



# CSM TRIBOMETERS

Nano & Micro range for Tribological studies

- //// Friction and Wear Characterization
- //// Pin-on-Disk, Flat-on-Flat, Ball-on-Disk, ...
- //// High-Temperature and Vacuum options
- //// Compliant to ISO & ASTM standards

# CSM Tribometer

## Introduction to the CSM Tribometers

In tribometry, a sphere, a pin or flat is loaded onto the test sample with a precisely known force. The pin is mounted on a stiff lever, designed as a frictionless force transducer. The friction coefficient is determined during the test by measuring the deflection of the elastic arm. Wear coefficients for the pin and disk materials are calculated from the volume of material lost during the test. This simple method facilitates the study of friction and wear behaviour of almost every solid state material combination with or without lubricant. Furthermore, the control of the test parameters such as speed, frequency, contact pressure, time and environmental parameters (temperature, humidity and lubricant) allows simulation of the real life conditions of a practical wear situation.

Tribometers are unique instruments designed for ultra high precision force measurement. They can conduct both linear reciprocating and rotating modes. One important feature of all CSM Tribometers is that the experiment stops automatically when the coefficient of friction reaches a predefined threshold value or when a specified number of cycles is reached. Also, the tribometer is supplied with an enclosure so that controlled atmospheres of varying humidity or composition can be used. Specialized versions of the Tribometer have been developed for high & low temperature operations, reciprocating motion and high vacuum testing. The CSM Tribometers can be equipped with a depth measuring sensor for real-time display of depth information which is important in studying the time dependent wear properties. Furthermore, an electrical conductivity option allows testing of electrical insulation of coatings.

## Features of the CSM Tribometers

- > High Resolution attained with unique frictionless force sensor design
- > Easy and automated calibration procedures
- > High-precision feedback controlled motor motion
- > Precisely calibrated instrument for friction and wear
- > Linear and Rotating sample displacement
- > Sample Heating Option (up to 1000°C)
- > Automatic switch off at friction coefficient threshold or total number of cycles
- > Tests compliant to ASTM G99 & DIN 50324
- > Tests in liquids, controlled humidity or inert gases within Plexiglas enclosure

- > Continuous wear depth measurement (optional)
- > Continuous electrical contact recording (optional)
- > Precision engineered in Switzerland by CSM.

## Linear Reciprocating Tribometer

The Linear Tribometer reproduces the reciprocating motion typical of many real world mechanisms. The instrument measures a friction coefficient for both the forward and backward displacement of the stroke and the software generates data on Hertzian pressure, static partner and sample wear rates. The reciprocating technique is also very useful for studying the variation over time of the static coefficient of friction - as opposed to the dynamic coefficient measured with the Pin-on-Disk configuration. Most contact geometries can be reproduced including Pin-on-Plate, Ball-on-Plate and Flat-on-Plate (others on request). The Linear Tribometer can be equipped with a heating and cooling plate for testing under a wide variety of temperatures.

## Vacuum Tribometers

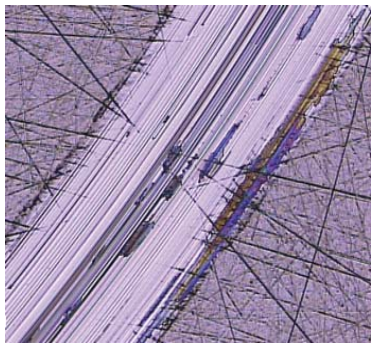
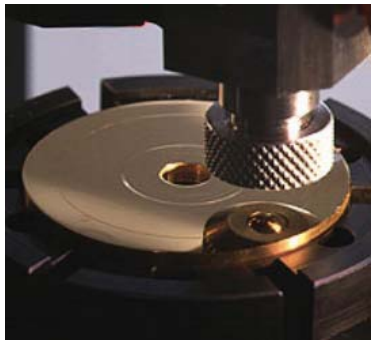
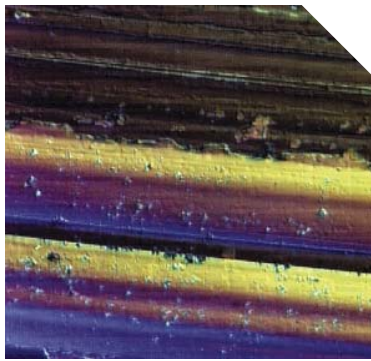
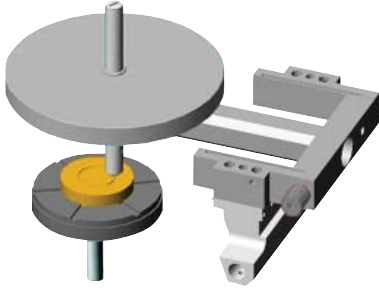
All CSM Instruments Tribometers are also available in a high vacuum configuration. This fully automated instrument allows perfect control of tribological conditions.

## Electrical contact resistance (option)

The electrical contact option is a useful measurement when variations of conductivity could be observed in a coating/substrate system. For example, the difference of conductivity between a coating and a substrate can be detected and allows determination of the rupture of the coating during a wear test.

## Depth measurement (option)

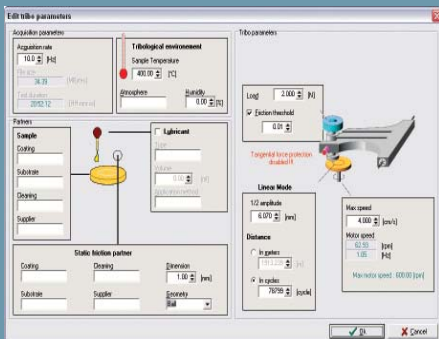
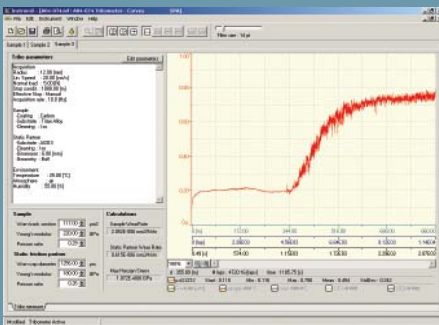
The depth of the pin or ball in contact with the sample can be continuously monitored during a Tribometer test. The wear depth measurement records the vertical displacement of the arm during the test.



## Complete software package

The CSM Tribometer software (Microsoft Windows 2000/XP) includes a complete set of features for setting up the Tribometer and handling the data.

- > Real time display of friction coefficient, temperature, depth or pin-substrate electrical contact (optional)
- > Easy setup of all the test parameters including rotational speed, frequency, number of laps, threshold coefficient of friction, temperature and time.
- > Automatic calculation of mean coefficient of friction, standard deviation and maximum/minimum values from selected parts.
- > Two user channels are available for simultaneous display of additional data such as temperature and humidity.
- > Wear rate calculation of partner and sample.
- > Calculation of the Hertzian stress.
- > Advanced modelling software for simulation
- > Data export in ASCII format.

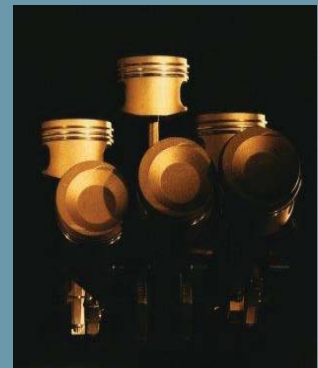


## Options

- > Online wear depth measurement
- > Electrical contact measurement
- > High speed (1500 rpm)

## General Applications

- Semiconductor Technology
  - > Passivation Layers
  - > Metallization
- Data Storage
  - > Protective coatings on magnetic disks
  - > Magnetic coatings on disk substrates
  - > Protective coatings on CD's
- Optical Components
  - > Eye glass lenses
  - > Optical scratch-resistant coatings
  - > Contact lenses
- Decorative coatings
  - > Evaporated metal coatings
- Wear Resistant Coatings
  - > TiN, TiC, DLC
  - > Cutting Tools
- Pharmaceutical
  - > Tablets and pills
  - > Implants
  - > Biological tissue
- Automotive
  - > Paints and polymers
  - > Varnishes and finishes
  - > Windows
  - > Brake pads
- General Engineering
  - > Rubber resistance
  - > Touch screens
  - > Lubricants and oil additives
  - > Sliding bearing
  - > Self-lubricating Systems



Do not hesitate to contact us if you need more information or a free demo!

## CSM Tribometer Specifications

	Nano	Micro
<b>Load range</b>	50 $\mu$ N - 1 N	up to 60 N
<b>Load resolution</b>	0.1 $\mu$ N	30 mN
<b>Maximum Friction force</b>	10 $\mu$ N - 1 N	10 N (20 N optional)
<b>Friction resolution</b>	1 $\mu$ N	5 mN
<b>Maximum temperature</b> (Tribo High Temperature *)	-	1000 °C
<b>Rotation</b>		
<b>Speed</b>	1 - 100 rpm	0.3 - 500 rpm (1500 rpm optional)
<b>Maximum test radius</b>	30 $\mu$ m - 10 mm	30 mm
<b>Maximum torque</b>	-	450 mN.m
<b>Linear module</b>		
<b>Stroke length</b>	10 - 500 $\mu$ m	60 mm
<b>Speed</b>	Up to 10mm/sec	Up to 100 mm/sec
<b>Frequency</b>	0.1 - 10 Hz	1.6 Hz at full stroke Up to 10 Hz with limited stroke

## CSM Tribometer options

<b>Wear depth measurement</b>	20 nm - 50 $\mu$ m	Up to 1.2 mm
<b>Heating module</b>	-	Ambient to 150°C in liquid
<b>Electrical contact resistance</b>	-	0 - 1000 Ohms
<b>Vacuum system</b>	-	Up to 10 <sup>-7</sup>

[\*] No reciprocating option for the High Temperature Tribometer

Specifications may be subject to change, please contact us for updates

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