• **Group IV (Synthetic):** Group IV is comprised of polyalphaolefin base stocks and is often referred to as PAO. Like all synthetics, polyalphaolefins are derived from chemicals to produce a highly uniform and stable base oil. PAOs have excellent thermal stability, high resistance to oxidation, good flow at low temperatures and a high viscosity index. Polyalphaolefin base oils are the most commonly used synthetic base oil type and are used in a number of applications including engines, hydraulics, gearboxes and some compressors.

• **Group V (Synthetic):** Group V synthetics encompass all other synthetic base stocks. Like the Group IV polyalphaolefins, Group V synthetics are also derived from chemicals and chemical reactions. Group V base oils have historically been used in niche applications, but have expanded in use due to the increased complexity of offshore equipment designs, increased stress on components and an advancing lubricant culture of operators to more effectively utilize these advance fluids. Group V base stocks used in the E&P market include polyalkylglycols for high-temperature gearbox or gas compression, synthetic esters for reciprocating compressors and environmentally responsible hydraulics, and polyolesters for refrigeration applications.

**Lubricant additives**

Because base oils have certain limitations by themselves, lubricant additives are necessary to achieve an expected level of performance in a component. This expected performance includes achieving an expected life of the oil and of the component in normal operating conditions. Thus, lubricant additives are specific components which are added to base oil for the purpose of protecting or enhancing the base oil, cleaning and protecting internal system components or neutralizing internal contaminants. Below are a list of the most common types:

• **Anti-oxidant:** Minimizes the formation of resins, varnish, acids, sludge and polymers;

• **Anti-wear:** Designed to adhere to internal surfaces to provide a sacrificial layer in the event of slight metal-to-metal contact. This additive is most important during mixed-film lubrication where the fluid separates most of the surface, but some contact is likely to occur;

• **Friction modifier:** Used to achieve either reductions in friction in applications like engines or a specific level of friction in transmissions or fluid couplings;

• **Tackifier:** Used to assist the lubricant in adhering to a surface so a fluid film can be maintained;

• **Extreme pressure:** Also referred to as EP additives, these are required for applications, such as gearboxes, which are under heavy load. The EP additive adheres to the gear surface and is activated by temperature to provide a cushion between contact of the gear teeth. Solid lubricants, such as MOS2, can be used in application where there are very extreme loading conditions that create temperatures too high for traditional sulphur phosphorus EP additives;

• **Foam inhibitor:** Additives that inhibit the formation of foam from the churning of air in the component by facilitating the release of the air from the lubricant. The formation of foam can significantly reduce the fluid film strength by enabling air pockets to penetrate between internal surfaces. Foaming is normally caused by low oil levels or leaking fittings that enable air to enter the system. Significant foaming can lead to increased wear of the surfaces and significantly lead to foam inhibitor additive depletion;

• **Dispersant:** Additives that encapsulate contaminants in the lubricant so they can be carried to installed filtration;

• **Emulsifier:** Allows mineral oil to be mixable with water. Frequently used in metal-cutting oils and in some lubricants for wet applications;

• **Detergent:** Additives used to keep internal surfaces clean from contaminants. Detergents are designed to coat internal surfaces of components during normal expected operation to prevent deposits from forming. Deters may have a limited ability to clean existing system deposits;

• **Oxidation inhibitors:** This additive type is necessary as equipment operation causes heat, moisture and other contaminants to degrade the base oil. Oxidation inhibitors significantly reduce the rate of oxidation to an acceptable level so a reasonable fluid life can be achieved;

• **Viscosity index improvers:** Viscosity index improvers enhance the base oil to provide better stability with regard to changes in the fluid’s viscosity through temperature changes. Viscosity index improvers can also critical when operators face significant changes in operating temperatures, such as aviation applications and arctic operations. A higher viscosity index enables the lubricant to either thicken or thin at a slower rate as operating temperatures fall or rise;

• **Pour-point depressants:** The pour point of a lubricant is the temperature at which a lubricant is semi-solid and no longer maintains its expected flow characteristics. Pour-point depressants enable a lubricant to flow at very low temperatures to prevent lubricant starvation to components;

• **Corrosion/rust inhibitors:** Internal metallic components are subject to corrosion in the presence of moisture and heat. Lubricant corrosion/rust Inhibitors serve to slow the corrosion process on internal surfaces.

**Lubricant properties**

Viscosity is the measurement of a fluid’s resistance to flow and is the single most important property of a lubricant. Vis-

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