ExxonMobil
Energy lives here™

Innovate confidently

ExxonMobil advanced synthetic base stocks

ExxonMobil Chemical synthetic base stocks

Energizing lubricant innovation

Our broad portfolio of advanced technology synthetic base stocks deliver the blending flexibility you need to formulate innovative lubricants for today's demanding marketplace.

Energizing lubricant innovation

To formulate innovative lubricants for today's demanding marketplace, you can count on the blending flexibility offered by our robust portfolio of advanced technology synthetic base stocks.

SpectraSyn™ MaX PAO

As the trend toward lower viscosity engine oils to promote fuel economy continues, and the need grows for new electric vehicle fluids, you now have a solution: SpectraSyn™ MaX PAO. Through unprecedented balance of low viscosity and low volatility, groundbreaking SpectraSyn MaX PAO is designed to help deliver enhanced fuel economy and energy efficiency without sacrificing durability and wear protection.

SpectraSyn Elite™ mPAO

Your finished lubricants must provide outstanding performance over a wide temperature range, enhanced energy efficiency, long drain intervals and cold-start capability and fluidity. To help you achieve these goals, we offer SpectraSyn Elite high-performance, high-viscosity metallocene polyalphaolefin (mPAO) base stocks. With improved shear stability, higher viscosity index (VI) and lower pour points, SpectraSyn Elite mPAO portfolio enables better blending efficiency and performance capabilities than conventional synthetic PAO.

SpectraSyn™ PAO

To help your lubricants keep pace with ever-increasing performance demands, even in the extremes of hot and cold temperatures, SpectraSyn synthetic polyalphaolefin (PAO) base stocks are available in a full range of low and high viscosities. SpectraSyn PAO meets fluidity requirements for a variety of synthetic and synthetic blend lubricants.

SpectraSyn Plus™ PAO

SpectraSyn Plus PAO offers you the flexibility to formulate top-tier lubricants with enhanced low-temperature performance. An advanced low-viscosity synthetic fluid with low volatility and low-temperature fluidity, SpectraSyn Plus PAO can help you formulate innovative lubricants that meet the challenges of extended drain intervals and improved energy efficiency.

Synesstic™ AN

A synthetic base stock that solves the need for exceptional hydrolytic and thermo-oxidative stability. As a blend component with PAO or mineral oils, Synesstic alkylated naphthalene (AN) can enhance lubricant performance in a variety of automotive and industrial applications through its excellent additive solvency and seal compatibility.

Esterex™ esters

When your finished lubricants need to deliver longer equipment life and high-temperature capability, find your solution with Esterex esters. They can be used as a sole base stock or in combination with other base fluids to enhance the capabilities of your lubricants. Many esters are readily or inherently biodegradable (see "Biodegradability data" table in Esterex esters section).

Your source for advanced synthetic base stocks

Today's formulators face demands for greater energy efficiency, emissions reductions and fuel economy. They also strive to create lubricants that provide longer drain intervals, better performance in a wider temperature range and increased durability under severe conditions. These challenges spark a need for innovation.

Our broad portfolio of advanced synthetic base stocks can help meet the high performance expectations of Original Equipment Manufacturers (OEM), as well as increasingly demanding specifications. Let us work together to energize your innovation.

SpectraSyn™ MaX PAO*

Grade	SG at 15.6/ 15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	CCS at A/B cP**	NOACK volatility, wt. %	Flash point (COC) °C
	ASTM D4052	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D5293	ASTM D5800/ DIN51581	ASTM D92
SpectraSyn MaX 3.5	-	3.51	14.26	128	-78	790	11.6	234

SpectraSyn Elite™ mPAO*

Grade	SG at 15.6 / 15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	Flash point (COC) °C
	ASTM D4052	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D92
SpectraSyn Elite 65	0.846	65	614	179	-42	277
SpectraSyn Elite 150	0.849	156	1649	210	-33	277
SpectraSyn Elite 300	0.849	303	3358	241	-33	286

SpectraSyn™ PAO*

Grade	SG at 15.6/ 15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	CCS at A/B cP**	NOACK volatility, wt. %	Flash point (COC) °C
	ASTM D4052	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D5293	ASTM D5800/ DIN51581	ASTM D92
SpectraSyn 2	0.798	1.7	5.0	N/A	-66	–	–	157
SpectraSyn 2B	0.799	1.8	5.0	N/A	-54	–	–	149
SpectraSyn 2C	0.798	2.0	6.4	N/A	-57	–	–	>150
SpectraSyn 4	0.820	4.1	19.0	126	-66	1,424 A	<14.0	220
SpectraSyn 5	0.824	5.1	25.0	138	-57	2,420 A	6.8	240
SpectraSyn 6	0.827	5.8	31.0	138	-57	2,260 B	6.4	246
SpectraSyn 8	0.833	8.0	48	139	-48	4,800 B	4.1	260
SpectraSyn 10	0.835	10.0	66	137	-48	8,840 B	3.2	266
SpectraSyn 40	0.850	39.0	396	147	-36	–	–	281
SpectraSyn 100	0.853	100.0	1240	170	-30	–	–	283

**CCS at A/B: A= -35°C, B= -30°C

SpectraSyn Plus™ PAO*

Grade	SG at 15.6/ 15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	CCS at -35°C cP	NOACK volatility, wt. %	Flash point (COC) °C
	ASTM D4052	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D5293	ASTM D5800/ DIN51581	ASTM D92
SpectraSyn Plus 3.6	0.816	3.6	15.4	120	<-65	1,050	<17	224
SpectraSyn Plus 4	0.820	3.9	17.2	126	<-60	1,290	<12	228
SpectraSyn Plus 6	0.827	5.9	30.3	143	<-54	3,600	<6	246

* Typical properties; actual values will vary; not to be construed as specifications; sales specifications available at exxonmobilsynthetics.com.
(b) Single sample or two sample average determination
BRCP 4843 at 20/20°C

A= Adipate, NP= Neopolyol, P= Phthalate, TM= Trimellitate

Source of test results/product information: ExxonMobil data

Synesstic™ AN*

Grade	SG at 15.6/ 15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	Flash point (COC) °C	Color	Water ppm	TAN mg KOH/g
	ASTM D4052	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D92	ASTM D1500	ASTM E1064/ *D6304	ASTM D974 (Mod)
Synesstic 5	0.908	4.7	29.0	74	-39	222	<1.5	<50	<0.05
Synesstic 12	0.887	12.4	109	105	-36	258	<4.0	<50*	<0.05

Esterex™ esters*

Grade	SG at 15.6/ 15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	Flash point (COC) °C	Water ppm	TAN mg KOH/g	Biodeg %[b]
	ASTM D4052/ *BRCP 4843	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D92	ASTM E1064/ *D6304	ASTM D974 (Mod)/ *BRCP 4625	OECD 301F/ *OECD301B
Esterex A32	0.928*	2.8	9.5	149	-65	207	<500*	<0.08	70.2
Esterex A34	0.922*	3.2	12	137	-60	199	<1000*	<0.08*	78.5
Esterex A41	0.921	3.6	14	144	-57	231	<500	0.01	76.5
Esterex A51	0.915	5.4	27	136	-57	247	<350	0.02	58.5
Esterex NP343	0.945	4.3	19	136	-48	257	<350	0.02	76.4*
Esterex NP451	0.993	5.0	25	130	-60	255	<500	0.01	83.6
Esterex P61	0.967	5.4	38	62	-42	224	<1000*	<0.07	71.4
Esterex P81	0.955	8.3	84	52	-33	265	<1000*	<0.14	54.5
Esterex TM111	0.978*	11.9	124	81	-33	274	<1000*	<0.16	<1.0

* Typical properties; actual values will vary; not to be construed as specifications; sales specifications available at exxonmobilsynthetics.com.
([b]) Single sample or two sample average determination
BRCP 4843 at 20/20°C

A= Adipate, NP= Neopolyol, P= Phthalate, TM= Trimellitate

Source of test results/product information: ExxonMobil data

SpectraSyn™ MaX polyalphaolefin (PAO) base stock

Enables step-out fuel economy and energy efficiency

Groundbreaking SpectraSyn MaX PAO is designed to help you create low-viscosity lubricants that enhance fuel economy and energy efficiency while delivering wear protection and long drain intervals.

Today's automakers want engine and driveline oils that increase fuel economy, helping them meet strict emission regulations. They want electric vehicle fluids that enhance mileage range. Now you can deliver these benefits with a next-generation base stock solution: SpectraSyn MaX PAO.

Compared to Group III and traditional PAOs, SpectraSyn MaX PAO is designed to help provide:

- Better fuel efficiency in internal combustion engines to lower CO_2 emissions
- Better energy efficiency in electric vehicles to extend mileage range
- Enhanced durability and wear protection

The key to this step-out performance: unprecedented balance of low viscosity and low volatility. Through its one-of-a-kind molecular structure, SpectraSyn MaX PAO offers:

- Outstanding low-temperature properties
- Excellent thermal and oxidative stability
- Enhanced lubricity, traction and flashpoint

For engine oils, that means enhanced fuel economy, wear protection and durability. For EV fluids, it means stable dielectric properties, enhanced energy efficiency, and a safer, lighter, more efficient system. Meet the future of lubrication.

Performance benefits include:

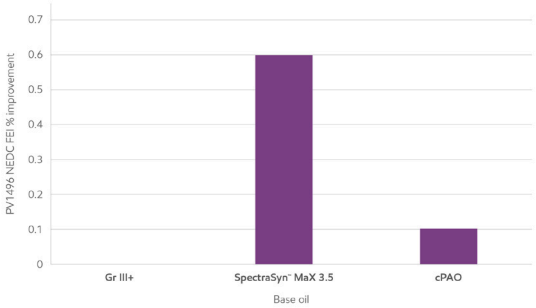
- Enhanced fuel economy for engine oils and driveline fluids
- Energy efficiency for EV driveline and industrial applications
- Thermal management for e-motor and battery use

SpectraSyn™ MaX PAO*

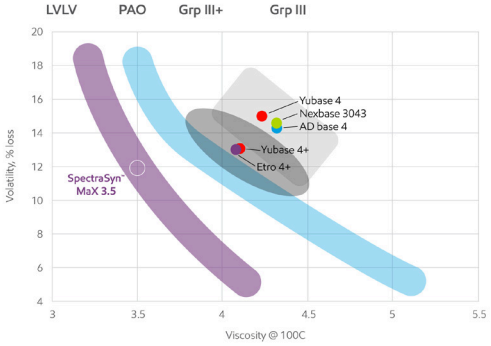
Grade	SG at 15.6/ 15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	CCS at A/B cP**	NOACK volatility, wt. %	Flash point (COC) °C
	ASTM D4052	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D5293	ASTM D5800/ DIN51581	ASTM D92
SpectraSyn MaX 3.5	-	3.51	14.26	128	-78	790	11.6	234

*Typical properties; actual values will vary; not to be construed as specifications; sales specifications available at exxonmobilsynthetics.com.

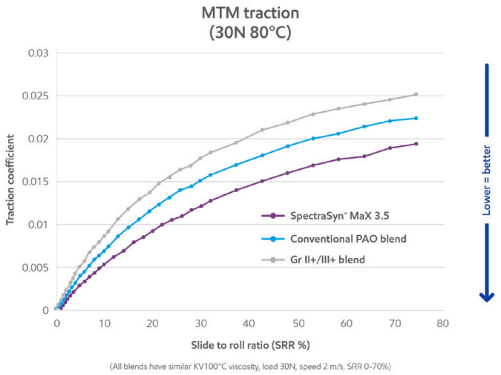
Improved fuel economy



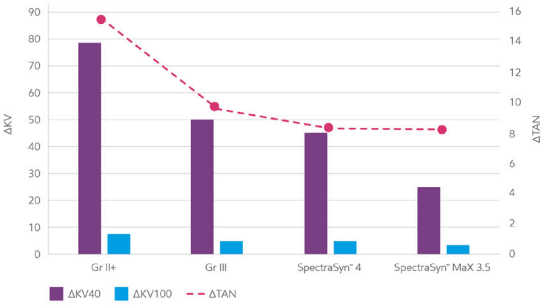
Uncompromising balance (LVLV)



Greater energy efficiency



Enhanced oxidative stability



Source of test results/product information: ExxonMobil data

SpectraSyn Elite™ 65 & 150 metallocene polyalphaolefin (mPAO) base stocks

Empowering innovation for evolving lubricant needs

To help meet increasing demands for energy efficiency, enhanced performance and product durability, look to the advanced technology of SpectraSyn Elite (mPAO).

Demand continues to grow for lubricants that offer greater energy efficiency, longer drain intervals, better performance in a wider temperature range and increased durability even under severe conditions. To help satisfy these needs, formulators must develop innovative products. That's why so many of them are turning to SpectraSyn Elite metallocene polyalphaolefin (mPAO) base stocks.

High-performance, high-viscosity SpectraSyn Elite mPAO provides the versatility you need to formulate a wide range of innovative finished lubricants to help meet the needs of the demanding marketplace. Created using a proprietary catalyst process, SpectraSyn Elite mPAO synthetic base stocks deliver improved shear stability, blending efficiency, higher viscosity index (VI) and lower pour point compared to conventional PAO. Additionally, SpectraSyn Elite mPAO can help to provide enhanced energy efficiency in formulated oils.

SpectraSyn Elite mPAO is well suited for industrial and automotive applications. Meet today's and tomorrow's challenges with SpectraSyn Elite mPAO base stocks that deliver a truly next-generation, advanced technology solution.

Performance benefits include:

- Improved shear stability for durability
- High VI for low- and high-temperature performance
- Low pour point and better Brookfield Viscosity for improved low-temperature fluidity

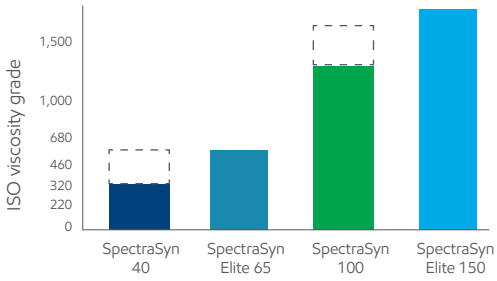
SpectraSyn Elite™ 65 & 150 mPAO*

Grade	SG at 15.6 / 15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	Flash point (COC) °C
	ASTM D4052	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D92
SpectraSyn Elite 65	0.846	65	614	179	-42	277
SpectraSyn Elite 150	0.849	156	1649	210	-33	277

* Typical properties; actual values will vary; not to be construed as specifications; sales specifications available at exxonmobilsynthetics.com.

Enhanced blending flexibility

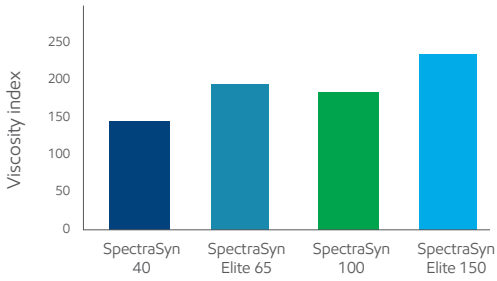
Viscosity grade coverage by product



SpectraSyn Elite mPAOs provide the ability to blend to a wide viscosity range.

Viscosity index comparison

Neat base stocks

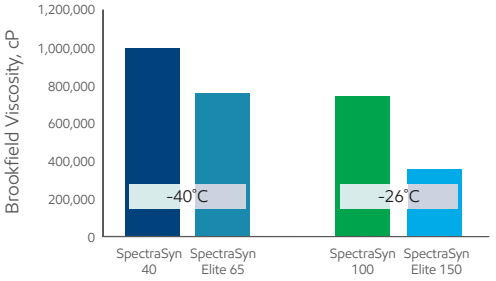


SpectraSyn Elite mPAOs demonstrate improved viscosity index.

Test method: ASTM D2270

Brookfield comparison

Neat base stocks

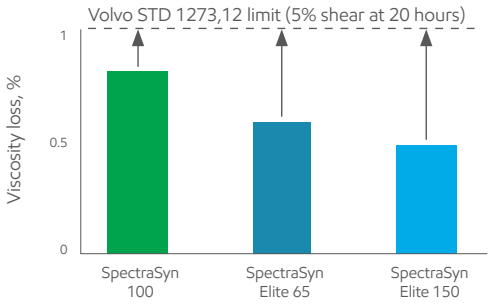


SpectraSyn Elite mPAOs have improved low-temperature fluidity.

Test method: ASTM D2983

Shear stability of formulated oils

Automotive gear oil — 75W-90



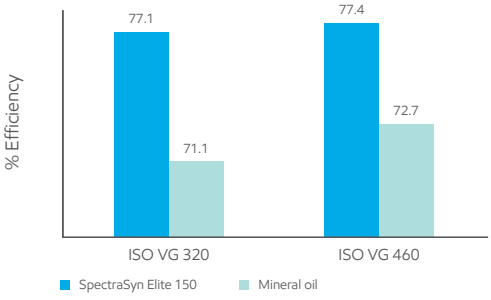
The shear stability benefits of SpectraSyn Elite mPAOs can translate into finished formulations.

Test method: CEC L-45-A-99 100 hrs

Energy efficiency of formulated oils

Worm gear efficiency rig

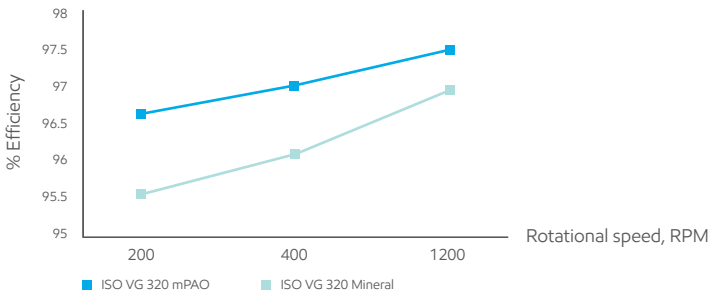
High sliding contact region



Test method: ExxonMobil method

FZG full load

Slide to rolling contact region



Test method: ASTM D5182

SpectraSyn Elite 150 can provide enhanced energy efficiency in formulated oils compared to mineral oils.

Source of test results/product information: ExxonMobil data

SpectraSyn Elite™ 300 metallocene polyalphaolefin (mPAO) base stock

Enhancing formulator flexibility

Offering unique formulation options, SpectraSyn Elite 300 is your high-viscosity base stock solution to help meet the ever more stringent requirements of high-performance lubricants.

This breakthrough extension of our family of metallocene polyalphaolefin (mPAO) base stocks demonstrates our ongoing commitment to helping you meet the demand for lubricants that provide energy efficiency, long drain intervals, and high performance at a wide temperature range.

Well-suited for industrial and automotive applications, SpectraSyn Elite 300 delivers:

- Enhanced film thickness, which can help your lubricants minimize wear, even in severe environments
- A unique balance of shear stability and low-temperature performance
- A broader lubricant temperature operating range due to high VI
- A low pour point and good Brookfield viscosity for enhanced low-temperature fluidity
- Excellent performance capabilities suited to formulating industrial oils and greases, as well as select automotive applications

Formulation flexibility

SpectraSyn Elite 300 expands our line of advanced mPAO base stocks, focused on competing with other high viscosity base stocks. Particularly well-suited for formulating industrial oils requiring high stability under severe operating conditions, SpectraSyn Elite 300 can be used in combination with lower viscosity fluids to achieve a wide range of oils and greases, as well as select automotive applications.

Our 50 kT world-scale mPAO plant demonstrates our commitment to helping the industry meet the increasing demand for these high-performance base stocks, so you can innovate — and grow — with confidence.

Performance benefits include:

- High viscosity index (VI)
- Excellent low-temperature properties
- Good shear stability for enhanced durability
- Flexibility in formulating a broad range of ISO VG lubricants

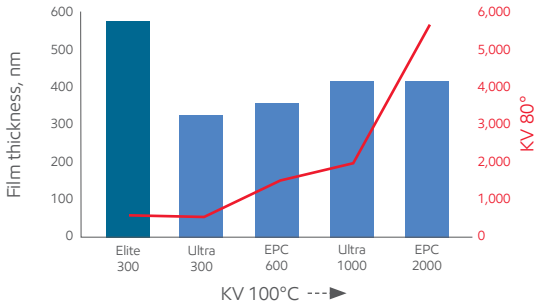
See comparisons to other high viscosity base stocks on the following page.

SpectraSyn Elite™ 300 mPAO*

Grade	SG at 15.6 / 15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	Flash point (COC) °C
	ASTM D4052	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D92
SpectraSyn Elite 300	0.849	303	3358	241	-33	286

* Typical properties; actual values will vary; not to be construed as specifications; sales specifications available at exxonmobilsynthetics.com.

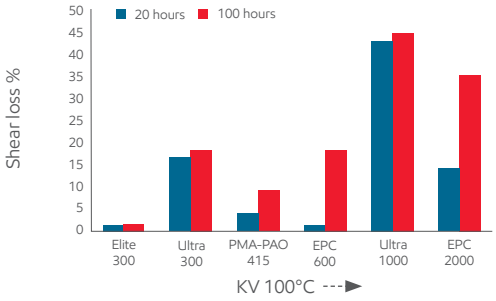
Film thickness
Neat base stocks



SpectraSyn Elite 300 demonstrates enhanced film thickness.

Test method: MTM film thickness, 20N load rolling @ 80°C

Shear stability
Neat base stocks



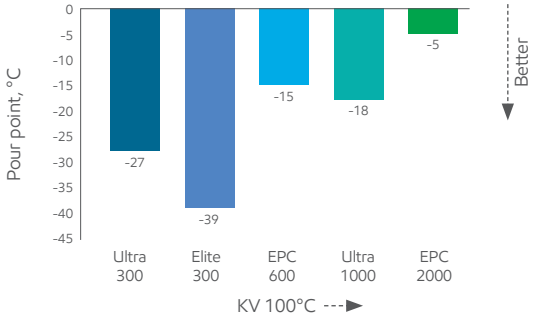
SpectraSyn Elite 300 provides good shear stability.

Test method: CEC L-45-A-99

High viscosity base stocks

Elite = SpectraSyn Elite mPAO
Ultra = SpectraSyn Ultra™ PAO
EPC = Ethylene propylene copolymer
PAMA = Polyalkylmethacrylate
PIB = Polyisobutylene
PMA-PAO = Polymethacrylate PAO

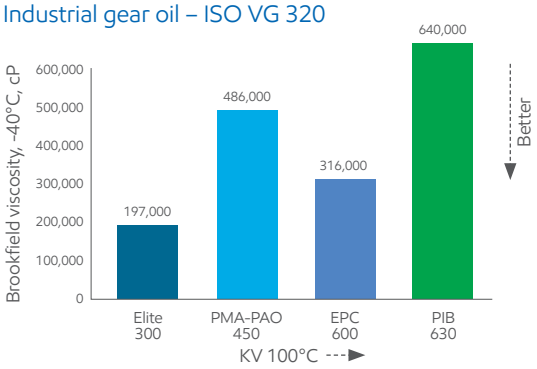
Pour point comparison
Neat base stocks



SpectraSyn Elite 300 provides lower pour point.

Test method: ASTM D5950

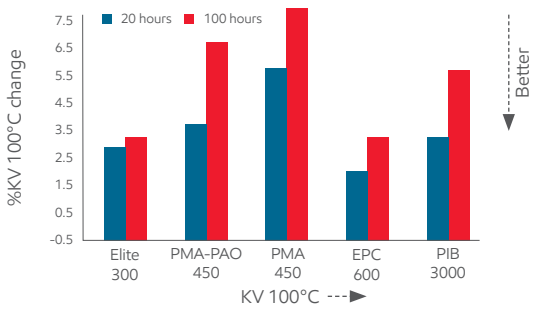
Brookfield comparison
Industrial gear oil – ISO VG 320



SpectraSyn Elite 300 provides excellent low-temperature fluidity.

Test method: ASTM D2983

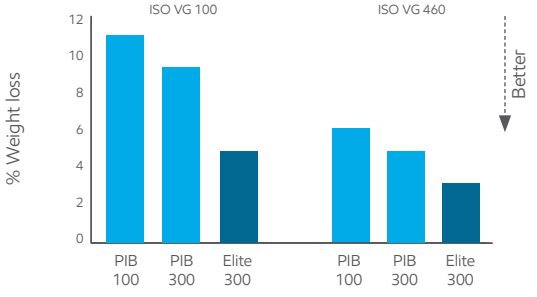
Shear stability of formulated oils
Automotive gear oil - SAE90



SpectraSyn Elite 300 shear stability benefits translate into finished formulations.

Test method: CEC L-45-A-99

Water washout protection
NLGI #2 grease lithium complex thickener commercial additive package



SpectraSyn Elite 300 can help contribute to better water washout protection.

Test method: ASTM D12; water washout at 79°C

Source of test results/product information: ExxonMobil data

SpectraSyn™ polyalphaolefin (PAO) base stocks

Trusted synthetic base stocks for your premium lubricants

SpectraSyn PAO base stocks are designed to help you create finished lubricants that satisfy ever-increasing performance demands.

Formulators of finished automotive and industrial lubricants face difficult challenges. The marketplace demands enhanced performance capabilities, improved flow at low temperatures and better durability. For trusted solutions, they can turn to our portfolio of PAOs, which help meet a wide range of performance requirements for many lubricant applications, such as passenger car engine oils, driveline lubricants, industrial machinery, greases and heavy-duty truck engines, as well as compliance with European and U.S. incidental food contact regulations.

Backed by our global supply network and decades of extensive research, SpectraSyn high-viscosity PAO base stocks are available in viscosity grades of 40 and 100 cSt. They are especially well suited for formulating industrial oils that require high stability under demanding conditions. Their high viscosity index (VI) can translate into improved flow at low temperatures and increased film thickness at high temperatures.

SpectraSyn low-viscosity (LoVis) PAO base stocks, available in viscosity grades from 2 to 10 cSt, are used to formulate synthetic lubricants and upgrade mineral oil-based products. Formulators use our LoVis PAOs to gain better low-temperature properties, low volatility and improved oxidative stability compared to mineral oils. LoVis PAOs are well suited for multigrade engine and automotive gear oils, as well as various ISO viscosity grade industrial oils.

Find the solutions to your formulation challenges by choosing SpectraSyn PAO base stocks.

Performance benefits include:

- High VI for enhanced wear protection and energy efficiency
- Low-temperature fluidity for optimal flow
- Low volatility to minimize oil consumption
- Excellent thermal and oxidative stability for long drain intervals

SpectraSyn™ PAO*

Grade	SG at 15.6/ 15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	CCS at A/B cP**	NOACK volatility, wt. %	Flash point (COC) °C
	ASTM D4052	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D5293	ASTM D5800/ DIN51581	ASTM D92
SpectraSyn 2	0.798	1.7	5.0	N/A	-66	—	—	157
SpectraSyn 2B	0.799	1.8	5.0	N/A	-54	—	—	149
SpectraSyn 2C	0.798	2.0	6.4	N/A	-57	—	—	>150
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SpectraSyn 10	0.835	10.0	66	137	-48	8,840 B	3.2	266
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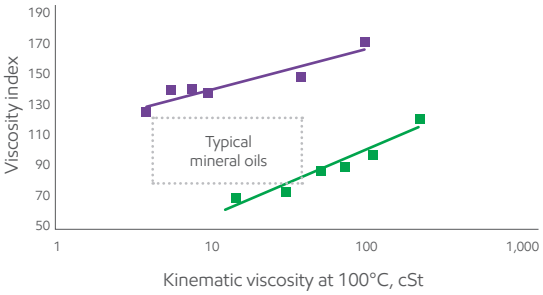
SpectraSyn 100	0.853	100.0	1240	170	-30	—	—	283

* Typical properties; actual values will vary; not to be construed as specifications; sales specifications available at exxonmobilsynthetics.com.
**CCS at A/B: A= -35°C, B= -30°C

Viscosity index comparison

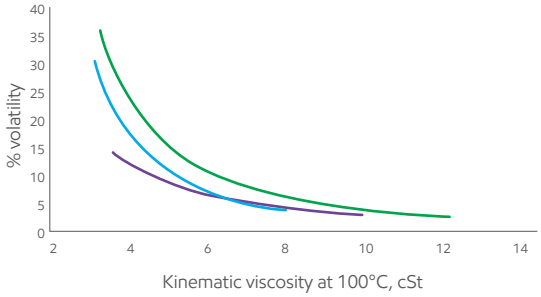


PIB
PAOs

At any given viscosity, the VI of the PAO is significantly higher than PIB and mineral oils.

Test method: ASTM D2270

NOACK volatility



Group II
Group III
PAO

SpectraSyn™ PAOs demonstrate lower volatility at higher temperatures than mineral oils.

Test method: ASTM D5800/DIN51581

Oxidation stability test

PAO vs. mineral oil (2% antioxidant)

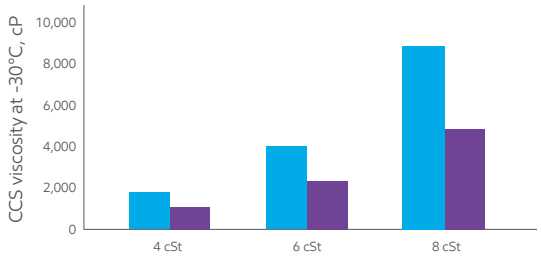
Product	Mineral oil Group II	6 cSt PAO	40 cSt PAO	100 cSt PAO
% Vis change at 100°C	215.7	3.5	2.6	1.8
TAN change, mg	14.5	0.1	0.08	1.1
Lead loss, mg	160.7	0.9	0.1	0.2
Sludge	Moderate	Nil	Nil	Trace

Good oxidative stability is essential for applications at elevated temperatures with air contact.

PAOs show excellent oxidative stability when formulated with suitable antioxidants.

Test conditions: 163°C (325°F), 72 hours
Test method: ExxonMobil method

Cold crank simulator comparison



Group III mineral oil
PAO

PAOs have significantly lower viscosity at low temperatures compared to a Group III mineral oil.

Test method: ASTM D5293

Source of test results/product information: ExxonMobil data

SpectraSyn Plus™ polyalphaolefin (PAO) base stocks

Low volatility and low-temperature fluidity

SpectraSyn Plus PAO base stocks offer low volatility and CCS viscosity than typical equivalent PAO grades.

If your challenge is to formulate top-tier automotive lubricants that meet the current trends for low viscosity oils, then ExxonMobil Chemical has the solution.

In order to meet ever more stringent emission regulations, automotive original equipment manufacturers (OEMs) are demanding lower and lower lubricant viscosity grades. Both engine oils and transmission oils are seeing significant viscosity reductions in the drive to find energy efficient benefits.

To help meet these demands, lighter base oils are being used. These oils typically have better low temperature fluidity (as also defined by the API viscosity classifications) but tend to have high volatility which can increase emissions and oil consumption.

As the industry moves to lighter and lighter viscosity grades (i.e., 0W or 70W) with tighter volatility requirements, SpectraSyn Plus™ PAO with its low volatility and low temperature viscosity, allows the formulator to further optimize their base stock blends to achieve the required performance.

SpectraSyn Plus™ is available in three viscosity grades ideally suited for modern automotive lubricant applications.

Performance benefits include:

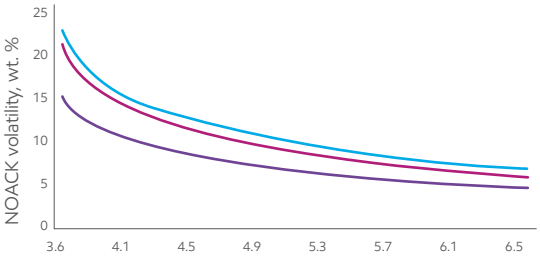
- Low volatility for extended drain intervals
- Low CCS viscosity for better engine starting and low temperature oil flow
- Improved energy efficiency

SpectraSyn Plus™ PAO*

Grade	SG at 15.6/ 15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	CCS at -35°C cP	NOACK volatility, wt. %	Flash point (COC) °C
	ASTM D4052	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D5293	ASTM D5800/ DIN51581	ASTM D92
SpectraSyn Plus 3.6	0.816	3.6	15.4	120	<-65	1,050	<17	224
SpectraSyn Plus 4	0.820	3.9	17.2	126	<-60	1,290	<12	228
SpectraSyn Plus 6	0.827	5.9	30.3	143	<-54	3,600	<6	246

* Typical properties; actual values will vary; not to be construed as specifications; sales specifications available at exxonmobilsynthetics.com.

Volatility vs. viscosity



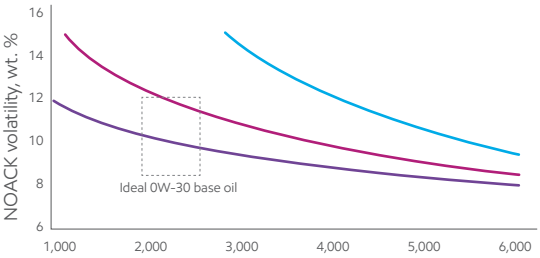
Kinematic viscosity at 100°C, cSt ASTMD445

- Group III
- Group IV
- SpectraSyn Plus™ PAO

Test method: ASTM D5800

Blending performance

Blending NOACK vs. CCS at -35 °C

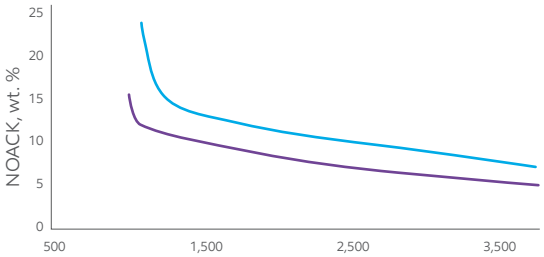


CCS at -35°C, cP, ASTM D5293

- Group III, blend of 4 & 6 cSt
- SpectraSyn Plus™ PAO & Group III blend
- SpectraSyn Plus™ PAO & SpectraSyn™ 6

Test method: ASTM D5800

Improved volatility



Low-temperature viscosity (CCS at °C, cP), ASTM D5293

- Conventional PAO
- SpectraSyn Plus™ PAO

Test method: ASTM D5800

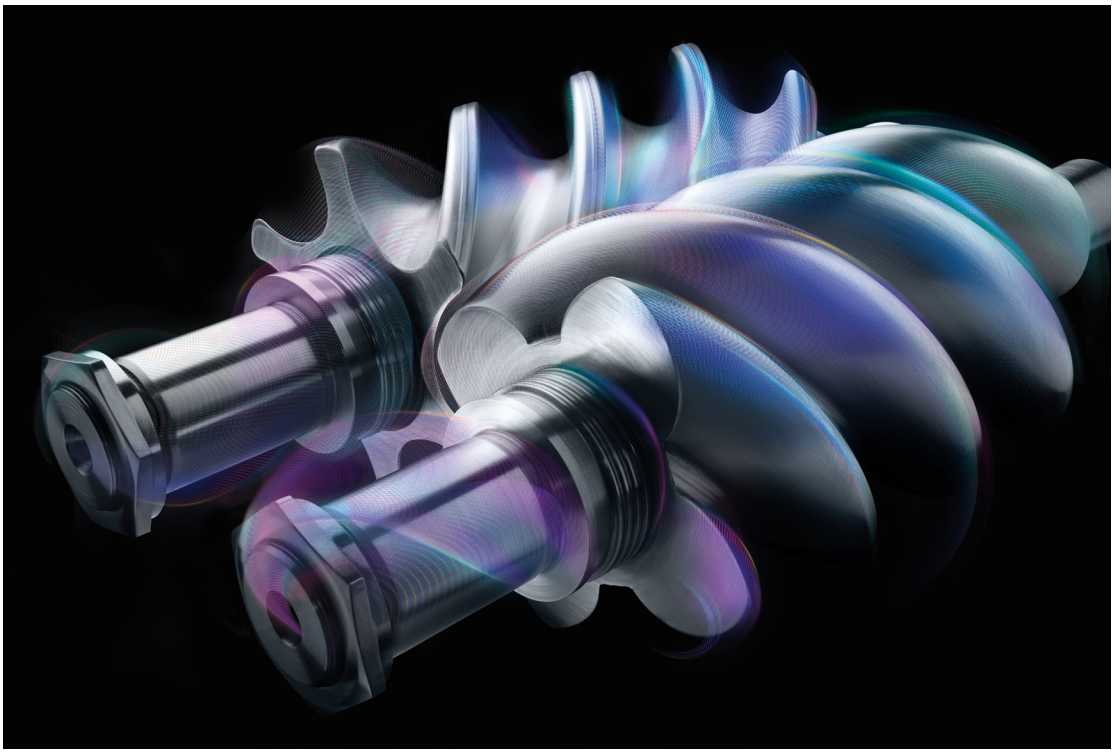
Your source for advanced synthetics

For an extensive range of advanced synthetic lubricant base stocks, you need an innovative supplier — ExxonMobil Chemical. With our broad portfolio of polyalphaolefin (PAO), alkylated naphthalene (AN) and ester base stocks, we provide reliable, global base stock solutions that can help you achieve your business goals.

Source of test results/product information: ExxonMobil data

Synesstic™ alkylated naphthalene (AN) base stocks

Stability and solubility to help you enhance performance



Empower your lubricants to deliver durability and optimum performance in all kinds of operating conditions.

Formulating lubricants that perform well even in extreme conditions can be challenging, but many customers today expect this capability. To help you meet these expectations, we offer Synesstic AN base stocks. They are designed to empower lubricants to deliver durability and optimum performance in all kinds of operating conditions.

Synesstic AN features excellent thermal and oxidative stability contributing to lubricant life and deposit control. It also has exceptional hydrolytic stability, making it a good choice for use in high-moisture environments in place of esters.

Synesstic AN combines the stability of a polyalphaolefin (PAO) and solubility benefits of an ester, helping formulators extend the performance of synthetic and mineral-oil-based lubricants used in many automotive and industrial applications.

Available in 5 and 12 cSt grades, Synesstic AN is listed on the U.S. FDA Inventory of Effective Food Contact Substance Notifications, making it suitable for applications with incidental food contact. In addition, Synesstic AN is H1/HX-1 National Sanitation Foundation (NSF) registered.

Kosher and halal certifications available upon request.

Performance benefits include:

- Thermal and oxidative stability for long lubricant life
- Hydrolytic stability for use in high-moisture environments
- Seal compatibility enhancement
- Improved additive effectiveness as an ester replacement

Synesstic™ AN*

Grade	SG at 15.6/ 15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	Flash point (COC) °C	Color	Water ppm	TAN mg KOH/g
	ASTM D4052	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D92	ASTM D1500	ASTM E1064/	ASTM D974 (Mod)
Synesstic 5	0.908	4.7	29.0	74	-39	222	<1.5	<50	<0.05
Synesstic 12	0.887	12.4	109	105	-36	258	<4.0	<50*	<0.05

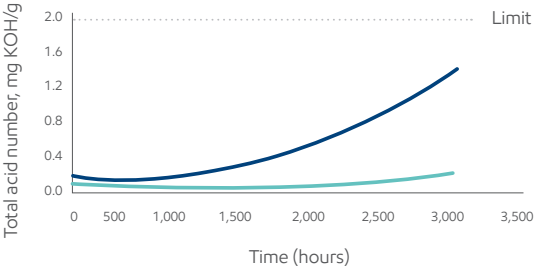
* Typical properties; actual values will vary; not to be construed as specifications; sales specifications available at exxonmobilsynthetics.com.

Polarity effects on lubricant additives

E = Ester molecule A = Additive molecule AN = AN molecule

Compared to esters, alkylated naphthalenes can improve additive effectiveness through less competition for the surface, allowing a more complete additive film.

Synesstic™ 5 AN performance advantage in ISO VG 46 compressor formulation

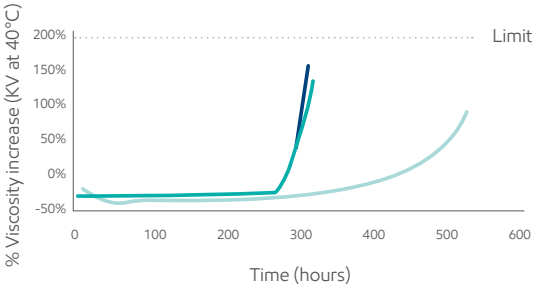


PAO/polyol ester/additive
PAO/Synesstic™ 5 AN/additive

Synesstic™ 5 AN improves oxidative and hydrolytic stability with the potential to extend compressor oil lifetime.

Test method: ASTM D943

Oxidation resistance in SAE 5W-30 engine oils

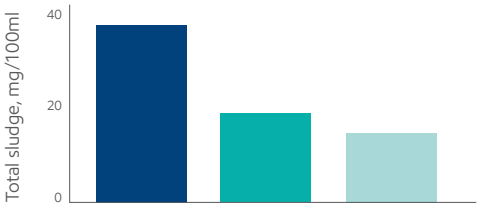


Group III
Group III with ester
Group III with Synesstic™ 5 AN

Synesstic™ 5 AN improves oxidation stability in engine oils formulated with Group III base stocks.

Test method: ExxonMobil oxidation screening test

Synesstic™ AN base stocks sludge performance data



PAO
PAO + AN5
PAO + AN12

Synesstic™ AN base stocks added to PAO increases overall blend solubility and cleanliness.

Test method: Cincinnati Milacron Test

	5W-30 grade oil	
Test	75% PAO blend **10% polyol ester** [1] 15% adpac [2]	75% PAO blend **10% Synesstic™ 5** 15% adpac [2]
Sequence IVA Wear, µm	541	147
Sequence VIB Phase 1 FEI[3], %	1.0	1.3

[1] TMP C8C10 ester [2] Adpac does not contain friction modifier [3] Fuel Efficiency Index

Sequence IVA Test (ASTM D6891)

- Use of Synesstic™ AN improves durability due to more effective use of the additives present in the additive package (adpac).

Sequence VIB Test (ASTM 6837)

- Use of Synesstic™ AN improves efficiency (FEI) due to reduced friction as a result of more effective additive performance.

Synesstic™ AN complements additives to improve durability.

Source of test results/product information: ExxonMobil data

Esterex™ esters

Versatile synthetics for challenging conditions

To formulate lubricants that extend equipment life under challenging conditions, count on the oxidative stability and solvency of Esterex esters.

Esters are synthesized to produce molecular structures especially suited for high-performance lubrication. With stability and solvency that help limit deposit formation, Esterex esters offer a valuable solution for formulations that deliver dependable lubricant performance and extended life.

Our full Esterex line includes adipate, neopolyol, phthalate and trimellitate esters. They can be used in applications such as compressor oils, gear oils, transmission fluids and engine oils. Their compatibility with polyalphaolefin (PAO) and other base stocks, also available from ExxonMobil Chemical, offers another solution for your formulation challenges.

Esters have a wide operating temperature range and are characterized by good thermal/oxidative stability and solvency — qualities the lubricant market demands. They have low volatility, along with lubricity and cleanliness, which can improve durability and lubricant life in tough applications. Many esters are readily or inherently biodegradable*.

Performance benefits include:

- Good thermal and oxidative stability for extended drain intervals
- Enhanced solvency for deposit prevention and seal swell
- Readily or inherently biodegradable options*

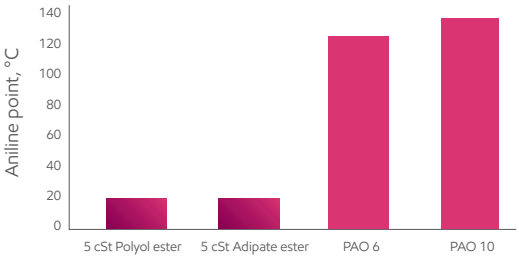
* See "Biodegradability data" table on following page

Esterex™ esters*

Grade	SG at 15.6/15.6°C	KV at 100°C cSt	KV at 40°C cSt	VI	Pour point °C	Flash point (COC) °C	Water ppm	TAN mg KOH/g	Biodeg %[b]
	ASTM D4052/ **BRCP 4843	ASTM D445	ASTM D445	ASTM D2270	ASTM D97/ D5950	ASTM D92	ASTM E1064/ **D6304	ASTM D974 (Mod)/ **BRCP 4625	OECD 301F/ **OECD301B
Esterex A32	0.928**	2.8	9.5	149	-65	207	<500**	<0.08	70.2
Esterex A34	0.922**	3.2	12	137	-60	199	<1000**	<0.08**	78.5
Esterex A41	0.921	3.6	14	144	-57	231	<500	0.01	76.5
Esterex A51	0.915	5.4	27	136	-57	247	<350	0.02	58.5
Esterex NP343	0.945	4.3	19	136	-48	257	<350	0.02	76.4**
Esterex NP451	0.993	5.0	25	130	-60	255	<500	0.01	83.6
Esterex P61	0.967	5.4	38	62	-42	224	<1000**	<0.07	71.4
Esterex P81	0.955	8.3	84	52	-33	265	<1000**	<0.14	54.5
Esterex TM111	0.978**	11.9	124	81	-33	274	<1000**	<0.16	<1.0

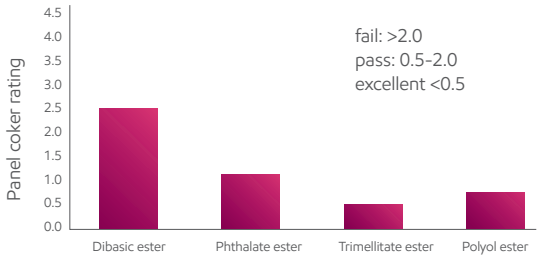
* Typical properties; actual values will vary; not to be construed as specifications; sales specifications available at exxonmobilsynthetics.com.
**S.G.@20°C, BRCP 4843
([b]) Single sample or two sample average determination
A= Adipate, NP= Neopolyol, P= Phthalate, TM= Trimellitate

Ester solvency



Test method: ASTM D611

Thermal-oxidative stability comparison



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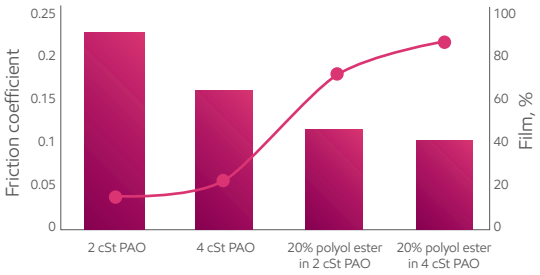
Lubricity in PAO on HFRR*



*HFFR = high-frequency reciprocating rig

Test method: ASTM D6079

Ester type	OECD 301B % in 28 days	CEC L 33 A 93 % in 21 days
Mono esters	30-90	70-100
Dibasic esters	10-80	70-100
Phthalate esters	5-70	40-100
Trimellitate esters	0-40	0-70
Linear polyol esters	50-90	80-100
Branched polyol esters	0-40	0-40
Mineral oil	0-20	NA

Source: Synthetic Lubricants and High-Performance Functional Fluids, 2nd Ed. L.R. Rudnick, R. L. Shubkin, Ed. Chapter 3, P 80. Additionally, mineral oil data from Biodegradation Test Methods and PAOs report, Lawrence K. Low, EMBSI, August 2005.

Biodegradability data

Product	% Biodegradability in 28 days		Assessment
	OECD 301 F	OECD 301B	
Esterex™ A32	70	-	Readily biodegradable
Esterex™ A34	78	-	Readily biodegradable
Esterex™ A41	76	-	Readily biodegradable
Esterex™ A51	59	-	Inherently biodegradable
Esterex™ P61	71	-	Readily biodegradable
Esterex™ P81	55	-	Inherently biodegradable
Esterex™ TM111	<1	-	Not inherently biodegradable
Esterex™ NP343	-	76	Inherently biodegradable
Esterex™ NP451	84	-	Readily biodegradable

OECD classifications
Readily biodegradable: In order to be classified as "readily biodegradable," a test material must meet two OECD requirements: It must achieve greater than 60% biodegradation in 28 days and must pass the "10-day" window criterion, which means that once the 10% biodegradation mark has been attained, test material must then reach the 60% biodegradation mark within 10 days.
Inherently biodegradable: In order to be classified as "inherently biodegradable," the test material must meet the following OECD requirement: greater than 20% biodegradation.

Source of test results/product information: ExxonMobil data

ExxonMobil

exxonmobilsynthetics.com

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