

## ExxonMobil on Benefits of Synthetic Gear Oils

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**Base oils play an important role in determining the performance of an industrial gear oil.** They influence characteristics such as low temperature performance, biodegradability, energy efficiency and high temperature thermal and oxidative stability.

When considering base oil options for a formulation, it's important to consider the common operating conditions that the equipment will be subjected to. Each base oil type has its own distinct characteristics, so you must select one that will meet the needs of the specific applications. For example, some base oils perform better in high or low temperatures, while others are geared more toward delivering energy efficiency benefits.

In most cases, synthetic base oils—such as polyalphaolefins and a Group V base oil or a blend of the two—will be most ideally suited for a high performance lubricant. Synthetics typically offer better performance at extreme high and low temperatures and longer oil life, resulting in lower maintenance and operating costs, less used oil disposal, improved equipment durability and enhanced energy efficiency.

### Potential Energy Efficiency Savings from Using Synthetics

In fact, in-service and field testing has proven that synthetic gear oils—such as Mobil SHC 600 series and Mobil SHC gear series oils—can help deliver up to a 3.6% improvement in energy efficiency as compared to conventional mineral gear oils.

One of the many companies that have seen success with Mobil SHC gear oils is Chinese-based Xinyu Iron & Steel Co. The company was experiencing abnormal wearing of the gear and short oil drain intervals for gearboxes in 16 sets of conveyors, so they converted from a mineral-based oil to Mobil SHC 630.

After the conversion, the average operating temperature of the gearboxes decreased by 6.7 degrees Celsius and the electric motor current decreased by about 3.3%—yielding an annual savings of more than \$1,800—as well as important safety benefits from less-frequent equipment interactions.

Note that these results are based on the experience of a single customer; actual results can vary, depending upon the type of equipment used and its maintenance, operating conditions and environment, and any prior lubricant used.

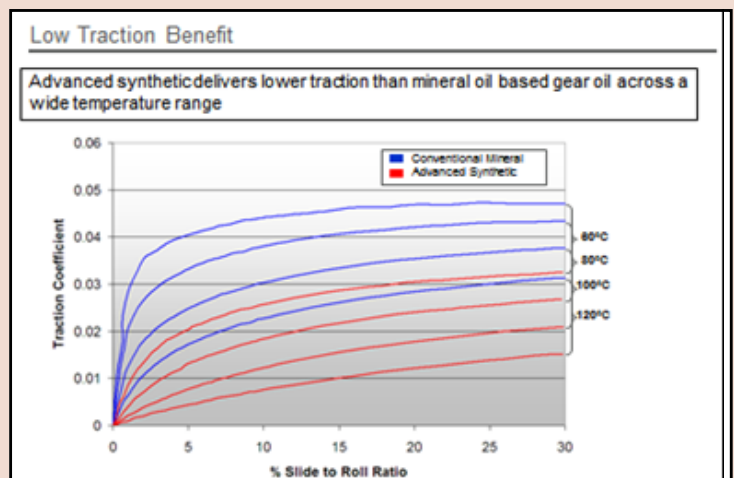
While synthetic base oils are a preferred option most of the time, there are select situations where it makes sense to use a mineral-based gear oil, such as if there are extreme levels of contamination due to specific equipment operating conditions that result in

the need for frequent oil changes. In these cases, it might be more practical to use a mineral oil.

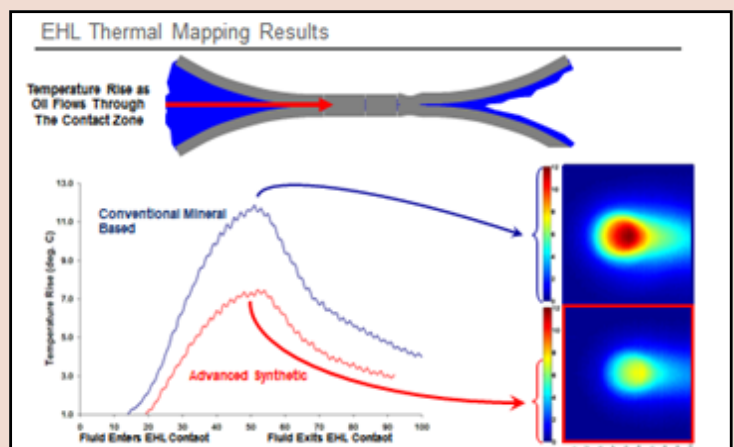
### Operating Temperature Benefits of Synthetics

High operating temperatures can quickly degrade the gear oil, resulting in the need for frequent oil changes. Extreme low operating temperatures can also impact an oil's flow characteristics.

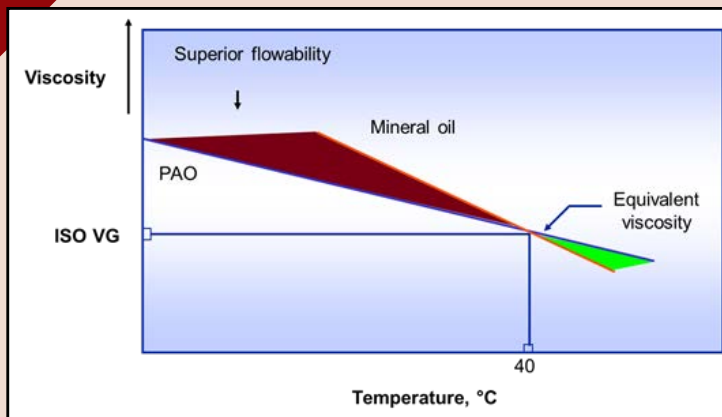
A high-quality, synthetic oil formulated with the right basestocks and additives can help to deliver enhanced low- and high-temperature performance, as well as help deliver low-temperature pumpability to ensure proper flow properties in extreme cold climates as well as improved thermal stability to mitigate lubricant degradation at high temperatures.



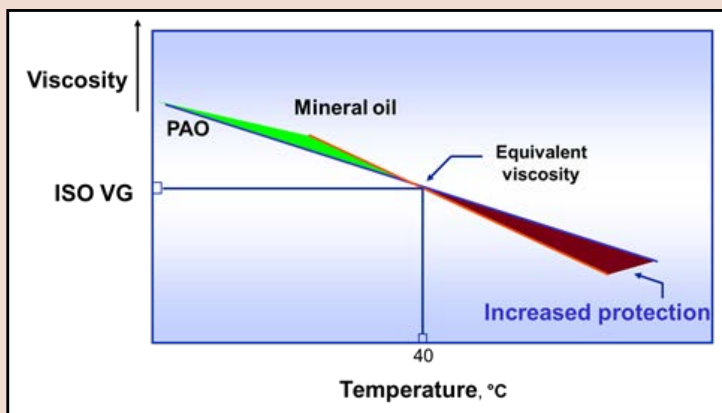
**Figure 1** Actual traction coefficient measurement over range of slide to roll ratios and temperatures shows that synthetics have much lower traction coefficient than typical mineral oils. This leads to a more energy efficient operation, reduced heat generation, and lower overall system operating temperatures.



**Figure 2** MTM thermal mapping shows that synthetics operate at lower temperatures in the contact zone, leading to longer oil and equipment life.



**Figure 3 Synthetic oils (PAO) deliver improved flow at low temperatures.**



**Figure 4 Synthetic oils (PAO) deliver improved viscosity control and equipment protection at higher temperatures.**

## Formulating Gear Oils

Most lubricants today are formulated using traditional lubricant development processes, which rely on blending a conventional base stock with an off-the-shelf additive package to create a product that meets basic industry specifications.

However, due in part to today's competitive marketing environment, traditional formulations often focus on delivering exceptional results solely based on one or two criteria — such as energy efficiency — which may negatively impact other critical performance areas.

ExxonMobil devotes significant resources to product research and development, using an advanced, scientifically engineered formulation approach that leverages our leading technology and application expertise to deliver lubricants such as gear oils that are optimized for their intended applications.

We call this our balanced formulation approach, which relies on the use of the right base stocks and carefully designed additive systems that complement the properties of the base fluids to deliver exceptional performance across all critical areas for each application.

That's why the first step in our approach is to define the application's operating conditions. We consider the temperature operating range, types of seals used, load, and specific original equipment manufacturer (OEM) requirements,

among other items.

Once we understand all of the performance benefits the oil will need to deliver, we then formulate the oil using the right advanced base stocks and additive components before putting the lubricant candidate through a range of industry-standard laboratory tests.

We also supplement this testing with our own dynamic testing using industrial equipment and field trials. Our proprietary rig tests are designed to stress the lubricant under conditions even more demanding than it is likely to experience in severe operating conditions, and in combination with field trials results, they help give us an accurate indication of real-world performance.


Strong OEM relationships are an important part of this development process. ExxonMobil's Equipment Builder Group has been working for many years with leading OEMs from around the world to help develop advanced lubricants. These relationships help provide unique insights into advanced equipment and allow us to better understand and address specific operating conditions.

## Final Comments

In addition to baseline gear performance demands, gear oils must meet a wide variety of OEM and industry requirements that are constantly evolving, such as material compatibility with seals, paints and other materials.

Formulators are regularly revising formulation chemistry to ensure compatibility, which can sometimes lead to tests that are run under accelerated conditions to simulate equipment/oil life.

However, these tests do not necessarily correlate with real-world conditions, so extensive field service trials are often required to ensure that the oils will perform as needed. That's why, as mentioned previously, we always put our lubricants through our proprietary rig tests, which simulate real-world conditions.

The company's commitment to extensive product research and development expertise ensures that we are at the forefront of lubricant innovation and able to stay ahead of these trends. 

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