



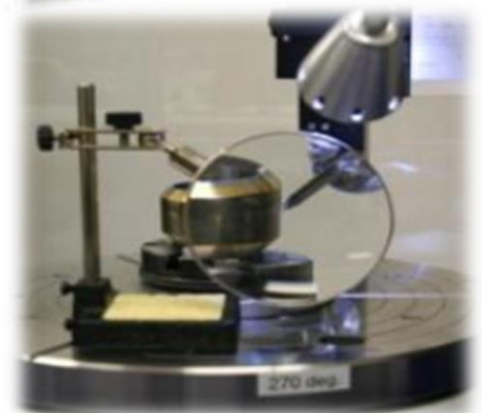
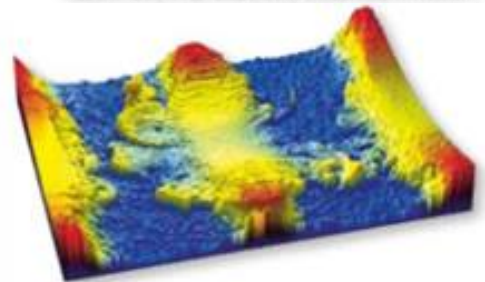
Marshall Space Flight Center Tribology and Metrology

Engineering Solutions for Space Science and Exploration

The Materials and Processes Laboratory's Tribology and Metrology

team conducts a variety of tests and analyses in order to characterize surface interactions in materials subjected to relative motion. Tribology is the science and technology of friction, lubrication, and wear. This includes natural and biological systems as well as common applications such as gears and bearings. Engineers in the Tribology laboratory can design experiments and perform tests to determine the tribological properties of materials and lubricants used in both standard and esoteric mechanical assemblies, simulating a wide variety of environmental conditions including extreme terrestrial environments and other low-vacuum operating conditions. Common requests involve performing standard ASTM testing to evaluate oils, greases, dry film lubricants, and coatings on materials for resistance to wear and surface degradation. The Tribology team possesses extensive experience and capability at characterizing and analyzing bearings, including high-speed turbopump bearings. This can take the form of acoustic testing, starting/running torque measurements, computer modeling analysis, and more.

The Metrology Laboratory handles precision measurements and dimensional metrology, which is typically performed both in support of tribology and failure analysis. Using non-contact 3D metrology, stylus profilometry, high accuracy dimensional inspections, this team is capable of quantifying texture, form, and dimensions for parts and surfaces. These tools are widely used during failure investigations of valves and bearings, and the results provide valuable input during the design process. Depending on the customer's needs, the data acquisition and reporting can be tailored to best suit the critical areas of interest. Whether that be the surface texture of an additively manufactured component or the cylindricity of a critical bore, we can provide the information needed to keep things running smoothly.



Key Benefits

Tribology

- > Tribometers capable of performing ASTM Specification with pin/ball-on-disk, pin/ball-on-plate, 4-ball, block-on-ring, disk-on-disk, and scratch test setups.
- > Linear, rotary, reciprocating, and block-on-ring motion available to meet the desired relative motion.
- > Up to 2 kN force and 5.7 Nm torque available for testing at ambient pressure.
- > Up to 200N force available for testing in vacuum.
- > Humidity control for testing up to 85% Relative Humidity
- > Elevated temperature testing to 400 °C
- > Cryogenic temperature testing to -120 °C
- > Test environments include ambient or vacuum pressures. Lubricants and abrasive substances available for testing at ambient pressure.
- > Bearing functional analysis including noise and torque testing up to 10 oz-in (start/run for bearings and cogging torque for brushless DC motors).
- > Multiple banks of Rolling Contact Fatigue testers to evaluate fatigue life of materials.

Metrology

- > Several non-contact 3D surface imaging options including focus variation, laser scanning confocal, and white light Interferometry. Capable of measuring coating thickness, step heights, surface texture, surface features, and more.
- > High precision contact surface profiling equipment for texture topography, waviness, and form.
- > Dimensional measurement capability with micro-inch capability.
- > Bearing inspection tools including axial and radial internal clearances, rolling element and raceway characterization, and wear path monitoring.
- > Rotary indexing stage used for measuring roughness, roundness, contour, eccentricity, flatness, and parallelism. Designed primarily for cylindrical parts though more geometries are available.
- > Detailed photo-documentation capabilities ranging from standard digital cameras with light benches to high-magnification digital microscopes.

For more information, please visit www.nasa.gov/centers/marshall/about/business.html

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