



In the USA there are a few different types of synthetic base stocks used in engine oils. We will touch on a few in this tech paper.

1) **GENERALITIES**

The word *Synthetic* is confusing; it describes a process, not a material. For example, white sand is synthesized into glass, but glass is never called “synthetic sand”. Most people *think that ALL Synthetic oils are made of the same base, THIS IS WRONG!* For most of the USA, there are mainly THREE types of synthetic oils (or as we like to say, synthetics are DESIGNER oils).

a) Synthetic GROUP3

- Petroleum oil that is refined to deliver a good base oil. The process and end product is the least expensive of the 3 types of synthetics.
- This type of product was considered a Petroleum oil until a recent legal battle was lost.
- Molecules are not as consistent in their size as in a PAO or ESTER (mentioned below) but are better than a Group 1 and 2 petroleum oil.
- **Advantages of the G3:** cleaner base, a higher Viscosity Index (ability to flow) and better all around performance.

b) Synthetic GROUP4 (PAO)

- PAO, *short for POLY-ALPHA-OLEFINE* -or easier to understand, it is SYNTHESIZED PETROLEUM oil. It is refined in a special process, or in simple words “synthesized”. It still starts out by being pumped out of the ground (petroleum).
- **Advantages of the G4 (PAO):** better than regular petroleum and G3 oils for handling heat, oxidation, low temperature startups and higher film strength.

Drawback PAO, G3, and PETROLEUM:

- Dynamic types of oil: you have to build up oil pressure and have rotation before a film is produced. Better said, you have to HYDROPLANE the engine parts like you hydroplane a car in the rain to create a film! Or, in the case of water-skiing, you have to build speed for the skier to get up and plane on the water.
- PAO's are **NOT REALLY** EXPENSIVE because they are made from *crude oil* and produced in large quantities.



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c) **Synthetic GROUP5 (Esters)**

GROUP 5 (Diester, POLYMER ESTER, Polyolesters, polyesters and COMPLEX) Motul® uses esters in many of its products.

- ESTERS ARE MOSTLY MADE OF VEGETABLES, minerals and animal fatty acids. Motul's® esters contain a lot of *coconut* and *veggie* derivatives.
- Esters are much more expensive because the ingredients all have to be collected from natural RENEWABLE resources and synthesized (a very expensive process) in smaller quantities.
- **Advantages of the G5 (Esters):** esters have all the advantages of a PAO but more of them.
 - *ESTERS CAN HANDLE HEAT BETTER THAN PAO's*
 - *WHEN BURNED, ESTERS LEAVE FAR LESS (COKING) DEPOSITS.*
 - *ESTERS ARE POLAR/STATIC types of OILS : ESTERS are ATTRACTED TO METAL PARTS WITH AN ELECTRO-CHEMICAL BOND. THIS MEANS NO MORE METAL TO METAL START UPS. This also means that A FILM IS THERE BEFORE the oil pressure light goes out PREVENTING PREMATURE WEAR of high-stressed parts like cam lobes. THE FILM CREATED IS up to 5 TIMES STRONGER THAN PETROLEUM OIL.*

THE NUMBER 1 REASON TO RUN AN ESTER SYNTHETIC OIL is BOND. The Electro-chemical bond is made because the ESTER MOLECULE IS POLAR! Sort of like a refrigerator magnet! It is attracted to metal and it sticks.

THE PAO MOLECULES ARE NEUTRAL and act like a piece of plastic placed on the Frig. They just fall off. FYI, all *commercial jet planes use an ester synthetic of some type and not a PAO!* You need to run an ester of some sort for maximum protection!

2) WHY HANDLING HIGHER RUNNING TEMPS IS IMPORTANT?

With petroleum oils, there is a much better risk of failure from volatility problems than with synthetics. Why?

HAVE YOU EVER BURNED BUTTER while cooking? YES, everybody has burned butter! The running temp or maximum temp is low. When butter reaches its' maximum running temp it starts to evaporate (*volatility*). Then it carbonizes and finally it sticks to the metal pan. Now, compare butter to VEGETABLE OIL in which you deep fry "French fries". To make vegetable oil hot enough to carbonize, you would almost need a direct flame!

PETROLEUM oil is LIKE BUTTER as far as handling heat! And SYNTHETICS are LIKE VEGETABLE oils. synthetics won't burn up and stick to your engine parts or go out the breather as fast as petroleum oils will. Remember, ESTERS leave almost no DEPOSITS if they do burn.

THIS IS THE SECOND REASON to run a SYNTHETIC OIL: because you're not supposed to have extreme heat problems every day.



3) **BASIC TECH POINTS: RACING AND HIGH PERFORMANCE OILS**

MOTUL 300V RACING SERIES ARE RATED AS SG/SH, WHILE OR HIGH PERFORMANCE STREET OILS ARE THE NEW SJ RATED.

- Engines, especially air or oil cooled designs need lubricants that can handle higher running temps to INCREASE VISCOSITY RETENTION, while reducing consumption and oil film breakdown.
- High Performance engines always increase the load pressures placed upon moving components. High lift cams and stiffer valve springs load up the lifters, rocker arms and valve ends. Newer designs incorporate gear driven overhead cams which bring a new challenge. More internal gearing will shares the engine oil faster. Because of that, Motul® adds more medium EXTREME PRESSURE (EP) additives such as ZINC and a STRONG EP additive, called a SULFURIZED ESTER to handle the shear / meshing of the engine.
 - a) EP additives come into play at the instant a medium extreme pressure is applied and high temperatures are created. ZINC lays down a barrier that prevents metal to metal contact and the SULFURIZED ESTER produces a sacrificial film that is destroyed during very strong extreme pressures as it prevents SEIZING. EP additives are generally corrosive especially those used in car gearboxes. WE use this ESTER because it is FAR LESS CORROSIVE and more environmentally safe than others that can do the job.
This is what those TV advertised products forget to tell you when you see them test a ball bearing under 100,000 pounds of pressure.
 - b) To explain it easier, let's take a sandwich wrapped in plastic wrap (the EP additive would be the plastic wrap). If you were to squeeze the sandwich you would contact the plastic wrap with your fingers (your fingers representing the gears) and the sandwich would squish. However, your fingers NEVER made contact with the bread!
- Performance engines NEED A BALANCED FRICTION MODIFIER PACKAGE, so that the ring seal stays strong, roller and ball bearings roll in the race and plain bearings have as little drag as possible.

NOTE: The SULFURIZED ESTER is a part of this friction reduction package due to its ability to STICK to engine parts (ferrous metals)

- Performance engines used in endurance type of competition need strong ANTI-ACID (BASE, TBN, total base number).
Condensation (the steam that you see coming out of your tail pipe in the morning) is a natural by-product of combustion in an engine. This condensation, which is acidic water, passes by the rings under compression into the crankcase and mixes with the sulfur, SULFURIC ACID is created. ANTI-ACID (base) neutralizes the acid before it can cause any damage.
- High revving engines need strong ANTI-FOAM ADDITIVES: higher RPM aerates the oil more.

We must pop the bubble before it causes damage! Why?

- a) Foam is air; air is a better insulator then a transmitter of heat. It does not transmit heat from hot metal parts to the oil very well or vice versa.
- b) Problem - OIL PUMPS DO NOT PUMP AIR!



- i) Oil pressure can DROP.
 - ii) TEMP'S can RISE due to inefficient heat exchange.
- Endurance engines NEED STRONG DISPERSANTS to suspend materials and combustion by-products which are created and rubbed off during normal operations.
If you find worn components in your older race engine, ask yourself a question: WHERE DID THE MATERIAL GO?
 - i) The parts were beaten or compressed and the material is still there.
 - ii) The materials were rubbed off and washed RIGHT INTO THE OIL! We want the material to stay in tiny pieces and stay mixed in the oil, so that the oil filter can do its job. There are many devices on the market now that surround the filter with a magnet to capture some wear metals.
 - Race engines NEED A STRONG DETERGENT, WHY? Because of more heat generation (more horsepower per ci) trying to fry the oil onto the engine parts, and added dirt being dropped into the oil from the by-products from combustion.
 - Motul® SYNTHETICS CAN (if you cannot find your brand) be mixed with MOST high quality mineral, Group 3, PAO or ESTER synthetic oils, without major problems. Try to stay close to the viscosity range. (I.e. 10w40 mixed with 10w40). If you have mixed oils, Motul® recommends an oil change when you get home from a “long” trip that has consumed the oil, since the oil additive and base from our oil is now not balanced.

THESE ARE SOME OF THE MAIN ISSUES THAT MOTUL® LOOKS AT WHEN DESIGNING A PERFORMANCE ENGINE OIL.

As discussed earlier, synthetics can handle much higher running temperatures than conventional petroleum oils and can withstand more stress. Many people ask, so what! I don't push my vehicle that hard and I change oil every 1000 miles! I don't need expensive performance oil in my car.

This type of thinking is wrong!!!!

The question we have for you are simple ones: why do you wear a helmet, gloves, boots, and jacket? Why do you buy INSURANCE?

In case of an accident! If within the first fifty (50) miles after an oil change, a rock hits your radiator or the thermostat sticks, the water pump stops pumping or whatever causes a major heat problem in your cooling system, what would you rather have in your engine? A mineral oil that acts like butter, which burns up and evaporates very quickly and also carbonizes? Or an oil that can handle high RUNNING temps like synthetics (325°f to 367°f)?

High quality oils are INSURANCE not only maintenance. The same is true about brake fluids and gear oils.

In Europe, the **OEMs now decide what minimum quality an oil must have and issue their own approvals.** **Motul® has** been on the cutting edge of these approvals for many years and currently have **an entire line dedicated to the SPECIFIC applications of Audi, MB, BMW, VW, PORSCHE, and most of the European brands on the market.**



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In the USA, the API CONTROLS THE STANDARDS FOR USA AUTOMOTIVE ENGINE OILS. The newest ratings are SL AND NOW SM oils.

Many SL/SM rated oils, especially the thinner type are intended for modern engines that use ROLLER BEARINGS on most of the valve train components reducing the need for Very High EP additives and must use O2 sensors and Catalytic converters.

The reason for the newer SL/SM rating is that with 0w30 and 5w30 oils, you run the risk of more oil consumption. So the ZINC and Phosphorus levels were reduced. If consumption was an issue, the smog emissions components may be damaged from high levels of these additives.

Although (EP) Extreme Pressure additives play a big role in preventing wear in performance engines. HIGH LIFT CAMS, STIFFER SPRINGS, HIGH COMPRESSION PISTONS AND RINGS, HIGER RPM, all require the maximum EP resistance. **Motul® not only looks at additives but superior base oils, new super strong VI (Viscosity Improvers) and special proprietary ingredient blending that is second to none!**

Careful attention must be placed when designing a new performance SL/SM oil because other EP additives must be used to their most effective level. Our newest type EP additives have been developed and tested by our racing division in equipment that demands the razors edge in performance. Our new SL/SM and European factory approved performance oils are the best there is for all around protection and horsepower for modern type STREET engines.

