High-temperature Lubricants

In future aircraft flying at three or more times the speed of sound, aerodynamic heating can result in vehicle skin temperatures as high as 1600 degrees Fahrenheit, well above the temperature limitations of airframe bearings. Solid lubricants oxidize or dissociate at temperatures below 900 degrees; other lubricants could meet the temperature requirement, but only after complex and time consuming secondary treatment. Therefore, Lewis Research Center started a program several years ago to develop improved high-temperature lubricants.

A material that emerged from Lewis' research is a plasma-sprayed, self-lubricating metal-glass-fluoride coating able to resist oxidation at very high temperatures. That technology is now in commercial use under the trade name Surf-Kote C-800, marketed by Hohman Plating and Manufacturing, Inc., Dayton, Ohio under a patent license from NASA. Surf-Kote C-800 contains a special sodium-free glass for oxidation protection, silver for protection in the low temperature range and calcium fluoride for high-temperature protection. The coating is intended for service from minus 200 degrees to 1600 degrees Fahrenheit to reduce wear and prevent galling and seizure of metals. Among its uses are lubrication for sliding contact bearings, shaft seals for turbopumps, piston rings for high performance compressors, and hot glass processing machinery; it is also widely used in missile and space applications. At upper left, a Hohman worker is coating a shaft with plasma spray.

Company president Bernard Stupp has consulted with Lewis Research Center on vacuum deposited coatings and has adapted NASA technology in several coating areas, such as sputter deposition and ion plating. Sputtering involves bombarding a surface with high energy particles to deposit an extremely thin dry film lubricant; at lower left, Stupp is observing a sputtering device he invented as it deposits a coating on a bearing race. Ion plating is a coating process whereby a metal is vaporized, ionized and attracted to the surface to be coated by the influence of electrical fields. Ion plating allows use of almost any metal that can be melted to coat surfaces with uniform thickness and excellent adhesion; below, a gear is being ion plated with a soft metal that will act as a dry lubricant. About half of Hohman's ion plating work is for lubrication; other coatings are for corrosion resistance, electrical conductivity or insulation.