EELQMS QUALITY MANAGEMENT SYSTEM

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The importance of the correct base oil to the finished lubricant

Base oils are critical to the effective functioning of a finished lubricant. Although the technology that enables the lubricant to perform as expected is contained within the additive package, that must be used at the correct treat rate and in accordance with the technology provider's instructions, the use of the correct base oil in the right quantities is equally as important.

Base oil categorisation or categories are defined within guidelines established by the American Petroleum Institute (API). These guidelines characterise base oils by their viscosity index, sulfur and saturates content. Viscosity Index (VI) is a measure of viscosity change relative to temperature change where viscosity is resistance to flow. i.e. the lower the VI, the more the viscosity is affected by changes in temperature range.

API BASE OIL CATEGORIES				
Base Oil Category	**Sulfur (%)**		**Saturates (%)**	**Viscosity Index**
Group I (solvent refined)	> 0.03	and / or	< 90	80 to 120
Group II (hydrotreated)	< 0.03	and	> 90	80 to 120
Group III (hydrocracked)	< 0.03	and	> 90	> 120
Group IV	PAO Synthetic Lubricants			
Group V	All other base oils not included in Group I,II,III and IV			

Group I base oils are categorised as solvent-refined and mineral-oil based. Due to the high sulfur content of greater than 0.03%, and/or saturates at less than 90%, and a viscosity index of 80 to 120, they are not suitable for today's modern automotive engine applications within Europe.

High levels of sulfur can accelerate oil degradation and reduce the effective operation of exhaust after-treatment devices such as particulate filters and catalytic converters which are designed to remove harmful exhaust gasses in modern automotive vehicles.

Saturates are naturally occurring in mineral oil and help bond the molecules together which resist breakdown and oxidation or loss of viscosity. The higher the level of saturates the stronger the bond and the less likely oxidation or loss of viscosity will occur.

Group II base oils are further refined with hydrotreating and based on mineral oils but provide an advanced performance over Group I base oils.

Hydrotreating converts undesirable elements such as aromatics to hydrocarbon structures which are more desirable. The more highly refined a base oil is, the greater the benefits in terms of thermal stability, oxidation stability, pour point, operating temperature, and viscosity index*.

These types of base oils have a lower sulfur and higher saturates content than Group I base oils and they are more suited to modern automotive engine applications when combined in the right quantities with advanced formulation base oils like Group III and Group IV.

Group III base oils are called synthetic as their molecules have been subject to hydrocracking in order to be broken apart and reconstituted which helps deliver superior performance compared to Group I and Group II base oils. Although their sulfur and saturates content are comparable with those of Group II base oils, Group III are characterised by a higher viscosity index of greater than 120. Group III+ is a marketing term, rather than a strict API specification, that refers to higher Viscosity Index base stocks residing within the Group III category. These types of base oils are widely used in newer vehicles of European origin for 0W-XX for factory fill and in warranty service fill grades, and to a certain extent, for the lighter ILSAC grades in North America and the Far East.

Group IV base oils are a specific type of synthetic base stocks called PolyAlphaOlefins (PAO). Unlike Group I, II and III base oils, PAO is not directly produced from crude oil through conventional refining processes. These base oils comprise of complex and fully paraffinic chemical structures with superior stability and viscosity index.

PAO can be more expensive than other types of paraffinic base oils and, apart from potential solvency issues from formulating purely with PAO, the cost of using these types of synthetic base oils relative to other base oils that are available can influence formulators' choice of base oil rather than just the performance of PAO alone.

Modern automotive engine lubricant formulations require a mixture of different base oils to support fuel economy, vehicle performance that owners expect, as well as helping reduce emissions and support the effective operation of exhaust after-treatment devices such asl particulate filters and catalytic convertors whilst maintaining the integrity of the finished lubricant.

Just as additive companies test their products in the major automotive manufacturer's engine tests, so base oil manufacturers also invest a lot of time and money to validate the performance of their base oils in the appropriate additive technologies. The base oils are regularly tested in order to maintain the approvals and ensure the integrity of the finished lubricant, and so the performance of the product in the field.

In this way base oils act as more than just a carrier for the additive technology. They can comprise as much as 90% of the finished lubricant in volume terms, but it is vital they are paired with the correct additive technology at the correct treat rate, and in the right quantities and base oil mix of different categories to ensure the finished lubricant performs as expected.

ATIEL has established a series of Base Oil Interchange (BOI) guidelines set out within the Code of Practice that Lubricant Marketers and Lubricant Developers must use when formulating finished lubricants meeting the requirements of the ACEA Oil Sequences. These guidelines recognise the different performance of base oils within groups or 'slates' and the use of different base oils is strictly regulated.

The ATIEL BOI guidelines define the minimum engine testing necessary to ensure that the standard of engine lubricant performance, defined by the ACEA Oil Sequences, will be maintained when one basestock is substituted by another in validated formulations.

Basestocks having the same quality control specifications are assumed to be interchangeable, only if they belong to the same slate or to linked slates and so substitution of a basestock by another basestock within the same base stock slate, or within linked slates, is permitted. In all other cases, the guidelines apply.

These BOI guidelines, as well as Viscosity-Grade-Read-Across (VGRA) guidelines, allow lubricant marketers and developers to reduce the number of engine tests needed to validate the use of alternative base stocks and viscosity grades when formulating engine oils that are able to meet the latest performance specifications set out by the ACEA Sequences.

Interchange guidelines are key, not only for avoiding unnecessary and expensive engine testing programmes, but critically for reducing new product development time.

This enables new lubricant formulations to be brought rapidly to market to meet consumers' and manufacturers' needs, while ensuring the absolute technical integrity and performance of the formulations.

More information can be found in the latest Code of Practice available to download on ATIEL's website at https://atiel.eu/code-of-practice/.

The use of unapproved base oils or base oils from the wrong groups, in the wrong quantities or mismatched with incorrect additive technology risks the performance of the finished lubricant, in the engine. This could lead to higher engine deposits, accelerated wear, damage to exhaust after-treatment devices and, at worst, eventual engine malfunction and failure.

If in doubt consult your official basestock supplier for advice.

** Source Castrol*

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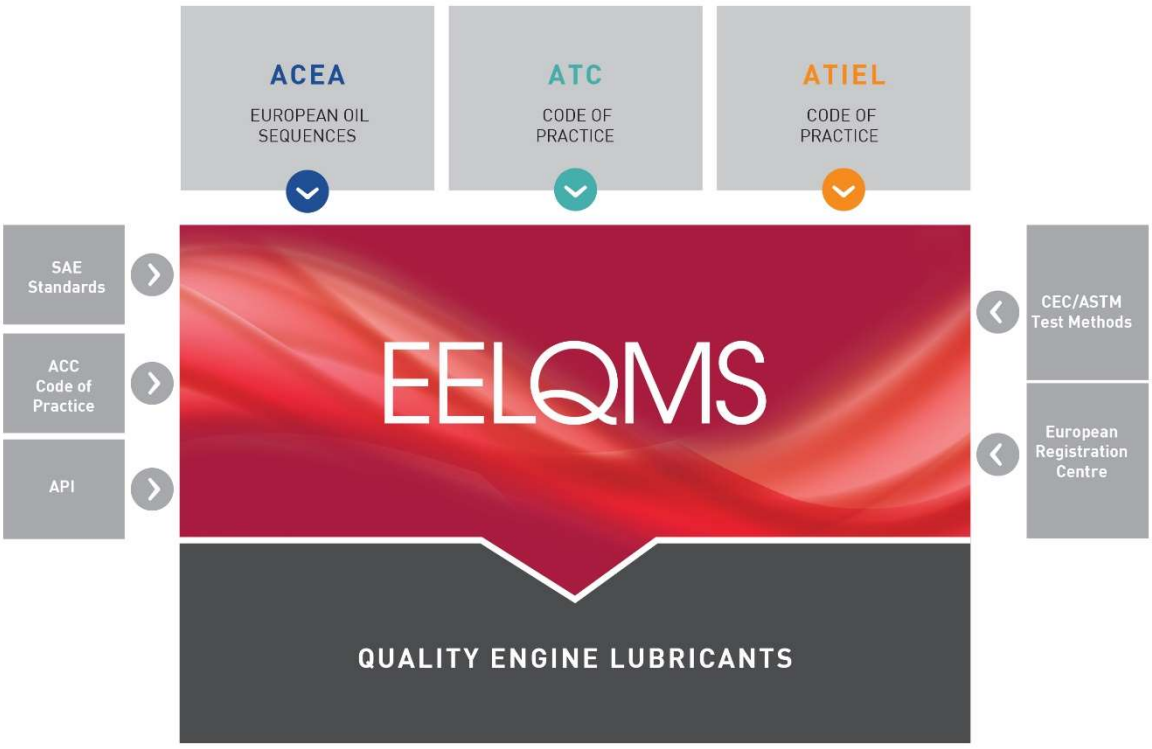
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