

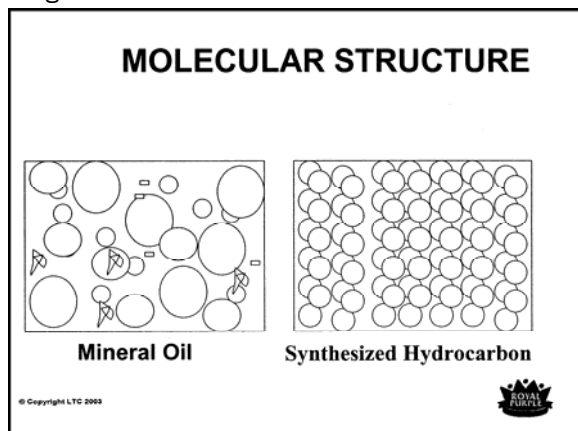
# Successfully Applying Synthetic Lubricants

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The decision to use synthetic lubricants in place of the usual mineral oils is difficult for many reliability engineers because of a lack of knowledge of lubricants in general. Synthetics conjure up images of super-expensive and exotic lubricants that could be difficult to cost-justify through improvements in reliability. Just what is a synthetic oil, and when should it be considered? How difficult is it to cost-justify these oils?

## Where synthetics come from and how they are used

Mineral oils are refined directly from crude (mineral) oil. Synthetic lubricants have their origins in crude oils, but are considered to be “man-made”, as they are not found in the natural state. Take PAOs (Polyalphaolefins), for example. This synthesized hydrocarbon is extracted from ethylene gas, and polymerized (or converted) into unique molecules that are identical both in chemical structure and molecular size. Unlike mineral oils, which have a great diversity in both the molecular size and the chemical makeup of each molecule, PAO molecules have molecular consistency and highly predictable lubricant properties. This gives PAO's the attributes that we typically hear touted for this lubricant family: low pour points, better thermal stability, better oxidation stability, better heat transfer, more resistance to water inclusion (or hydrolytic stability), and reduced oxidation byproducts that often produce undesirable varnish and sludge.



So how does a reliability engineer make good economic decisions based on these benefits and the ASTM test results listed on typical product data sheets? The engineer should look for applications that have the following characteristics:

- Lubricant temperatures over 160° F.
- High levels of contamination (solids or water) in the lubricant
- Equipment subjected to variations of high and low temperatures
- History of frequent equipment failures (bearings, gears, etc.)

Over-the-road trucks contain complex sets of rotating equipment, and are subjected to all of the above extreme lubricating conditions. Most, if not all, of the major truck OEMs recommend synthetic oil in their transmissions. Here, suitably selected synthetics reduce the wear, increase the time between oil changes, decrease warranty claims, and improve the bottom line for the trucking industry.

## External contaminants still threaten lubricants

However, as excessive dirt is detrimental to all oils, even the best synthetic lubricants can use some “de-contamination help” to increase the service life of both the oil and the equipment. A regular filtration regimen can remove contaminants from the oil, reducing the amount of damage done to the bearings and gears. Desiccant filter breathers remove the moisture from the air that is “breathed” into the equipment during alternating hot/cold cycles, but these filter-breathers must be regularly maintained to be effective. In contrast, face-contacting bearing housing seals, such as the MagTecta® from AESSEAL require no maintenance and will effectively prevent the ingress of dirt and moisture along the shaft. These seals will also reduce or even eliminate the need for both oil filtration and desiccant breathers.



## Application examples tell the story

A major American tire manufacturer converted a 200 hp chilled water supply pump from standard mineral oil to Royal Purple ISO Grade 68 and replaced the leaking lip seals with dual-face MagTecta® bearing isolators. This

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superior synthetic oil reduced the friction in the pump, the bearing temperature went from 172°F to 120°F, and the electrical current draw going from 39.5 A to 36 A. This resulted in a power savings of \$6,778 per year.

Another example involves a chemical plant. This facility began to experience bearing failures in their 500° F hot oil pumps within 90 days of plant startup, despite the fact that the pumps were already being lubricated by a premium brand of synthetic oil. Root cause analysis determined that failures occurred because high temperatures had caused the less-than-optimum synthetic oil to oxidize. All pumps underwent immediate oil changes with nine of the 18 hot oil pumps also being converted to a superior film strength type synthetic oil for comparison. The superior film strength oil eliminated the bearing failures in these nine pumps and, after converting the remaining nine pumps, enabled the establishment of annual oil change intervals.

## Cost justifications are easy

Although larger improvements have been reported, suppose a four-fold extension of oil exchange intervals were achieved. This then results in a 75% reduction of oil usage after changing over to the synthetic lubricant. The reduction in consumption makes up for the fact that the synthetic lube costs four times as much as the mineral oil used before. If, on several conventionally lubricated pumps, yearly maintenance efforts consumed 200 man-hours of maintenance labor, this would now be reduced to only 50 man-hours. At \$50 per man-hour, yearly savings are \$7,500.

Another refinery was experiencing high vibrations and an audible noise from the inboard bearing of a critical, non-spared pump in one of its process units. The refinery was able to avoid a unit shutdown by draining the oil with the pump operating and replacing the quart (~ one liter) of ISO 32 synthetic oil already in the pump with a superior film strength ISO Grade 32 synthetic. The high vibrations disappeared (see Ref. 1 for a technical explanation), as did the audible noise and it was decided repairs to the pump were no longer necessary. The value of an avoided repair was estimated as \$2,500 for a bearing change only, \$13,000 for bearings and seals, and \$54,000 for a

complete pump overhaul. Additionally, unit downtime would have amounted to \$140,000 per day. Whatever the differential cost of a quart (or liter) of high film strength synthetic, perhaps two or three dollars in 2004, it is insignificant compared to the cost of a failure incident on critical, non-spared refinery pumps. Critically important and hot service pumps should, therefore, be lubricated with high film strength synthetic oils.

These examples are but a few of the hundreds where synthetic lube oil selection was responsible for significant improvements in pump reliability. High bearing temperatures and vibration excursions related to elevated surface roughness of bearing metals can very often be cured by selecting and installing superior performing lubricants. Especially in problem pumps, upgrading to high-strength lubricants can improve equipment reliability in a manner unattainable by any other means.

Indeed, since oil changes are often feasible while pumps are on-line and running, using superior film strength synthetic lubricants often results in immediate payback. Virtually every cost justification calculation indicates unusually large benefits for employing these lubes on problem pumps and 10:1 payback in a single year is the norm.

## Synthetic lube selection and contamination protection summary

We can summarize good lubrication practices as: choosing the right oil, taking proper care of it, and changing it on time. Yet, while good lubrication practices lead to improved equipment reliability by maximizing the performance of the oil selected, there are limitations. This is because, in and of themselves, good practices cannot impart lubricating properties that the oil never possessed in the first place. At issue is thus the definition of the *right oil*, or *appropriate oil type*. Putting it another way, improvements in lubricant quality can only be achieved by selecting and utilizing oils with superior lubricating properties. But these oils must be kept clean; exterior contaminants must not be allowed to enter. This superior cleanliness can be achieved with MagTecta® dual-face magnetic bearing housing seals.

Ref 1: Bloch, H.P. and A.R. Budris; "Pump User's Handbook", 2nd Ed. (2006), Fairmont Press, Lilburn, GA 30047; ISBN 0-88173-517-5