

# ExxonMobil Chemical Advanced synthetic base stocks

Innovative lubricants start here





# 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 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 helps you formulate innovative lubricants that meet the challenges of extended drain intervals and improved fuel economy/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, particularly where biodegradable fluids are required.

### 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.

You can rely on our broad portfolio of advanced synthetic base stocks to 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 Elite™ mPAO\*

| Grade                | SG @ 15.6 / 15.6°C | Kv @ 100°C<br>cSt | Kv @ 40°C<br>cSt | VI         | Pour point<br>°C | Flash point (COC)<br>°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               | 1705             | 206        | -33              | 282                     |

## SpectraSyn™ PAO\*

| Grade          | SG @ 15.6/<br>15.6°C | Kv @ 100°C<br>cSt | Kv @ 40°C<br>cSt | VI         | Pour point<br>°C   | CCS @ A/B<br>cP** | NOACK<br>volatility, wt. % | Flash point (COC)<br>°C |
|----------------|----------------------|-------------------|------------------|------------|--------------------|-------------------|----------------------------|-------------------------|
|                | ASTM D4052           | ASTM D445         | ASTM D445        | ASTM D2270 | ASTM D97/<br>D5950 | ASTM<br>D5293     | ASTM D5800/<br>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 @ A/B: A= -35°C, B= -30°C

## SpectraSyn Plus™ PAO\*

| Grade               | SG @ 15.6/<br>15.6°C | Kv @ 100°C<br>cSt | Kv @ 40°C<br>cSt | VI            | Pour point<br>°C   | CCS @ -35°C<br>cP | NOACK<br>volatility, wt. % | Flash point (COC)<br>°C |
|---------------------|----------------------|-------------------|------------------|---------------|--------------------|-------------------|----------------------------|-------------------------|
|                     | ASTM D4052           | ASTM D445         | ASTM<br>D445     | ASTM<br>D2270 | ASTM D97/<br>D5950 | ASTM D5293        | ASTM D5800/<br>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                     |

## Synesstic™ AN\*

| Grade        | SG @ 15.6/<br>15.6°C | Kv @ 100°C<br>cSt | Kv @ 40°C<br>cSt | VI            | Pour point<br>°C   | Flash point (COC)<br>°C | Color         | Water<br>ppm          | TAN<br>mg KOH/g    |
|--------------|----------------------|-------------------|------------------|---------------|--------------------|-------------------------|---------------|-----------------------|--------------------|
|              | ASTM<br>D4052        | ASTM D445         | ASTM D445        | ASTM<br>D2270 | ASTM D97/<br>D5950 | ASTM D92                | ASTM<br>D1500 | ASTM E1064/<br>*D6304 | ASTM D974<br>(Mod) |
| Synesstic 5  | 0.908                | 4.7               | 29               | 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 @ 15.6/<br>15.6°C         | Kv @ 100°C<br>cSt | Kv @ 40°C<br>cSt | VI            | Pour point<br>°C   | Flash point (COC)<br>°C | Water<br>ppm             | TAN<br>mg KOH/g                   | Biodeg<br>% <sup>b</sup> |
|---------------|------------------------------|-------------------|------------------|---------------|--------------------|-------------------------|--------------------------|-----------------------------------|--------------------------|
|               | ASTM<br>D4052/<br>*BRCP 4843 | ASTM<br>D445      | ASTM<br>D445     | ASTM<br>D2270 | ASTM D97/<br>D5950 | ASTM D92                | ASTM<br>E1064/<br>*D6304 | ASTM D974<br>(Mod)/ *BRCP<br>4625 | OECD 301F/<br>*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 values

(<sup>b</sup>) Single sample or two sample average determination

BRCP 4843 @ 20/20°C

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

# SpectraSyn Elite™ metallocene polyalphaolefin (mPAO) base stocks

Empowering innovation for evolving lubricant needs



To meet increasing demand for energy efficiency, enhanced performance and product durability, trust 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 satisfy these needs, formulators must develop innovative products. That's why so many of them are turning to the extraordinary properties of 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 meet the needs of today's demanding marketplace. Created using a proprietary catalyst process, SpectraSyn Elite mPAO synthetic base stocks deliver improved shear stability, higher

viscosity index (VI) and lower pour point compared to conventional PAO. These outstanding base stocks also are designed to offer you better blending efficiency.

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

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#### 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
-

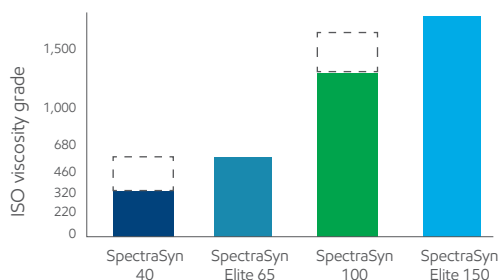
## SpectraSyn Elite™ mPAO\*

| Grade                | SG @ 15.6 / 15.6°C | Kv @ 100°C<br>cSt | Kv @ 40°C<br>cSt | VI         | Pour point<br>°C | Flash point (COC)<br>°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               | 1705             | 206        | -33              | 282                     |

\*Typical values

### Enhanced blending flexibility

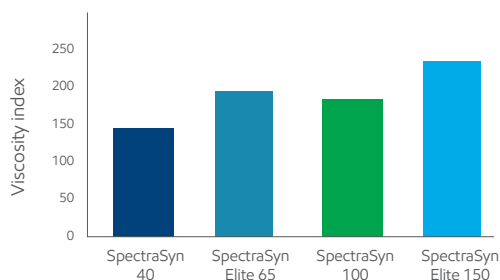
Viscosity grade coverage by product



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

### Viscosity index comparison

Neat base stocks

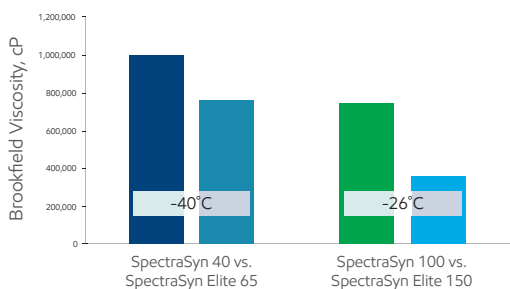


SpectraSyn Elite™ mPAOs demonstrate improved viscosity index.

Test method: ASTM D2270

### Brookfield comparison

Neat base stocks

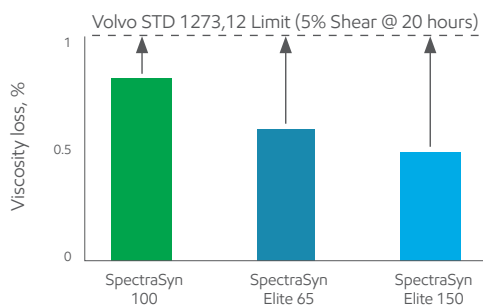


SpectraSyn Elite™ mPAOs have improved low-temperature fluidity.

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

# SpectraSyn™ polyalphaolefin (PAO) high- and low-viscosity base stock

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) translates 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. 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.

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#### Performance benefits include:

- High VI for enhanced wear protection and fuel efficiency
  - Low-temperature fluidity for optimal flow
  - Low volatility to minimize oil consumption
  - Excellent thermal and oxidative stability for long drain intervals
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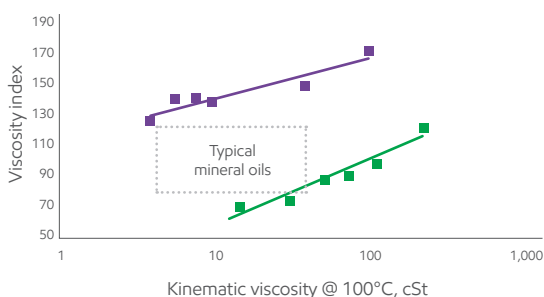
## SpectraSyn™ PAO\*

| Grade          | SG @ 15.6/<br>15.6°C | Kv @ 100°C<br>cSt | Kv @ 40°C<br>cSt | VI            | Pour point<br>°C   | CCS @ A/B<br>cP** | NOACK<br>volatility, wt. % | Flash point (COC)<br>°C |
|----------------|----------------------|-------------------|------------------|---------------|--------------------|-------------------|----------------------------|-------------------------|
|                | ASTM D4052           | ASTM D445         | ASTM D445        | ASTM<br>D2270 | ASTM D97/<br>D5950 | ASTM D5293        | ASTM D5800/<br>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 @ A/B: A= -35°C, B= -30°C

\*Typical values

## Viscosity index comparison

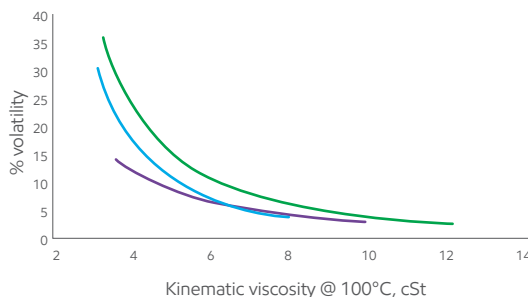


■ PIB  
■ PAOs

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)

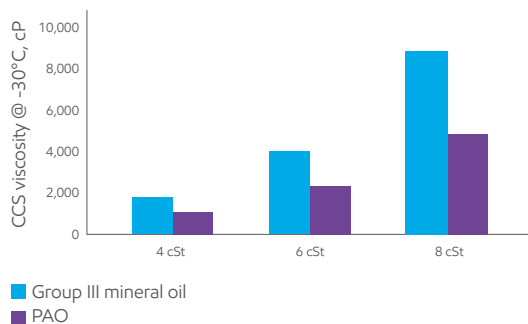
|                      | 215.7    | 3.5 | 2.6  | 1.8   |
|----------------------|----------|-----|------|-------|
| % Vis change @ 100°C |          |     |      |       |
| TAN change, mg       | 14.5     | 0.1 | 0.08 | 1.1   |
| Lead loss, mg        | 160.7    | 0.9 | 0.1  | 0.2   |
| Sludge               | 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

## 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



# SpectraSyn Plus™ polyalphaolefin (PAO) base stock

Low volatility and low-temperature fluidity



SpectraSyn Plus PAO base stocks offer lower 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, fuel efficient 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 fuel economy benefits.

To meet those 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 higher 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 lower volatility and improved 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.

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#### Performance benefits include:

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

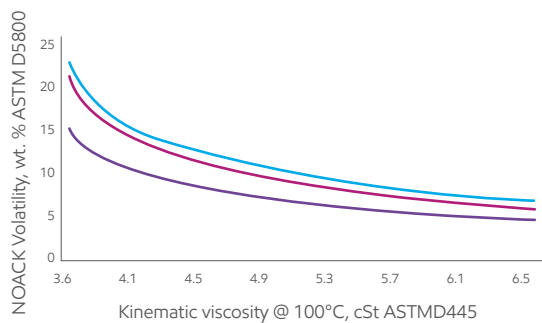


## SpectraSyn Plus™ PAO\*

| Grade               | SG @ 15.6/<br>15.6°C | Kv @ 100°C<br>cSt | Kv @ 40°C<br>cSt | VI            | Pour point<br>°C   | CCS @ -35°C<br>cP | NOACK<br>volatility, wt. % | Flash point (COC)<br>°C |
|---------------------|----------------------|-------------------|------------------|---------------|--------------------|-------------------|----------------------------|-------------------------|
|                     | ASTM<br>D4052        | ASTM D445         | ASTM D445        | ASTM<br>D2270 | ASTM D97/<br>D5950 | ASTM D5293        | ASTM D5800/<br>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 values

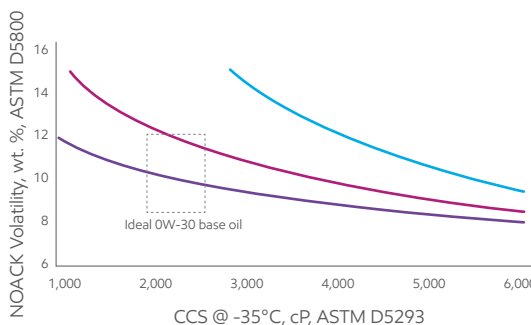
## Volatility vs. viscosity



■ Group III  
■ Group IV  
■ SpectraSyn Plus™ PAO

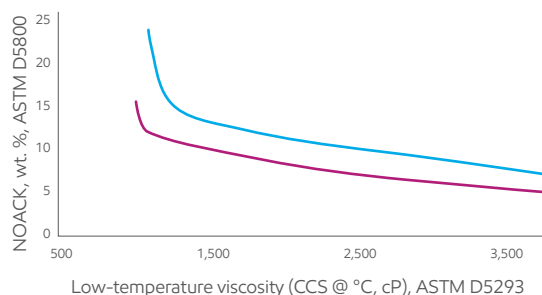
## Blending performance

Blending NOACK vs. CCS @ -35 °C



■ Group III, 4 & 6  
■ SpectraSyn Plus™ PAO  
■ SpectraSyn Plus™ PAO & Group III

## Improved volatility



■ Conventional PAO  
■ SpectraSyn Plus™ PAO

## 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.

# Synesstic™ alkylated naphthalene (AN) base stock

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 for enhanced lubricant life and deposit control. It also has exceptional hydrolytic stability, making it a good choice for use in high-moisture environments.

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.

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#### **Performance benefits include:**

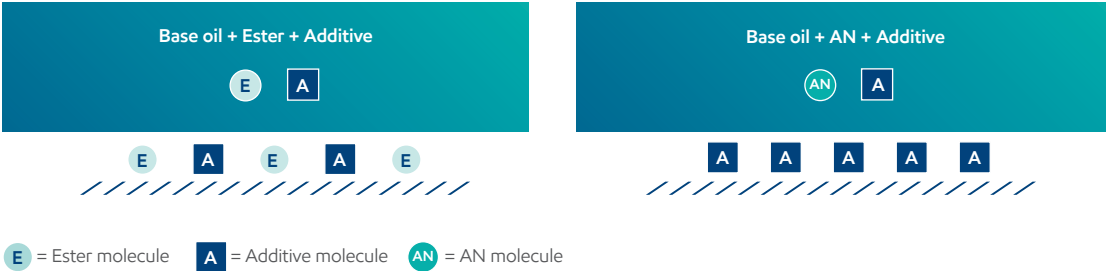
- Thermal and oxidative stability for long lubricant life
  - Hydrolytic stability for use in high-moisture environments
  - Seal compatibility enhancement
  - Improved additive effectiveness as an ester replacement
-

## Synthetic™ AN\*

| Grade        | SG @ 15.6/15.6°C | Kv @ 100°C cSt | Kv @ 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 D977/D5950 | ASTM D92             | ASTM D1500 | ASTM E1064/ | ASTM D974 (Mod) |
| Synthetic 5  | 0.908            | 4.7            | 29            | 74         | -39             | 222                  | <1.5       | <50         | <0.05           |
| Synthetic 12 | 0.887            | 12.4           | 109           | 105        | -36             | 258                  | <4.0       | <50*        | <0.05           |

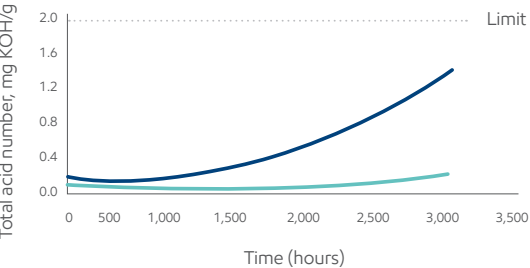
\*Typical values

## Polarity effects on lubricant additives



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

## Synthetic™ 5 AN performance advantage in ISO VG 46 compressor formulation

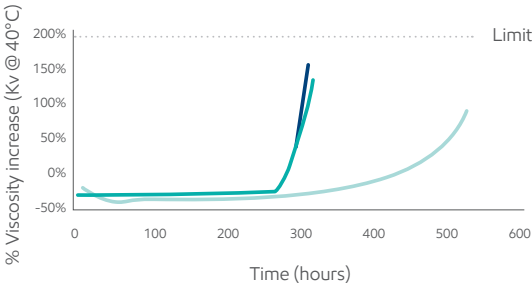


- PAO/polyol ester/additive
- PAO/Synthetic™ 5 AN/additive

Synthetic™ 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

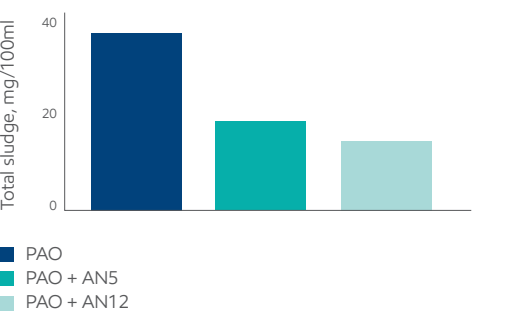


- Group III
- Group III with ester
- Group III with Synthetic™ 5 AN

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

Test method: ExxonMobil oxidation screening test

## Synthetic™ AN base stocks sludge performance data



- PAO
- PAO + AN5
- PAO + AN12

Addition of Synthetic™ AN base stocks to PAO increases overall blend solubility and cleanliness.

Test method: Cincinnati Milacron Test

| Test   | 75% PAO blend   |  |
|--|---|--|
|  | 10% polyol ester <sup>(1)</sup><br>15% adpac <sup>(2)</sup> | 10% Synthetic™ 5<br>15% adpac <sup>(2)</sup> |
| Sequence IVA<br>Wear, µm                       | 517   | 147  |
| Sequence IVB<br>Phase 1 FEI <sup>(3)</sup> , % | 1.0   | 1.3  |

<sup>(1)</sup> TMP C8C10 ester    <sup>(2)</sup> Adpac does not contain friction modifier    <sup>(3)</sup> Fuel Efficiency Index

### Sequence IVA Test (ASTM D6891)

- Use of Synthetic™ AN improves durability due to more effective use of the additives present in the adpac.

### Sequence IVB Test (ASTM D6837)

- Use of Synthetic™ AN improves efficiency due to reduced friction as a result of more effective additive performance.

Synthetic™ AN complements additives to improve durability.



# Esterex<sup>TM</sup> 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 improves durability and lubricant life in tough applications. Many esters are biodegradable, so they can be a good choice for formulating lubricants for environmentally sensitive applications.

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#### **Performance benefits include:**

- Good thermal and oxidative stability for extended drain intervals
  - Enhanced solvency for deposit prevention and seal swell
  - Biodegradability for environmental contact (ester specific)
-

## Esterex™ esters\*

| Grade         | SG @ 15.6/<br>15.6°C         | Kv @ 100°C<br>cSt | Kv @ 40°C<br>cSt | VI            | Pour point<br>°C   | Flash point (COC)<br>°C | Water<br>ppm          | TAN<br>tmg KOH/g                  | Biodeg<br>% <sup>b</sup> |
|---------------|------------------------------|-------------------|------------------|---------------|--------------------|-------------------------|-----------------------|-----------------------------------|--------------------------|
|               | ASTM<br>D4052/<br>*BRCP 4843 | ASTM D445         | ASTM<br>D445     | ASTM<br>D2270 | ASTM D97/<br>D5950 | ASTM D92                | ASTM E1064/<br>*D6304 | ASTM D974<br>(Mod)/<br>*BRCP 4625 | OECD 301F/<br>*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                     |

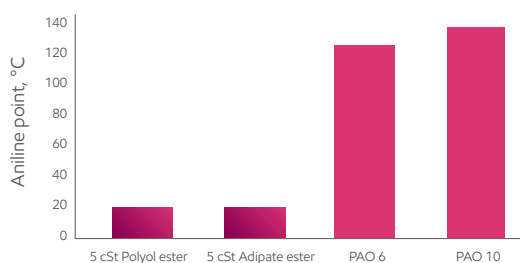
\*Typical values

(<sup>b</sup>) Single sample or two sample average determination

BRCP 4843 @ 20/20°C

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

## Ester solvency



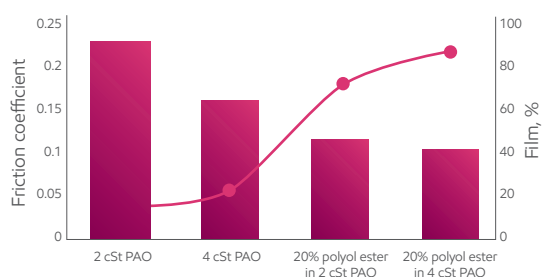
Test method: ASTM D611

## Thermal-oxidative stability comparison



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## Lubricity in PAO on HFRR\*



\*HFRR = high-frequency reciprocating rig

Test method: ASTM D6079

## Ester biodegradability in general

| Ester biodegradability in general |       |        |
|-----------------------------------|-------|--------|
| 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.



# Grow with the global leader

To create innovative lubricants, you can rely on ExxonMobil Chemical. We offer a suite of advanced synthetic base stocks, global supply network and world-class technical expertise to help you meet the challenges of formulating your next-generation lubricants.







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