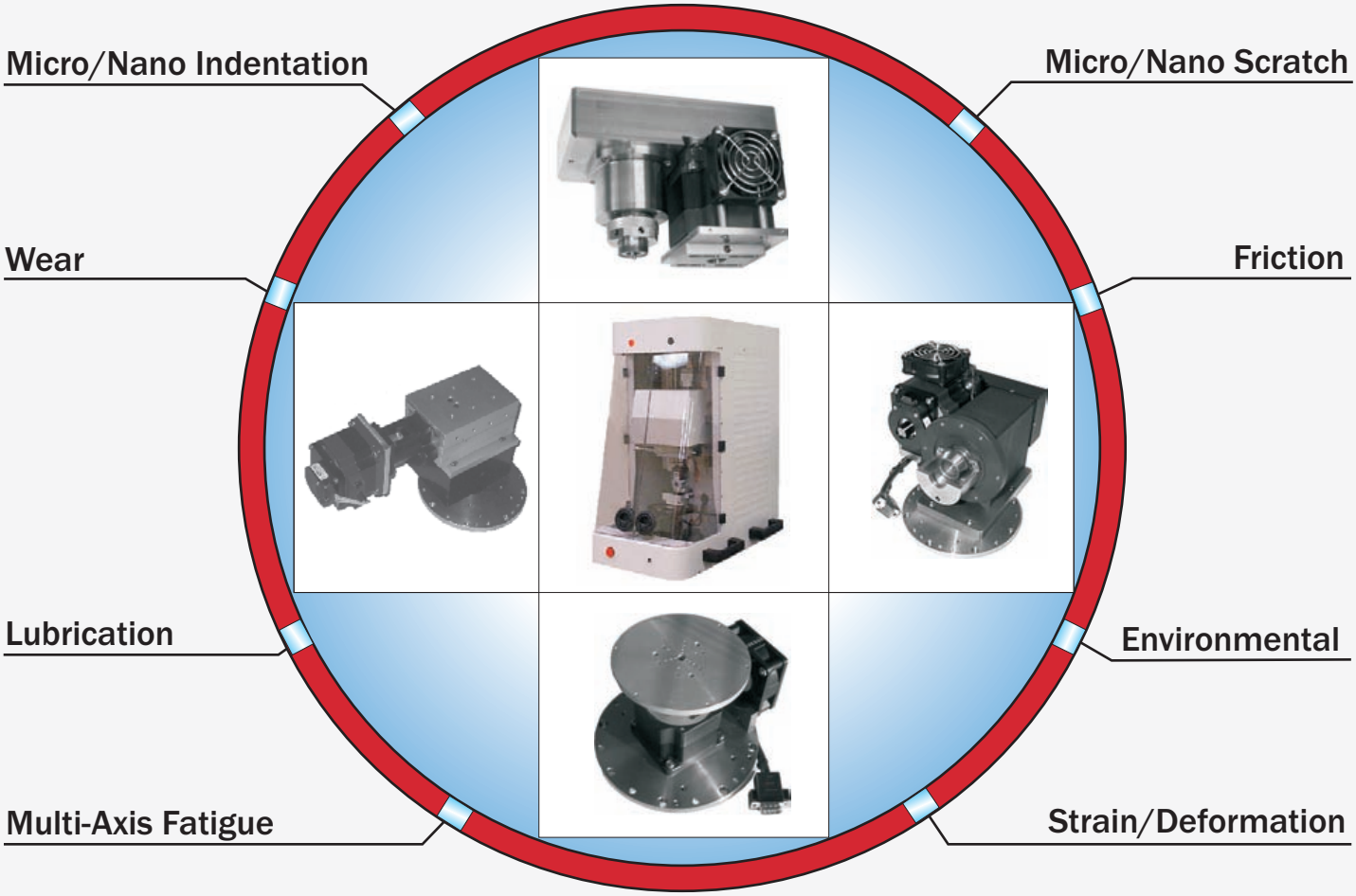
CETR

Comprehensive Materials Testing for Mechanical and Tribological Properties



UMT Series Testers

One Precision Platform

NANO SCALE **UNMT-1** Universal Nano & Micro Tester

MICRO SCALE **UMT-2** Universal Micro Materials Tester

MACRO SCALE **UMT-3** Universal Macro Materials Tester

APPLICATIONS

- Automotive, Aerospace
- Microelectronics
- Electric Contacts
- Metals, Ceramics
- Bio Materials, Medical
- MEMS, Optics
- Flexible & Hard Media
- Composite Materials
- Lubricants, Additives
- Thin Films, Coatings
- Polymers, Elastomers
- Paper, Fabric

FUNCTIONAL TESTING

Scratch
Adhesion
Delamination

Wear
Rotary
Linear
Reciprocating
Abrasive
Fretting

Indentation
Young's Modulus
Storage modulus

Adhesion
Pull-up
Stiction

Friction
Static
Dynamic

Fatigue
Multi-axis
Tension

Environmental
Temperature
Humidity

Lubricity
Hydrodynamics
Mixed

Strain
Elasticity
Plasticity

HARDWARE

Lower Specimen
- X Y Translation
- Horizontal & Vertical Rotation
- Fast Oscillations

- Vacuum Chamber
- Thermal Control
- Humidity Control

Upper Specimen
- X Y Z Translation
- Rotation

Data Acquisition
- 16 Sensor Inputs
- 16 Bit Resolution
- 200 kHz Data Rate

The Universal Nano+Micro+Macro Tester platform comes in three main configurations:

UNMT-1

for comprehensive nano and micro mechanical tests of thin films and nano-structured materials, with a load range of 1 µN to 10 N,

UMT-2

for comprehensive micro-mechanical tests of coatings and materials, with a load range of 1 mN to 200 N,

UMT-3

for comprehensive macro-mechanical tests of lubricants, metal and ceramic materials, with a load range of 0.1 N to 1 kN.

Parameters Monitored
- X,Y, Z Forces
- X, Y, Z, Q Positions
- X, Y, Z Torques
- Wear Depth & Rate, Deformations
- Acoustic Emission
- Temperature
- Humidity
- Electrical Capacitance
- Electrical Resistance
- Optical Images, Digital Video

SOFTWARE

Data Monitor Recording
- Real-Time Scope Mode
- Programmable Filtering

Motion Control
- Programmable Velocities & Positions
- Forces & Torques
- Synchronized Motions

Data Presentation
- Data Analysis
- Data Statistics
- Charts
- Format Conversions

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Technical Highlights

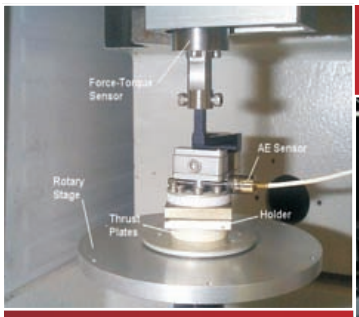
MULTIPLE TESTS on nano, micro and macro scales:

- static and dynamic friction
- ultra-low-speed (0.1 micron/s) stick-slip
- adhesive, abrasive and scratching wear
- pull-off adhesion/stiction
- scratch-adhesion and delamination
- indentation, hardness and elastic modulus
- multi-cycle, multi-axis fatigue
- strain, elasticity, plasticity and creep
- compression, tension and torsion
- three-point bending

MULTIPLE SENSORS for IN-SITU test monitoring:

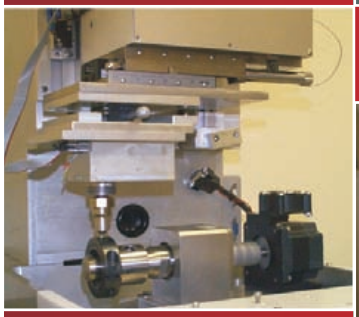
- ultra-precision force sensors of the proprietary technology and patented design (1 μN to 1 kN)
- 6-D sensors for simultaneous measurements of 3 forces and 3 torques in all X, Y and Z axes
- high-frequency acoustic emission sensors of the proprietary design, ultra-sensitive to tiniest cracks and wear
- wear and deformation sensors of micro (0.5 micron) and nano (20 nm) resolution
- contact and surface electrical resistance (mOhms to MOhms) for detection of film failure or buildup
- temperature and humidity sensors
- integrated vision system for micro-positioning and digital video of the failure dynamics
- integrated AFM for periodic nano-imaging of test surfaces, wear tracks, indents and scratches

Precision SERVO-CONTROL of loads, speeds, and positions for uniquely



pin-on-disk module with 1000°C chamber

disc-on-disc module

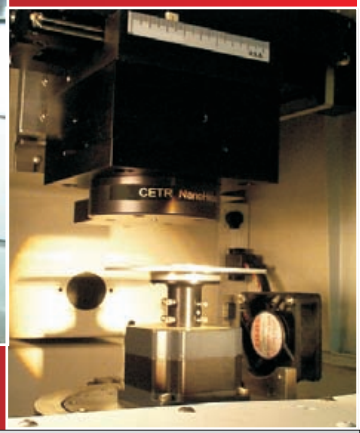


reciprocation module with 300° C chamber

block-on-ring module

nano-indenter

AFM module



TEST SCHEMATICS (EXAMPLES)

STANDARD	Pin/Ball-on-Disk	Disc/Plate-on-Disc/Plate
	Block/Pin-on-Ring	Indenter-on-Plate
	Crossed-Cylinders	4-Balls
	ISO/ASTM/DIN Standards	
INDUSTRIAL	Bearings	Razor-on-Hair
	Valves	Brush-on-Teeth
	Connectors	Orthopedic Joints
	Commutators	Semicon Wafers
	Contact/Wires	Head-on-Disk
	Screw-in-Nut	Cutting Tools
	Pin-in-Chain	Contact Lenses
	Shaft-in-Seal	Optical Media/Lenses

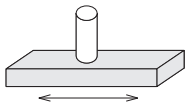
Four Types of Drive Modules

Lower Linear Fast Reciprocation with Upper Linear Motion

Lower Plate:	*up to 150 mm*
Lower Cylinder/Wire:	*1 µm to 25 mm*
Reciprocation Frequency:	*0.1 to 60 Hz*
Reciprocation stroke:	*50 µm to 25 µm*
Options:	*fluid bath, environm. chamber*

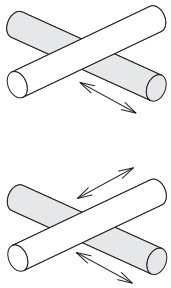
Wear & Fretting Tests

Upper Pin/Ball/Block: *stationary*
Multiple Wear Tracks:
auto-positioning, distance
0 to 75 mm, resolution 1 µm



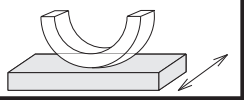
Cross-Cylinder Tests

Upper Cylinder: *0.1 to 25 mm*
Upper Tensioned Wire/Suture/Fiber:
1µm to 1 mm
Narrow Wear Track:
stationary upper sample
Wide Wear Track:
sliding upper sample,
0.001 to 10 mm/s
Multiple Wear Tracks:
auto-positioning 0 to 75 mm,
resolution 1 µm



Engine Tests

Upper Piston Ring: *stationary*
Lower Cylinder Liner: *reciprocating*

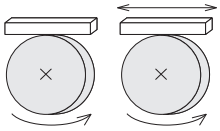


Lower Rotation (horizontal axis) with Upper Linear or Rotary Motion

Lower Ring/Bearing:	*10 to 80 mm*
Rotation:	*cw/ccw, 0.1 to 5,000 rpm*
Options:	*fluid bath, environmental chamber*

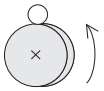
Block-on-Ring Tests

Upper Block or Plate: *1 to 150 mm*
Narrow Wear Track:
stationary block/plate
Wide Wear Track:
sliding block/plate,
0.001 to 10 mm/s



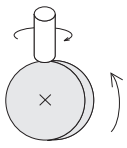
Ball/Pin-on-Ring Tests

Upper Ball: *1.5 to 25 mm*
Upper Pin: *1 to 25 mm,*
flat, spherical or conical end



Single/Multi-Crater Tests

Upper Ball or Pin: *rotating cw/ccw,*
speeds 0.1 to 1,000 rpm
Positioning on new craters:
radial - range 360°,
resolution 0.5 µm
axial - range 75 mm,
resolution 1 µm

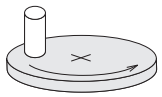


Lower Rotation (vertical axis) with Upper Linear or Rotary Motion

Lower Disc:	*up to 150 mm (optional 200 mm)*
Rotation:	*cw/ccw at two speed ranges:* *0.1 to 5000 rpm or 0.001 to 50 rpm*
Upper Ball:	*1.5 to 25 mm*
Upper Pin:	*cylinder 1 to 25 mm,* *flat, spherical or conical end*
Options:	*fluid bath, environmental chamber*

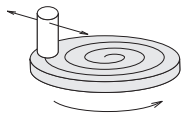
Single-Radius Pin/Ball-on-Disc Tests

Upper Pin or Ball:
stationary during test,
automatic positioning on disc radii
0 to 75 mm, resolution 1 µm



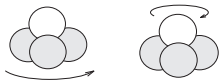
Spiral-Wear Pin/Ball-on Disc Tests

Upper Pin or Ball:
sliding radially on Lower Disc,
speeds 0.001 to 10 mm/s
Lower Disc' angular speed auto-
adjusted for constant linear speed



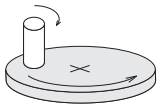
Four-Ball Tests

Upper Ball: *stationary in the center*
Three Lower Balls:
immersed in fluid bath



Single/Multi-Crater Tests

Upper Pin or Ball:
rotating cw/ccw, speeds
0.1 to 1,000 rpm
Positioning on new craters:
automatic radial positioning,
range 75 mm, resolution 1 µm
circumferential positioning,
range 360°, resolution 0.5 µm



Disc/Ring-on-Disc Tests

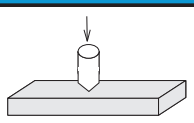
Upper Disc or Ring: *up to 150 mm*
Stationary or rotating: *cw/ccw, speeds 0.1 to 1,000 rpm*

Lower High-Precision Linear with Upper Linear Motion

Lower Plate:	*up to 150 mm*
Reciprocation Stroke:	*75 mm*
Positioning Resolution:	*1 µm*
Linear Speed:	*0.001 to 10 mm/s*
Options:	*fluid bath, environm. chamber*

Single/Multiple Indentation Tests

Upper Indenter:
Rockwell, Vickers, Berkovich
Positioning on new indents:
automatic, resolution 1 µm



Butterfly Wear-Track Tests

Upper Pin: *1 to 25 mm*
Upper Ball: *1.5 to 25 mm*
Upper Sliding:
synchronous with lower sliding