**A General Guide to Oils and Greases**

This information is designed to help you understand a little more about oils and greases, their specifications and how they work.

The level of detail is basic and is only meant to be used as a simple reference.

**OIL FUNCTIONS**

* ***Lubricate Parts and Prevent Wear***

This is the basic function of all oils. Keeping the moving parts separated. In general, the thicker the oil film, the better the wear protection, but the oil additives also play an important role. Modern additives often allow an oil of slightly lesser viscosity to be used and still provide the same level of protection.

* ***Reduce Friction***

The film of oil reduces friction simply because there is no metal-to-metal contact. The heavier the oil though, the greater the drag and hence more heat may be generated. Correct oil selection is therefore a balance of what is needed to protect the component without generating excessive drag.

* ***Protect against Rust and Corrosion***

As oils degrade they form corrosive by-products so the oil contains anti-corrosion and acid neutralising additives to protect components.

* ***Keep Components Clean***

Oils need to be very stable under heat and not cause system deposits. Different oils will last different lengths of time in a given application.

* ***Be Compatible with Seals***

The oil must lubricate and not cause deterioration of seals.

* ***Prevent Foam***

Foam reduces the lubrication properties of the oil, therefore industrial oils must be resistant to foaming or be able to ‘release’ any foam quickly.

**SPECIAL PROPERTIES FOR ENGINE OILS**

* ***Allow Easy Starting***

Most wear occurs in an engine at start up. Therefore, the oil must have the correct low temperature viscosity to flow quickly to the bearings and valve train to prevent wear. Some engines require low viscosity oils to start at all, especially some of the new diesel engines found in four wheel drives, where the oil is used to operate the pump to prime the fuel injectors.

* ***Cool the Engine***

At least 40% of the engine is cooled by the oil, not the radiator system. This means the oil is always under heat stress (oxidation) as it transfers heat from hot spots back to the sump. This includes main and big end bearings, the crankshaft, rods, other bearings plus timing gear and pistons.

* ***Reduce Combustion Chamber Deposits***

Some oil will always reach the combustion chamber – either via the cylinder walls or via the valves. It is then then burned off with the fuel. Therefore, it must burn clean enough so that it does not build up on valve seats or pistons tops which can cause problems.

**SPECIAL PROPERTIES FOR AUTOMATIC TRANSMISSION FLUIDS**

* They are a power transmission medium for the torque converter
* Act as a hydraulic fluid for the hydraulic – and electronic – control systems.
* They must transmit sliding energy in bands and clutches. This property varies between transmission makes, and is why there are so many ATFs on the market. Friction is the key.
* They transmit this energy in such a way that the shift is always smooth.

**SPECIAL PROPERTIES FOR MANUAL TRANSMISSION FLUIDS**

* Be capable of providing an easy gear shift for the life of the oil drain. This is a function of both viscosity and friction modifiers.
* Maintain long clutch life and prevent seal leaks.

**SPECIAL PROPERTIES FOR GEAR AND DIFFERENTIAL OILS**

* Must protect against pitting, spalling, scoring and scuffing caused by the large shear loads placed on the oil by the gear set.
* Protect against copper corrosion. Older technologies were not kind to copper alloys and used to turn them black via chemical attack. Most modern hypoid oils do not tend to do this due to advances in technologies.
* Limited Slip oils must enable the cone or clutch to work properly when distributing power to the drive wheels. As such, these contain a friction modifier to achieve this. It should be noted that oils designed for use in limited slip differentials can be used in standard hypoid differentials.

**ADDITIVES**

There are many types of oils and greases and they use many of the same types of ingredients. However, these are put together a little differently. Not all of these are found in every oil or grease.

Firstly, there are base oils, made from either crude oil at a refinery, or man-made (synthetics).

To achieve the functions required by finished lubricants, additives must be into the oil. These all do different things.

***Detergents***

Any oil with an API engine rating of SC or above, has a level of detergency. This detergency level is not necessarily related to all of the quoted API ratings of the oil, as some high detergent diesel oils may only meet lower petrol engine oil specifications. It is a balance. Detergents are usually metallic compounds and they control deposits and keep engines clean. They can clean up dirty engines depending on the product.

***Dispersants***

These are usually ashless (non metallic) organic chemicals. They keep contaminants and by-products dispersed in the oil helping to prevent deposits from forming. They are highly effective in controlling low temperature contaminants. They can keep them so fine in suspension, they pass through the oil filter with the oil additives!

***Extreme Pressure Additives***

API GL-2 and above oils, all contain extreme pressure (EP) additives of some description. They tend to be sulphur-phosphorus based although chlorine and boron are also used. Some types are also found in compressor and hydraulic oils, and especially in slideway oils and chain lubricants.

The function of an extreme pressure (EP) additive is to prevent adhesive wear and protect the components when the lubricating oil can no longer provide the necessary film thickness.

Oil additives offer a wide range of benefits, but in some circumstances they can actually be harmful to the machines in which they are added. For example, worm gearboxes. These machines have gearing composed of yellow metal (typically bronze). Certain extreme pressure (EP) additives can chemically react with these softer metals, causing premature wear and even failure.

Worm gearboxes are mainly comprised of two units: the worm and the worm wheel. The worm is what actually drives the worm wheel. It is a rod with a helical ridge on its surface that allows it to mesh with the teeth of the worm wheel to provide rotary motion.

These gearboxes are great for achieving high reduction ratios as well as high torque. In order to increase either of these values, the worm wheel is made larger in diameter. The larger circumference the worm wheel has, the greater the speed reduction and the greater amount of torque will be imparted through the exit shaft.

Generally, the worm is made of steel, while the worm wheel is made of a yellow metal. However, in some cases, both the worm and worm wheel are steel, or they both may be yellow metals. The worm is always harder than the wheel.

Yellow metals, as the name suggests, are yellowish in colour. They are alloys that contain copper. A standard definition would be a type of brass having about 60 percent copper and 40 percent zinc. Bronze is another type of yellow metal. These metals have been used for centuries to form gears and other components of simple machines.

EP additives that contain sulphur cause the most damage to these types of metals. Two different types of sulphur may be used within these additives. The first type is active sulphur. Sulphur in its active state readily reacts with metal surfaces to form a ductile metal soap that is sacrificial and allows opposing surfaces to contact one another with minimal damage. Active sulphur is chemically aggressive, and with yellow metals being softer than steel, they can begin to pit and form spalls due to this chemical attack.

Rising temperatures can increase the rate at which this reaction takes place. This is explained by the Arrhenius rate rule, which states that the rate of a chemical reaction doubles for every increase of 10 degrees C (18 degrees F) in oil operation temperature.

The second type of sulphur used within EP additives is inactive sulphur. It is less likely to bond to surfaces and react chemically.