

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.

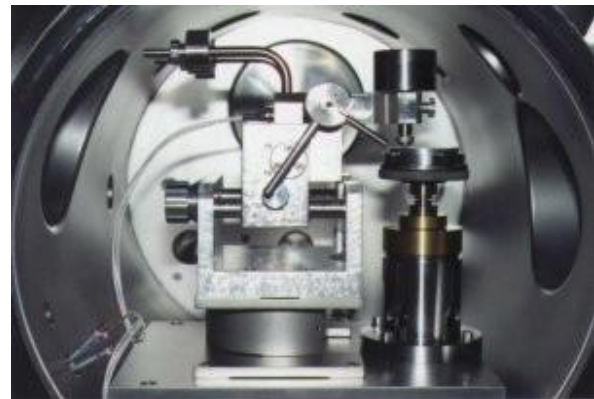


Figure 1: Vacuum tribometer (Pin-on-Disc system)

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).

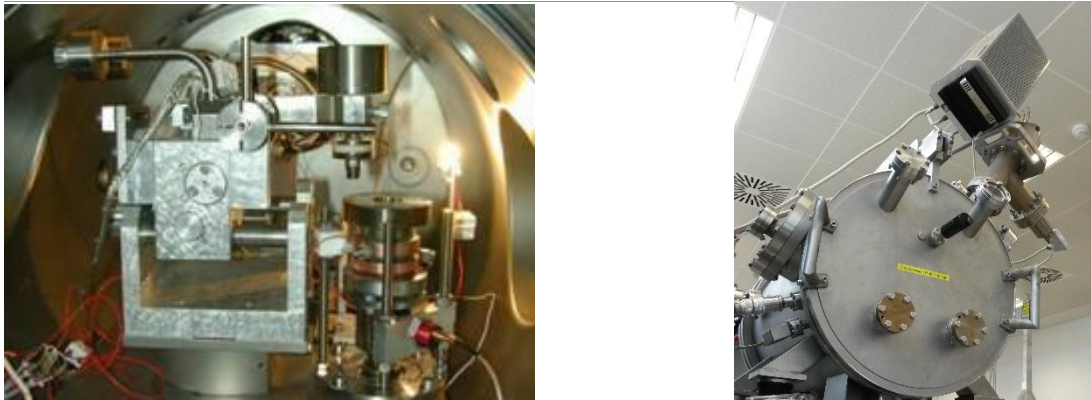


Figure 2: Vacuum tribometer with high temperature spindle and equipped with mass spectrometer

Specifications	
Samples	Examples (details on demand) <ul style="list-style-type: none"> • Balls DM=6mm • Pins with spherical tip (DM 4 – 7 mm) • Cylinders (lying): DM3-4mm, L5-8mm • Discs DM < 60mm or Plates of few cm²
Test (Output)	online measurement of <ul style="list-style-type: none"> • 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 humidity 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)