochure features industrial viscosity modifiers for petroleum based lubricants and greases. Specialty VMs for biobased or incidental food contact (NSF H1) are described in the **Biobased** and **Food Machinery** brochures from Functional Products Inc.

Viscosity modifiers may also be called or include:

- **“Viscosity index improvers”** or **“VI improvers”** when the VM provides a substantial increase to the viscosity at 100°C. This reduces the thinning of oil at high temperatures and improve the viscosity index (VI). Medium to high molecular weight polymethacrylates and olefin copolymers are examples.
- **“Thickeners”** when only viscosity at 40°C for an ISO grade or viscosity at 100°C for an SAE grade are desired without considering VI. Low molecular weight polybutenes are an example. This term can also include heavy petroleum cuts like bright stock.
- **“Synthetic base stocks”** for low to medium molecular weight polymers with excellent shear stability and strong thickening efficiency. High viscosity metallocene PAO (mPAO), liquid ethylene-propylene oligomers (EPO), and shear stable polymethacrylates are examples.

Contact us at [sales@functionalproducts.com](mailto:sales@functionalproducts.com) for custom dilutions, base fluids, and more to achieve your goals.

## Olefin Copolymers (OCP)

Olefin copolymers are a diverse group of polymers with medium to high molecular weight which are best suited for medium to low shear applications. These applications include: engine or crankcase oil, tractor fluids, hydraulic fluids, pneumatic oils, greases, rust preventatives, and general purpose industrial lubricants. OCPs are a cost effective replacement for heavy petroleum oils and provide both improved low temperature fluidity and greater high temperature viscosity.

### Olefin Copolymers in Liquid Form

High quality OCP pre-dissolved in highly refined petroleum oil is the fastest and most convenient option to add viscosity to a lubricant or grease formulation.

Product	Viscosity, at 100°C	PSSI, ASTM D6278	Chemistry	Base Oil	Thickening Efficiency, 10wt%
V-160	1000	22	OCP	Paraffinic	11.0 cSt
V-166	1200	35	OCP	Paraffinic	11.4 cSt
V-158	1200	45	OCP	Paraffinic	11.9 cSt
V-158F	1400	50	OCP	Paraffinic	12.1 cSt
V-186	4500	60	OCP	Paraffinic	12.3 cSt

## Styrene Olefin Copolymers

Styrene copolymers offer higher thickening, lower PSSI, and higher viscosity index than conventional olefin copolymers. **FUNCTIONAL V-4310 series** is based on diblock styrene polymer architecture which disperses carbonized soot particles to prevent sludge formation and abrasive wear.

**FUNCTIONAL V-4318, V-4312, and V-4314** offer difference balances of oil drain interval versus thickening efficiency.

**FUNCTIONAL V-4316** is a dilute but effective workhorse grade for multipurpose lubricants and adding water resistance, consistency, and tack to greases.

Product	Form	PSSI, ASTM D6278	Base Oil	Chemistry	Thickening Efficiency
V-4318	Liquid	0 – 5	Paraffinic	Styrene OCP	8.9 cSt
V-4312	Liquid	5 – 10	Paraffinic	Styrene OCP	10.0 cSt
V-4314	Liquid	20 – 25	Paraffinic	Styrene OCP	12.3 cSt
V-4316	Liquid	60	Paraffinic	Styrene OCP	11.2 cSt

## Polymethacrylates (PMA)

**FUNCTIONAL M Series** viscosity modifiers are polymethacrylate copolymers which offer greatly improved shear stability, viscosity index improvement, and low temperature fluidity versus olefin copolymer (OCP) viscosity modifiers. Olefin copolymers typically have PSSI from 20 – 60 by ASTM D6278 diesel injector shear; polymethacrylates can achieve PSSI as low as 0 by ASTM D6278 and require the more aggressive 20 Hour KRL (CEC L-45-A-99) test to exhibit shearing of viscosity. **FUNCTIONAL MH-2000, MH-4500, and MH-7000** are highly recommended starting points.

Product	Viscosity, at 100°C	PSSI, ASTM D6278	PSSI, 20 Hour KRL	Thickening Efficiency, 10wt%	Key Applications
MG-1000	1050	0	15	9.8 cSt	Gear oil and HF in (PAO)
MG-3000	550	0	20	11.0 cSt	Gear oil and HF in Group I-III
MH-2000	1050	1	35	9.7 cSt	Economy gear oil
MH-4500	1550	15	65	13.0 cSt	Hydraulic fluid
MH-7000	1550	36	N/A	14.6 cSt	High VI industrial, engine oil

For pour point depressants, see the **Industrial Additives** brochure from Functional Products Inc.

## Dispersant Polymethacrylates (D-PMA)

**FUNCTIONAL MD** polymethacrylates include a small percentage (<1%) of nitrogen functionality to greatly reduce deposits formed from high temperature and oxidation. **FUNCTIONAL MD** products are often used in clutch or transmission fluids for tractor, automotive, and racing where high heat and wear is generated.

Product	Viscosity, at 100°C	PSSI, ASTM D6278	PSSI, 20 Hour KRL	Thickening Efficiency, 10wt%	Key Applications
MD-2200	1550	3	35	9.0 cSt	Dispersant gear and hydraulic fluid
MD-8004	950	40	N/A	16.9 cSt	Tractor hydraulic, ATF

# High Viscosity Synthetic Base Stocks

Synthetic base stocks are defined here as shear stable polymers meeting or exceeding the 15% viscosity loss by DIN 51350-6 (also known as 20 Hour KRL or CEC L-45-A-99) for applications like HVLP high VI hydraulic fluid or OEM gear oils. These high viscosity options are able to effectively thicken low viscosity fluids with minimal shear loss in severe duty applications.

For information on our **FUNCTIONAL V-5000** biobased/biodegradable base stocks please see the [Biobased Brochure](#).

Product	Chemistry	Viscosity, at 40°C	Viscosity, at 100°C	Viscosity Index	PSSI, 20 Hour KRL	Flash Pt., D92 COC	Density, lb/gal	Color, D1500
V-731	EPO	19000	1100	270	10	280°C	7.1	0.5
V-732	EPO	40000	2000	290	15	290°C	7.1	0.5
MB-1010	PMA	44000	900	170	15	200°C	7.8	1.0
V-705	LT-PO	37000	6500	510	4	220°C	7.5	<0.5

## FUNCTIONAL V-731 and V-732

### Industrial Ethylene Propylene Oligomers

**FUNCTIONAL V-731** and **V-732** are low molecular weight copolymers (“oligomers”) of ethylene and propylene in liquid form. Ethylene propylene oligomer (or “EPO”) viscosity modifiers offer the best thermal, oxidative, and hydrolytic stability versus other synthetic base stocks including metallocene PAOs.

## FUNCTIONAL MB-1010

### Polymethacrylate Base Stock

**FUNCTIONAL MB-1010** is a high viscosity synthetic base stock which has been tailored for improved thickening efficiency, high VI improvement, and low temperature fluidity in PAOs for applications like full synthetic 75W automotive gear oils. **FUNCTIONAL MB-1010** contains polar ester functional groups and can improve the solubility of synthetic formulations versus EPO or mPAO thickeners.

## FUNCTIONAL V-705

### Proprietary ‘Low Temperature Polyolefin’ Base Stock

Proprietary “low temperature polyolefin” **FUNCTIONAL V-705** is ideally suited for low temperature, high VI hydraulic fluids in paraffinic oil. **FUNCTIONAL V-705** provides highly shear stable thickening without negligible effect on low temperature fluidity to achieve PAO-like fluidity with mineral oil formulations and economics.

**FUNCTIONAL V-705** is not recommended for the extreme temperatures and oxidative stress of industrial and automotive gear oils, transmission oils, or clutch fluids.