The "Plus" in Base Stocks: Meaning & Lubricant Implications

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As environmental regulations evolve and automotive technology advances, there's a growing need for lubricants to achieve better fuel economy through lower viscosity, while still providing exceptional engine protection. These new lubricant specifications have led to increasing interest in semi-synthetic and synthetic lubricants around the world. In fact, the global synthetic lubricants market is projected to reach $18.8 billion by 2026, growing at a compound annual growth rate of 5.8% from 2019 to 2026[1].

Semi-synthetic and synthetic lubricants are created using advanced base stocks mixed with a variety of additives to have the exact qualities needed for a specific application. Base stocks make up anywhere from 75-99% of finished lubricant products. This growing demand for advanced lubricants has consequently increased the use of higher performance base stocks, some of which are known as "plus" base stocks. However, as it stands, neither American Petroleum Institute (API) nor the Technical Association of the European Lubricants Industry (ATIEL) have standardised definitions of "plus" base stocks in reference to the larger industry scope.

As suppliers are forging ahead and introducing "plus" base stocks (Group I+, II+, and III+) to meet the rise in demand, questions remain around what the "plus" in base stocks means, what the key differentiators are for "plus" base stocks, and how this advent impacts finished lubricants. To answer these questions, it's important to first understand the history of "plus" base stocks.

The advent and history of "plus" base stocks

There is no formal definition of "plus" base stocks. Rather the "plus" is established by the performance that the base stock enables, recognising that these engineered fluids have a significant impact on a finished lubricants' physical properties and performance.

Base stock production is an intricate process with many variabilities that can alter the properties of the base stock if not actively controlled. Base stock properties like viscosity, pour point, cold cranking viscosity, NOACK volatility, oxidative stability and more must meet specific thresholds in order to perform well in their intended applications. Lubricant marketers therefore need to choose the right base stock for their formulation needs in order to protect their lubricant brands and optimise the value of their base stocks supply.

The development of "plus" base stocks was primarily driven by the need for higher quality lubricants in the automotive industry. Specifically, the industry shifted towards lower viscosity engine oils such as the Society of Automotive Engineers (SAE) 5W-30 in 1984. The numbers refer to the thickness, or viscosity, of the oil. Motor oil gets thicker when it's cold and thinner when it heats up. The first number indicates the viscosity of the oil at a cold temperature, and the second number indicates the viscosity at operating temperatures.

Lubricants like SAE 5W-30 require base stocks with lower volatility that enable the lubricants to meet engine test requirements at these lower viscosities. Prior to the introduction of Group II+ base stocks, manufacturers had to rely on Group III base stocks to blend an SAE 5W-30 engine oil. Because Group II+ has similar properties to a Group III, Group II+ can reduce or eliminate the need for a Group III in certain applications.

In the base stocks industry, there is a lot of complexity to the Group I, II and III categorisations. Standard setting organisations such as API are very strict

[1] *Synthetic Lubricants Market by Base Oil, Product and End User: Global Opportunity Analysis and Industry Forecast, 2019-2026*

on their read across rules, and an official "plus" categorisation has not been defined. Therefore, this categorisation, such as that of a Group II+ vs a Group II, is a marketing decision based on the anecdotal meaning of the pluses relative to the improvement of performance of the base stocks. There are several properties to consider when labelling a base stock as a "plus."

"Plus" properties and benefits

While the industry has not officially defined "plus" base stocks, there are several properties of base stocks that factor into whether marketers label it a "plus" – primarily Cold Cranking Simulator (CCS) performance, NOACK volatility and viscosity index (VI) for Group II+ and III+.

Focusing on Group II+ base stocks, there is improved CCS and NOACK volatility versus Group II base stocks at the same viscosity so the base stock can be used in more advanced lubricant formulations and applications. However, the label of "plus" is related to how the base stock can be used and not just those specific properties. Meaning there is not a particular CCS, VI, or NOACK which defines a "plus" base stock, but rather it's the combination of the three that allows the base stock to be used more advantageously. Group II+ enables manufacturers to reduce or eliminate the need for Group III from certain formulations and provides advantages for certain applications versus conventional Group II. Some primary differences between Group II+ and Group III and VI are price.

Finished lubricant manufacturers recognise the importance of minimising production costs while maximising performance of their products. In many instances a Group III base stock used to blend an SAE 5W-30 engine oil, for example, could be easily replaced by a high-quality Group II+ with a lower price point. Simply put, Group II+ can be considered the base stock sweet spot – delivering the performance needed for a typically lower price.

Using a Group II+ also has the potential to provide reduced manufacturing complexity. Instead of having a tank filled with Group II and another tank filled with Group III, manufacturers may only need one tank filled with Group II+ to blend lubricants. This potential efficiency could translate into cost savings for the lubricant producer.

The performance benefits of Group II+ vs Group II base stocks are specifically seen on the finished lubricant side and making the move to Group II+ is a decision dependent upon the mix of products the manufacturer makes. In certain industrial lubricants, some of the performance characteristics of Group II+ may not be valued. In those cases, Group II+ may not be the preferred base stock for the application. If the target application is automotive then the formulation benefits of high-quality Group II+ base stock may make it the optimal choice.

Not all "Plus" is created equal

When it comes to engine oil, there is a big shift from conventional (i.e. mineral based) oil to semi-synthetic and synthetics to provide better engine performance and protection.

The heart of these advanced lubricants is the lower volatility and better oxidation performance, meaning it doesn't thicken as quickly as a mineral oil and won't evaporate or degrade as quickly either. This leads to better wear protection, reduces sludge build up, keeps engines cleaner, and allows the oil to perform better at high and low temperatures. All of these factors ultimately enable users to extend their oil drain intervals (ODI) which is a driving force behind this shift to semi-synthetic and synthetic lubricants.

Group II+ base stocks can be used in semi-synthetic and synthetic lubricants, but the use depends on the scenario. Not all Group II+ base stocks are created equal and minor differences can play a big part in finished lubricant performance. The use of Group II+ base stocks in semi-synthetic and synthetic lubricants is often a marketing decision based on performance. Notably, a lot of the same molecules in Group II+ are in Group III, and Group II+ can also meet the threshold of performance capabilities for Group III base stocks. This makes Group II+ comparable to a Group III for many formulations.

Ultimately, as "plus" base stocks production increases, it's important that lubrication manufacturers continue to focus on the necessary properties of their products and use base stocks that enable the best performance at the best value.

LINK
www.exxonmobil.com/basestocks