TOO HOT, TOO COLD, JUST RIGHT:

The Effect of Temperature on Lubricant Viscosity

Your business is a well-oiled machine that operates best when all its parts—people, processes, physical plants—work seamlessly.

A plant's manufacturing line brought to a grinding halt by equipment issues related to a malfunctioning gearbox creates supply chain issues. A gas turbine with varnished valves can translate into added electricity costs for utility companies. And planes, trains, and automobiles stopped in their tracks by subarctic weather put people's lives and livelihoods at risk.

It might be better said that without a knowledge of the impact of temperature on lubricants, equipment failures are not uncommon. Just a single hour of downtime can result in losses of hundreds of thousands of dollars. Thus, an understanding of all the different impacts of temperature is necessary to help maximize the life of the lubricant and the equipment.

The Most Important Property of a Lubricant Is Viscosity

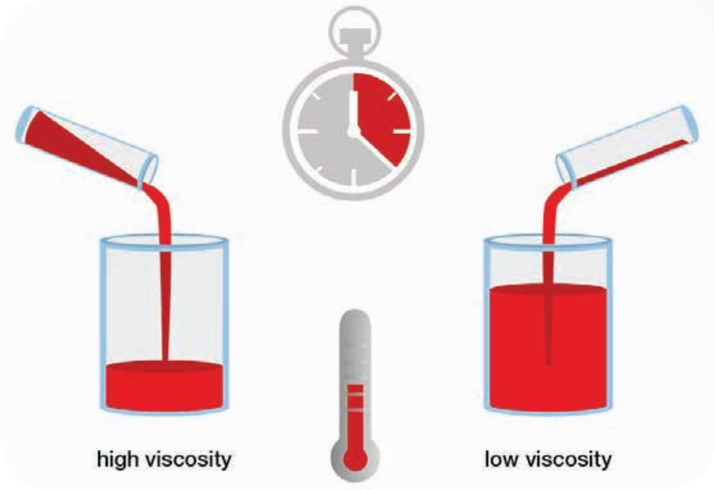
It is important to understand how a lubricant's resistance to flow (the viscosity)—and its impact on product selection—is more than operationally smart, it's bottom-line savvy. Even if it's 200° or -30°F.

So, let's start at the critical role viscosity plays when selecting the right lubricant and how changes in temperature require careful consideration when applying these lubricants to a single machine, at one site, or across a global enterprise.

How Viscosity and the Viscosity Index Work for You

Viscosity is the single most important performance property of a lubricant. If the lubricant is too thick, it flows more slowly (like molasses), creating more friction and thus negatively impacting the efficiency of equipment. If it's too thin (like water) and moves too freely or quickly, it does not form a sufficient film to separate moving parts, wearing out machines more quickly.

A lubricant's viscosity will change with changes in temperature. As lubricants get hot, their viscosity drops; as they get cold, their viscosity increases. A viscosity index (VI) is assigned to a specific lubricant so that users have a clear understanding of the viscosity state at varying temperatures. The lower the viscosity index, the more the viscosity is impacted by changes in temperature.



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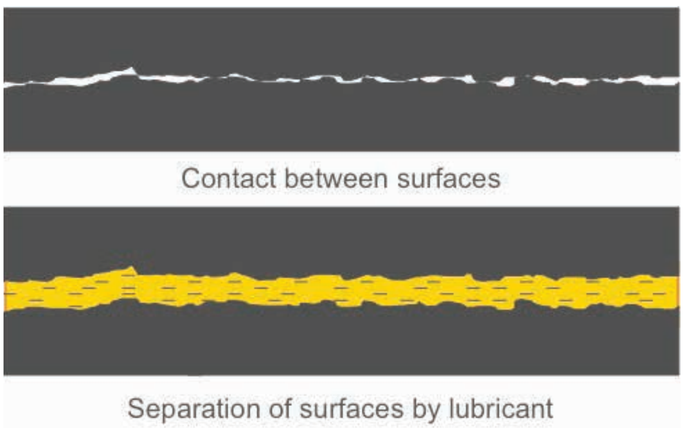
How Temperature Impacts Wear Protection

Although two metal surfaces that come into contact in a machine may look extremely smooth, magnification of the surfaces would reveal a scene that more closely resembles a mountain range with mountain tops (asperities) and valleys. It's these asperities that will come into contact as metal parts slide unless there's a proper fluid film at operating temperature. The fluid film needs to be thick enough at operating temperature to separate the two surfaces even under load; however, they should not be so thick that the parts have difficulty moving due to the viscous lubricant. For instance, if you have two metal plates that are moving against each other in a hot environment, a low-viscosity oil may not provide the ideal fluid film, resulting in metal-to-metal contact. This increases wear and heat while reducing component life *(see figure 1)*.

(figure 1)



Now, if you take those same two components and use a lubricant with a viscosity that is too high, there may be a drag effect at operating temperature that increases friction. This is an inefficient utilization of the lubricant, resulting in unplanned time delays, extra energy usage, and costs.

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Why Higher Temperatures Reduce Oil Life

The Arrhenius rate law states that with every increase of 10°C in a lubricant's base temperature, oil life is halved *(see figure 2)*.

(figure 2)

Current Oil Temperature	Twice-the-Life Oil Temperature
300°F (149°C)	282°F (139°C)
275°F (135°C)	257°F (125°C)
250°F (121°C)	232°F (111°C)
325°F (107°C)	207°F (97°C)
200°F (93°C)	182°F (83°C)
175°F (79°C)	157°F (69°C)
150°F (65°C)	132°F (55°C)
125°F (52°C)	107°F (41°C)

Cool, Clean, and Dry: Achieving Optimal States for Lubricant Viscosity

- The product chosen has been properly formulated to address all operational and environmental conditions, especially as they relate to specific industry applications and usage.
- Original equipment manufacturers' (OEMs') recommendations have been consulted, as the OEMs typically have determined the right type of lubricant and viscosity your equipment needs.
- A lubricant's starting viscosity and corresponding VI be understood. In addition, ask your oil supplier about their product to better understand the features and benefits as they relate to temperature (VI, thermal stability, oxidation protection).

By understanding all the critical temperature-related elements that can impact lubricant viscosity, functional decision makers, procurement buyers, and engineers can create a "well-oiled and greased" plan that keeps assembly lines and supply chains moving, power plants operating, and gears and pistons humming … whether the temperature is too hot, too cold, or just right.

FOR MORE INFORMATION, CONTACT US AT:
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