

LUBRICANT

The main task and most important function of lubricants are to reduce friction and offer wear protection, which extends machine runtimes.

Lubricants are used in a variety of industries with various requirements. Differences exist in the loads, temperature ranges, pressures, on equipment uptime and maintenance intervals, etc. These factors determine the requirements with regard to equipment protection, oil life time, reliability expectations and energy efficiency. Lubricant properties are adjusted by the application of additives in combination with either mineral oils or synthetic base oils.

The development of lubricants has become an integral part of the development of machinery and its corresponding technologies.

Lubricants as Part of Tribological Research

Tribology (derived from the Greek *tribein*, or *tribos* meaning rubbing) is the science of friction, wear and lubrication.

All lubricants are formulated with base oils & additives

Base Oils (100-60%) + Additives (0-40%)

Base oils

What are base oils?

Base oil is produced by means of refining crude oil. This means that crude oil is heated in order that various distillates can be separated from one another. During the heating process, light and heavy hydrocarbons are separated – the light ones can be refined to make petrol and other fuels, while the heavier ones are suitable for bitumen and base oils.

At least one base oil is used to blend an industrial lubricant, in many cases more than one type is used. The API groups are defined according to the base oils content of saturates, sulphur and the viscosity index. API oil groups and their characteristics

API oil groups and their characteristics,

API categorized base oils into five main groups. This breakdown is based on the refining method and the base oil's properties in terms of, among other things, viscosity and the proportion of saturates and sulfur content.

Group	Type	Saturates [%]	Sulfur [%]	Viscosity Index	Originated in the year & Type	
I	Mineral base stock	< 90	>0.03	80 - 119	1930s	The least refined type
II	Mineral base stock	≥ 90	≤ 0.03	80 - 119	1971s	A better grade of petroleum base oil
II+	Mineral base stock	≥ 90	≥ 0.03	110 - 119	1990s	A more refined grade of petroleum Group III base oil
III	Mineral base stock	≥ 90	≥ 0.03	≥ 120	1993s	The best grade of petroleum base oil
III+	Mineral or synthetic base stock	≥ 90	≥ 0.03	> 140	2015s	Produced by a gas to liquids (GTL) process.
IV	Synthetic base stock	Poly alpha olefins (PAO)			1974s	Consists of synthetic oils made of PAO
V	All other base stocks not included in Group I - IV				1940s	Any type of base oil other than mentioned above

In Mineral base stocks oil Majorly three types

1. Paraffinic
2. Naphthenic
3. Aromatics

In Synthetic base stock Majorly classifieds as below

1. Easters
 - 1.1. Natural: Rapeseed oil, Jatropha Oils etc
 - 1.2. Synthetic: Di-ester, Trimethyl ester, Poly Ester Etc.
2. Glycol
 - 2.1. Ethylene glycol
 - 2.2. Propylene glycol
 - 2.3. Co-glycol
3. Silicon
 - 3.1. Dimethyl silicon
 - 3.2. Methyl phenyl silicon
 - 3.3. Fluorinated silicon
4. PFE

Group I

Group I base oils are classified as less than 90 percent saturates, greater than 0.03 percent sulphur and with a [viscosity-index range](#) of 80 to 120. The temperature range for these oils is from 32 to 150 degrees F. Group I base oils are solvent-refined, which is a simpler refining process. This is why they are the cheapest base oils on the market.

Group II

Group II base oils are defined as being more than 90 percent saturates, less than 0.03 percent sulfur and with a viscosity index of 80 to 120. They are often manufactured by hydrocracking, which is a more complex process than what is used for Group I base oils. Since all the hydrocarbon molecules of these oils are saturated,

Group II base oils have better antioxidation properties. They also have a clearer colour and cost more in comparison to Group I base oils. Still, Group II base oils are becoming very common on the market today and are priced very close to Group I oils.

Group III

Group III base oils are greater than 90 percent saturates, less than 0.03 percent sulfur and have a viscosity index above 120. These oils are refined even more than Group II base oils and generally are severely hydrocracked (higher pressure and heat). This longer process is designed to achieve a purer base oil.

Although made from crude oil, Group III base oils are sometimes described as synthesized hydrocarbons. Like Group II base oils, these oils are also becoming more prevalent.

Group IV

Group IV base oils are [polyalphaolefin \(PAOs\)](#). These synthetic base oils are made through a process called synthesizing. They have a much broader temperature range and are great for use in extreme cold conditions and high heat applications.

Group V

Group V base oils are classified as all other base oils, including silicone, [phosphate ester](#), [PolyAlkylene glycol \(PAG\)](#), polyol ester, bio lubes, etc. These base oils are at times mixed with other base stocks to enhance the oil's properties. An example would be a PAO-based compressor oil that is mixed with a polyol ester.

Esters are common Group V base oils used in different lubricant formulations to improve the properties of the existing base oil. Ester oils can take more abuse at higher temperatures and will provide superior detergency compared to a PAO synthetic base oil, which in turn increases the hours of use.

Additives

What are additives?

Additives are the with different chemistry to adjust the lubricant properties according the need of the application.

The following table summarizes chemistry and function of additives in industrial lubricants.

Additive class	Function / Performance
AW additives	Generating protective layers against wear
EP additives	Generating protective layers against welding
Antioxidants	Lifetime extension (via quenching of alkyl radicals or peroxy- radicals)
Corrosion inhibitors	Protection of metal surfaces from corrosion, e.g., rust and extension of equipment lifetime (protect against moisture and oxygen)
Antifoam	Quick reduction of foam volume after oil churning (by mechanical destruction of the foam bubbles)
Metal- deactivator and -passivator	Complexing dissolved copper or forming protective layers on copper surfaces, capturing active sulfur
Detergents, Dispersants	Keep particles in dispersion, avoid sedimentation
Friction modifiers	Reducing friction between moving parts
PPD	Improving flowability at low temperatures and reduction of <i>Pour Point</i>
VII	Extension of the temperature operating window via reduced temperature dependence of the fluid viscosity
De-emulsifier	Separate water from oil

TO KNOW MORE ABOUT LUBRICANTS
PLEASE FOLLOW US ON LinkedIn