

Ultra High Vacuum Tribometer

In first stage of tribological development pin-on-disc tribometers offer the most simple and cost effective test to derive friction, wear and life-time of materials and coatings for use in space and planetary exploration.

This facility enables the investigation of materials and coatings with respect to friction and wear properties. It enables on-line measurement of friction force during unidirectional sliding according to standardised pin-on-disc or ball-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, SEM or microbalance, investigation of surface structure or material transfer by SEM/EDX. Reproducibility and Repeatability of test results proven by European Round Robin Test.

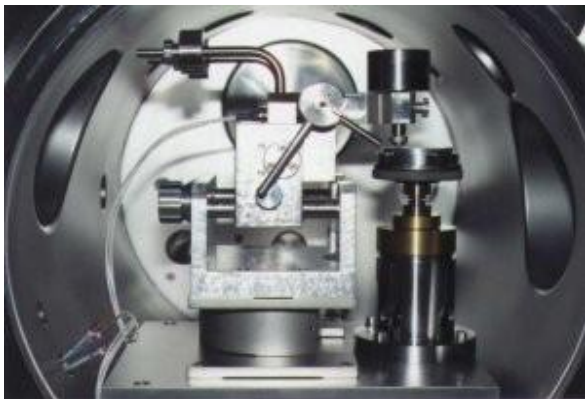


Image of the Ultra High Vacuum Tribometer:
Internal View showing the Tribo-System with
ball holder and disc

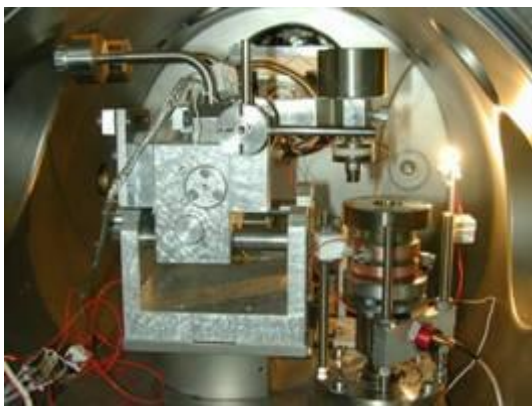
The device is fully PC-controlled. To the control parameters, e.g. sliding distance, motion profiles (uni, oscillating, ..), can be selected. On-line-data acquisition offers to post-process data, e.g. for automatic calculation of friction coefficients in running-in- or steady state, as well as endurance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

Measurement of

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

Different options are available:

- a) Testing in controlled gas environment: eg simulating Martina atmosphere (6 mbar in CO₂)
- b) Contamination monitoring: a mass spectrometer may be used to detect on-line contamination (e.g. outgassing of fluid lubricants or their cracks).
- c) Contact resistance on-line, slip-ring geometry selectable



Vacuum tribometer with high temperature spindle and equipped with mass spectrometer

Specifications	
Test	online measurement of <ul style="list-style-type: none"> • Friction force / coefficient • Linear wear (on-line) • Wear (geometric or mass loss) • Environmental Data • residual gas analysis (mass spectrometer of outgassing particles)
Temperature	from -100 up to + 300 °C, thermal cycles available
Loads	1 <> 30 N (loading under vacuum, dead weight) (loads from 0,01 to 1N can be achieved using the Milli-Tribometer)
Speed / Motion	Motion selectable from unidirectional to reciprocating (angles selectable) 0.005 <> 1 m/s (0,1 to 500rpm)

Environments	Vacuum selectable down to 10^{-6} mbar Air with controlled humidity Gases with controllable pressure (e.g. CO ₂ at 6 mbar)
Samples	Pin-on-disc, ball-on-disc, slip-rings
Accuracy	Friction force ± 0.01 N Sample temperature (pin and disc separately): $\pm 2^{\circ}\text{C}$ Linear Wear: $0 <> 2$ mm, ± 0.002 micrometer

Further AAC-devices enabling more test parameters under vacuum:

SALOTTE2: Pin-on-disc testing at low loads from 0,01N to 1N and high resolution of friction force: $\pm 0,005$ N

HVT: testing up to $+650^{\circ}\text{C}$ under vacuum in ring-ring-geometry