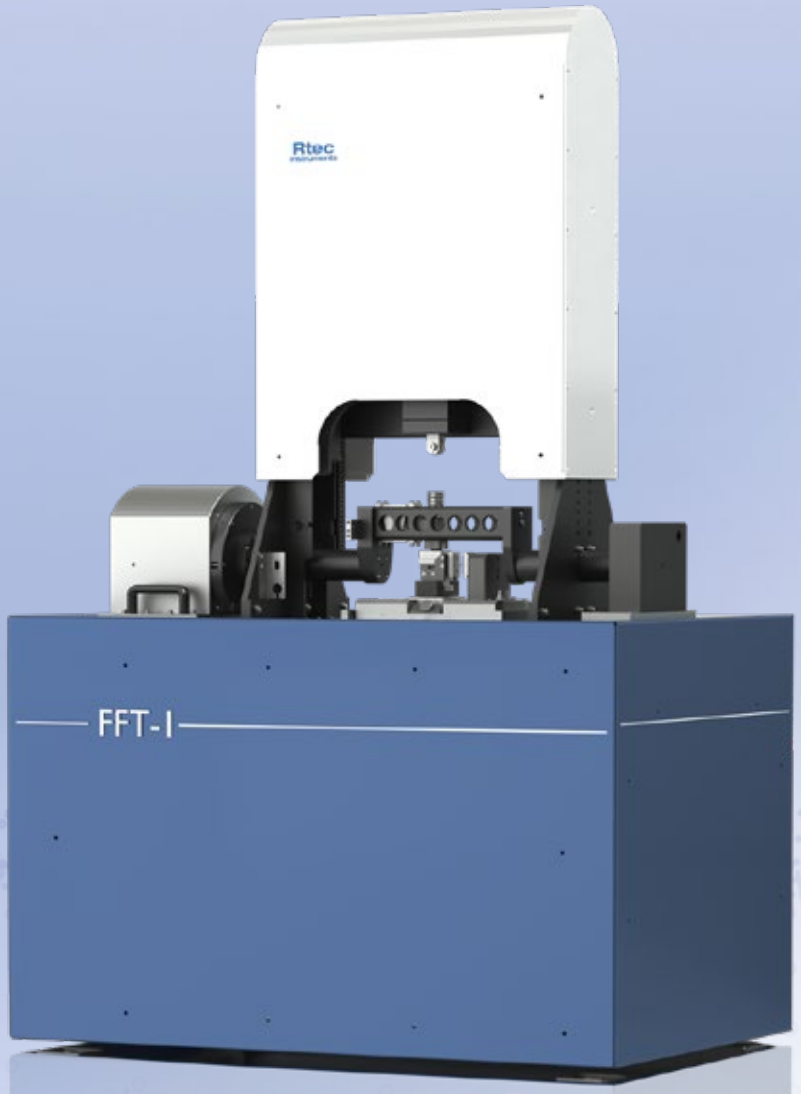
Rtec instruments

# Fretting Tester

## FFT Series




Fretting, Wear, Fretting Loops, 4-Ball
Stroke Control, Voice Coil Control,
Environmental Control

ACCREDITED
MSCB-132
Certified ISO 9001:2015

# Rtec-Instruments

## Fretting with Unmatched Performance

The fretting test modules cover a wide testing load range. Our technology breakthroughs in voice coil control and high-frequency signal processing algorithms provide fretting wear tests with less than 5 micron strokes.

The test module comprehensively characterizes fretting wear from micron to macro scale. Ultra-sensitive piezo-based load cells, with a robust design, high stiffness holders, and low floor noise, provide quantitative fretting wear characterization of materials, interfaces, thin films, and components.

Tests can be done in controlled environmental conditions to simulate real-life scenarios. Easy to use and intuitive data interpretation make this tester an ideal tool for researchers or quality control engineers.

### Real-time Stroke Control

We provide the smallest controllable stroke ranging from less than 5 µm to 4 mm, up to 500 Hz. Our stroke control comes with frequency monitoring and correction using LVDT.

### Environmental Control, Surface Electrical Measurement

Replicate real-life simulated environments with variable humidity, temperature, inert gas, and electrical measurements.

### High Reliability - Flexure Design

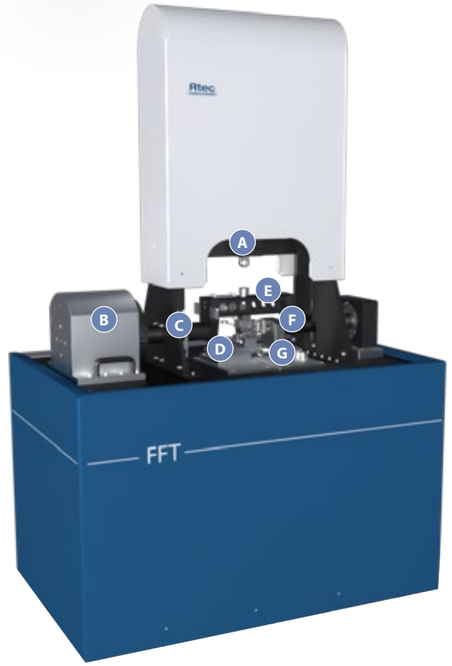
With design and manufacturing in-house, Rtec-Instruments provides unequaled robust platforms with flexural suspension that guide the magnetic assembly without bearings.

### High-Frequency Response Force Sensors

Piezo-based sensors measure friction force with ultra-high accuracy at high-frequency reciprocating tests.



# Fretting Tester Configuration




A

### Down Force Control

The applied forces can be controlled to gram force ranges with ease. Real-time correction account for sample wear and force change. The force can be constant or dynamically changed during the test.

B

### Voice Coil

Electromagnetic actuators impart fretting motion. Dependent on the number of coils and coil power. The FFT series comes in 3 standard modules. FFT-M, FFT-1, and FFT-2

C

### High Accuracy Position Control

The most accurate and precise displacement control in the market. Up to 1 nm resolution and micron level of accuracy. Extremely low noise. High responsiveness for the dynamic performance of the system.

D

### Environmental Controller

The environmental chamber allows for the control and measurement of temperature and humidity. In addition, a dual high-resolution thermocouple enables independent measurement of the heater temperature and the sample/lubricant temperature.

E

### Unmatched Waveform

Without the friction of rolling or bearings, the magnetic flexure-based design provides the control required for the most sensitive tests. The motor controls the smallest of increments of waveform and stroke control change.

F

### Friction Measurement and Additional In-line Sensors

The tester has advanced piezo sensors to measure high-frequency real-time friction. Ultra-low noise amplifiers detect minute changes in friction with ease. Acoustic emission sensors detect the onset of cracks. ECR measures surface resistance change to gain more insight into the material interface.

G

### Liquid Containers, Sample Holder

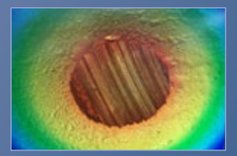
The liquid and sample holder are for standard and non-standard tests. The holders and liquid containers are easily customized based on the specific applications needed.

# Applications

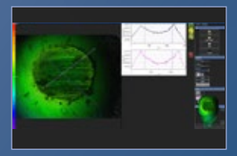
## Fretting nm to mm

- Automotive
- Lubricant
- Aerospace
- Electronics
- Power Plants
- Coatings
- Composite
- Polymers
- Metals
- Components
- Biomaterials
- Medical

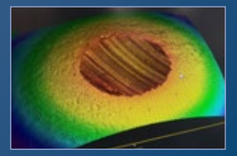

## Test Data



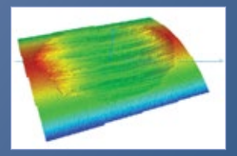
3D Wear Scar Mark



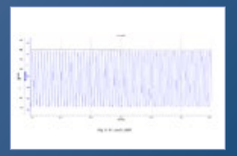
4-Ball



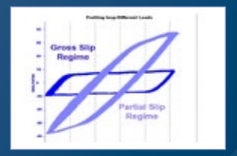
Volume Wear



3D Wear Scar Mark



High Frequency Data




Fretting Loops



# Any Size For Your Needs


### FFT-M Bench Top

Includes strokes from 5 µm, high-frequency oscillation for coatings, lubricants, and materials across a wide range of testing conditions. Contains programmable force control (no dead weights). Combined with piezo sensors to measure real-time friction. The easy-to-use flexure-based design makes this tester highly reliable and repeatable.


### FFT-2

Double the force range with dual high-power coils. Downforce up to 5000 N. The high-frequency piezo sensors measure real-time friction. The magnetic flexure-based design provides sensitive test control. Customizable liquid and sample holders make this instrument perfect for standard and non-standard tests.

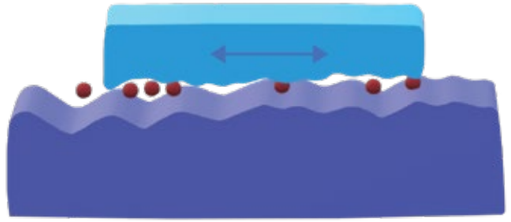
# Fretting Fundamentals

## Fretting

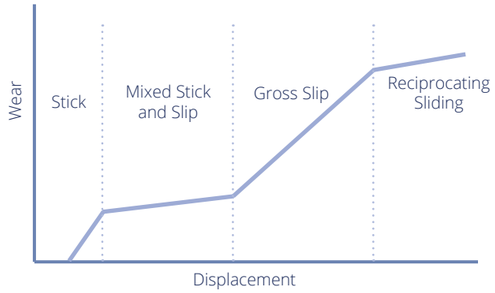
Fretting wear is a test where surface damage occurs between two contacting surfaces experiencing a small amplitude oscillatory displacement.

## Debris

- Debris formation from asperity contacts
- Oxidation at the contacting surface due to humidity, temperature, or chemical composition change
- Oil, lubrication starvation regimes causing wear
- Wear due to electric discharge
- Repetitive collision between surfaces
- Fatigue-related cracks - onset of debris
- Polymerization of organic materials at the surface
- Finely powdered debris - highly oxidized
- Residual steady stage flow of debris
- Diffusive wear
- Melting wear



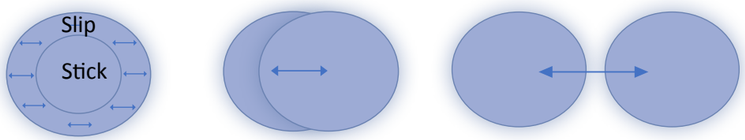
Sample under fretting motion




Regime Schematics

## Fretting Regimes

The tester can work across all fretting regimes: stick, stick-slip regime, and gross slip regimes. Several fretting parameters control these regimes' boundaries, including surface finishes and environment.




Stick and Slip | Gross Slip | Reciprocating Sliding

## Fretting Loops

A fretting loop is a hysteresis plot for the coefficient of friction (COF) vs. displacement. As the COF varies along the direction of motion, the fretting loop given by μ(x,y)=q(x,y)/p(x,y) where q(x,y) is the shear traction distribution along the interface and p(x,y) is the normal pressure distribution.


**Stick** | **Stick and Slip** | **Gross Slip**

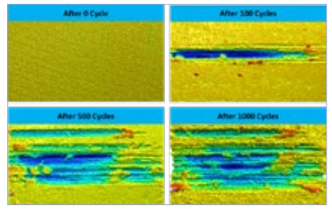


# High Speed Controllers

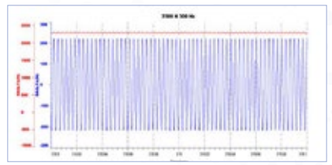
## Software

The tester comes with an operation and data analysis package. The test operation is recipe-based software that allows it to run standard or previously created recipes with a click of a button. The analysis package comes with visualization and statistical data analysis. Multiple files can be opened for easy comparison.

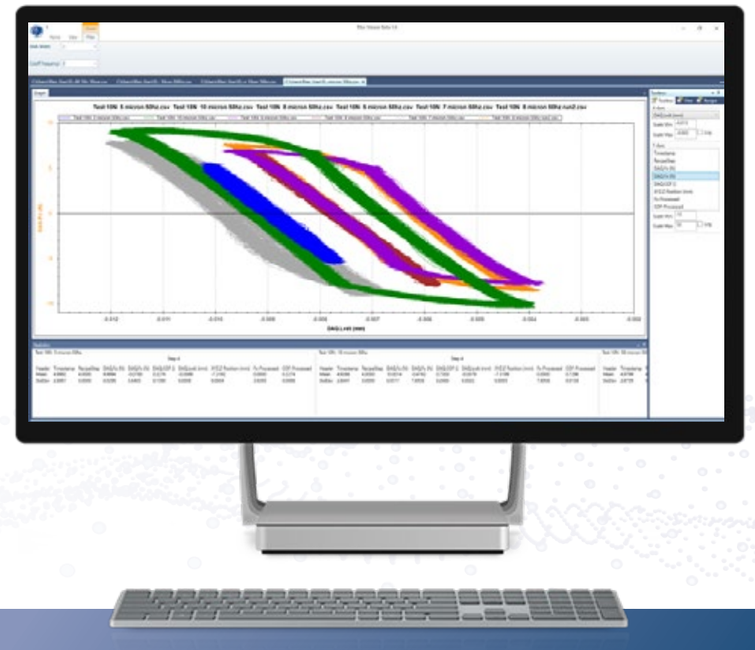
- Advanced control algorithms
- Intuitive and easy to use software
- Fully automatic motions
- Compliant with several standards
- Fast data reporting
- Analyze any kind of sample
- Automatic data analysis




3D profiler wear track image



2500 N, 300 Hz Data



## Specification Summary

FFT-M2 1000 N Down Force
FFT-M1 300 N Down Force

**Actuators**
- Displacement 5 μm - 4 mm
- Resolution: 0.1 μm
- Oscillation frequency: Up to 500 Hz

**Environment**
- Up to -40 °C, 180 °C, 500 °C, 1000 °C
- Humidity controlled chamber

**Sensors**
- Potentiostat
- Acoustic Emission
- Electrical Contact Resistance

**Common standards**
- ASTM E2789
- ISO 19291
- ASTM D6425
- ASTM D7421
- ASTM D5707
- ASTM D5706
- ASTM D7594
- DIN 51834-2
- DIN 51834-3
- DIN 51834-4

Rtec instruments


**Rtec-Instruments Inc**
*USA*
1810 Oakland Road, Ste B
San Jose, CA, 95131, USA
✆ +1 408 708 9226
info@rtec-instruments.com

**Rtec-Instruments SA**
*EMEA*
Chemin des Taborneires 4 (Box 115)
1350 Orbe (Switzerland)
✆ +41 24 552 02 60
info.eu@rtec-instruments.com

**Rtec-Instruments, CN**
*China*
8th Floor, Building A, Juntai International,
No. 300 Xicheng Rd, Jianye District, Nanjing, China 210019
✆ +86 025 83210072
info@rtec-instruments.cn

**Rtec-Instruments, JP**
*Japan*
Tokatsu Techno Plaza, Rm 409
5-4-6 Kashiwanoha, Kashiwa-shi, Chiba, Japan, 227-0882
✆ +81 50 5896 9916
info.jp@rtec-instruments.com


▲ **Rtec-Instruments Office**
● **Agent / distributor**

www.rtec-instruments.com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