aerospace & advanced composites

Aerospace & Advanced Composites GmbH
Viktor-Kaplan-Straße 2/Object F
2700 Wiener Neustadt, Austria
office@aac-research.at
+43 2622 90550-0
+43 2622 90550-99

Vacuum Tribometer

For first tribological assessment, so-called pin-on-disc tribometers offer the most simple and cost effective test to derive friction, wear and a fore-cast for the life-time of materials and coatings for use in space and planetary exploration.

AAC runs a vacuum tribometer, which enables the investigation of materials and coatings with respect to friction and wear properties in (thermal) vacuum. It enables on-line measurement of friction force during unidirectional sliding according to standardised pin-on-disc, ball-on-disc or cylinder-on-disc geometries. Environments vary from vacuum, gases under controllable pressures (e.g. to simulate Martian environment: 6mbar CO2) or to air with controlled humidity. Also linear wear is determined on-line. Mass spectrometer can be attached to analyse residual gas (e.g. desorption of contaminants from degradation of oils or greases).

Post-Analysis may cover measurement of wear by profilometry (stylus or 3D), SEM or microbalance, investigation of surface structure or material transfer by SEM/EDX. Reproducibility and Repeatability of test results were proven by a European Round Robin Test.

The device is fully PC-controlled: the control parameters, e.g. sliding distance, speed, motion profiles (unidirectional, oscillating with multiple stops, ..), can be selected. On-line-data acquisition offers to post-process data, e.g. for automatic calculation of friction coefficients in running-in or steady state, as well as endurance of solid lubricant coatings.

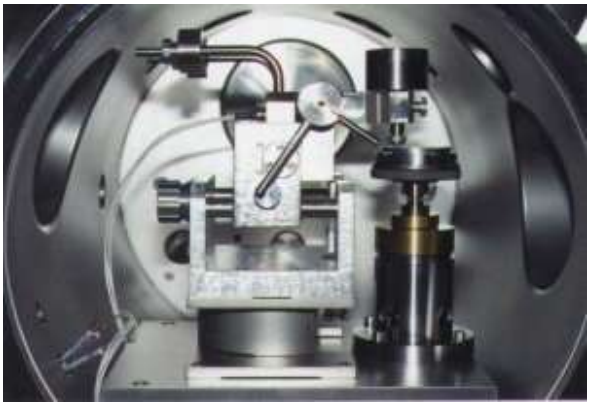

Figure 1: Vacuum tribometer (Pin-on-Disc system)

Measurement of

- Friction force / Friction coefficient
- Linear wear (on-line)
- Wear (geometric or mass loss)
- Environmental Data
- Optional (e.g. residual gas, user defined)

Different options are available (on demand):

a) Testing from air to high vacuum
b) Testing in controlled gas environment, e.g. simulating Martian atmosphere (6 mbar in CO2)
c) Motion selectable between unidirectional rotation to oscillating motion
d) Contamination monitoring: a mass spectrometer to detect on-line contamination (e.g. outgassing of fluid lubricants or their cracks).

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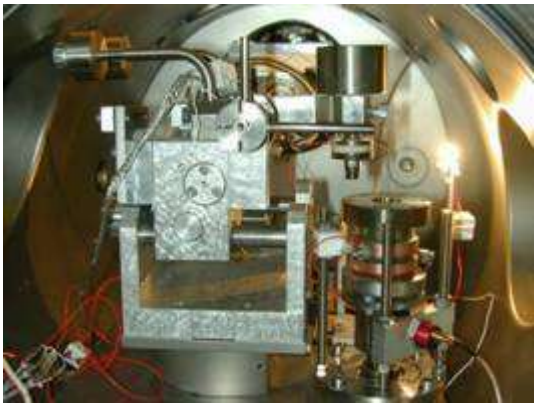

Figure 2: ***Vacuum tribometer with high temperature spindle and equipped with mass spectrometer***

Specifications	
Samples	Examples (details on demand) • Balls DM=6mm • Pins with spherical tip (DM 4 – 7 mm) • Cylinders (lying): DM3-4mm, L5-8mm • Discs DM < 60mm or Plates of few cm^2
Test (Output)	online measurement of • Friction force / coefficient • Linear wear (on-line) • Environmental Data • residual gas analysis (mass spectrometer of outgassing particles) Offline (post-testing): Wear (geometric or mass loss)
Loads	1 <> 30 N (loading under vacuum, dead weight) (loads from 0,01 to 1N can be achieved using other test devices)
Motion **Speed**	Motion selectable from unidirectional to reciprocating (angles selectable) 0.005 <> 1 m/s (0,1 to 500rpm)
Vacuum / **Environments**	Vacuum selectable down to 10^{-6}mbar Air with controlled humitiy Gases with controllable pressure (e.g. CO2 at 6mbar)
Temperatures	from -100°C up to + 300 °C, thermal cycles available
Accuracy	Friction force ± 0.01 N Sample temperature (pin and disc separately): ±2°C Linear Wear: ± 0.002 micrometer (range up to 1mm)

Your contact at AAC: Dr. Christian JOGL
Head of Microstructural Analysis
T +43 (0) 2622 90550-470
M +43 (0) 664 8464023
F +43 (0) 2622 90550-99
christian.jogl@aac-research.at
http://www.aac-research.at

For scientific assistance: Dr. Andreas MERSTALLINGER
Head of Space Testing
M +43 (0) 664 8251136
andreas.merstallinger@aac-research.at