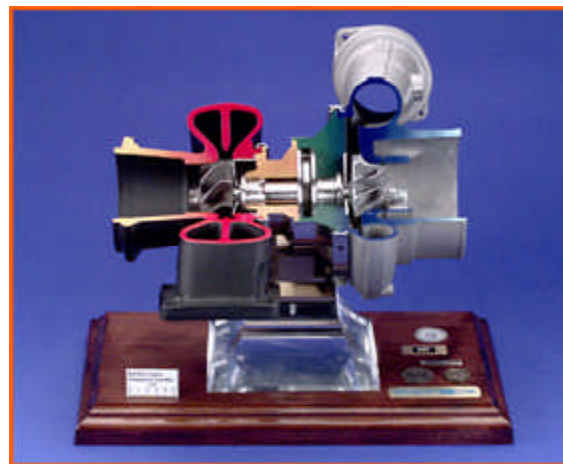
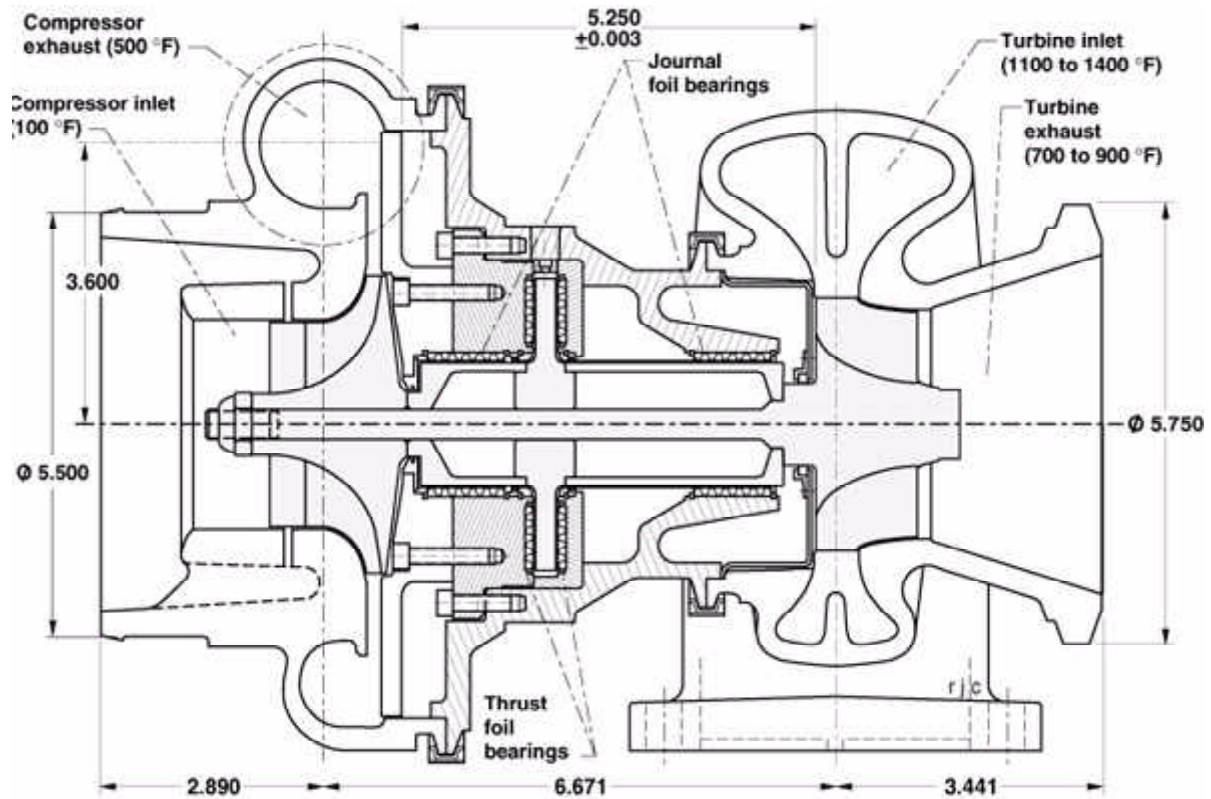


# High-Temperature Solid Lubricants Developed by NASA Lewis Offer Virtually "Unlimited Life" for Oil-Free Turbomachinery

The NASA Lewis Research Center is capitalizing on breakthroughs in foil air bearing performance, tribological coatings, and computer analyses to formulate the Oil-free Turbomachinery Program. The program's long-term goal is to develop an innovative, yet practical, oil-free aeropulsion gas turbine engine that floats on advanced air bearings. This type of engine would operate at higher speeds and temperatures with lower weight and friction than conventional oil-lubricated engines. During startup and shutdown, solid lubricant coatings are required to prevent wear in such engines before the self-generating air-lubrication film develops.

NASA's Tribology Branch has created PS304, a chrome-oxide-based plasma spray coating specifically tailored for shafts run against foil bearings. PS304 contains silver and barium fluoride/calcium fluoride eutectic ( $\text{BaF}_2/\text{CaF}_2$ ) lubricant additives that, together, provide lubrication from cold start temperatures to over 650 °C, the maximum use temperature for foil bearings. Recent lab tests show that bearings lubricated with PS304 survive over 100 000 start-stop cycles without experiencing any degradation in performance due to wear. The accompanying photograph shows a test bearing after it was run at 650 °C. The rubbing process created a "polished" surface that enhances bearing load capacity.



*PS304-coated bearing after 100 000 cycles at 1000 °F. This oil-free turbocharger features two journal foil bearings, two thrust foil bearings, a NASA PS304 coating, and a rigid rotor. All dimensions are in inches.*

This type of bearing performance suggests virtually unlimited life for foil-bearing-supported, oil-free turbomachinery. By adapting these technologies, future aer propulsion engines can run more efficiently and be maintenance free as well as oil free.

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**Headquarters program office:** OAT

**Programs/Projects:** P&PM, SGE

**Special recognition:** A patent will be issued on this coating technology in January 1999.