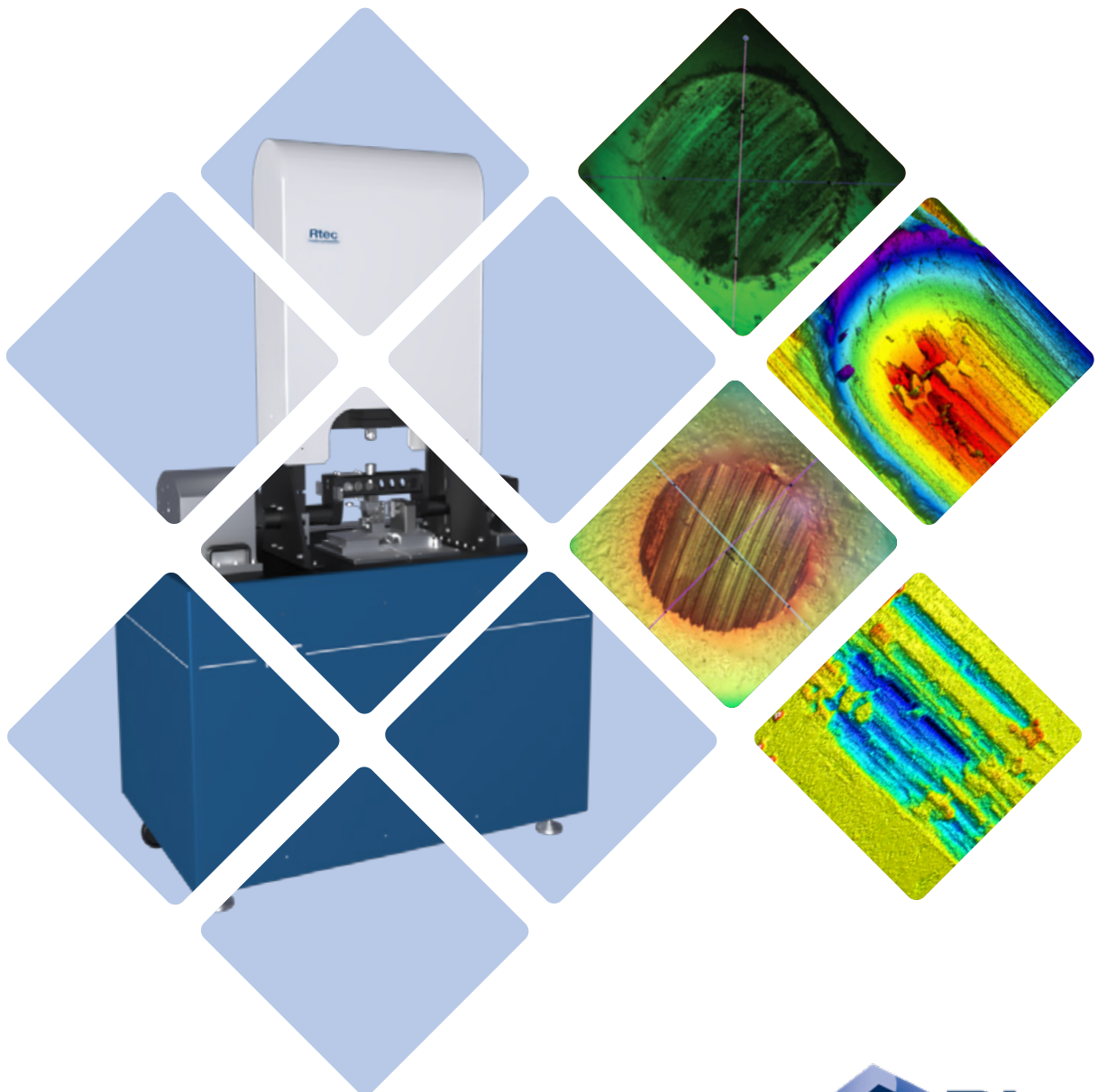


# Fretting Tester

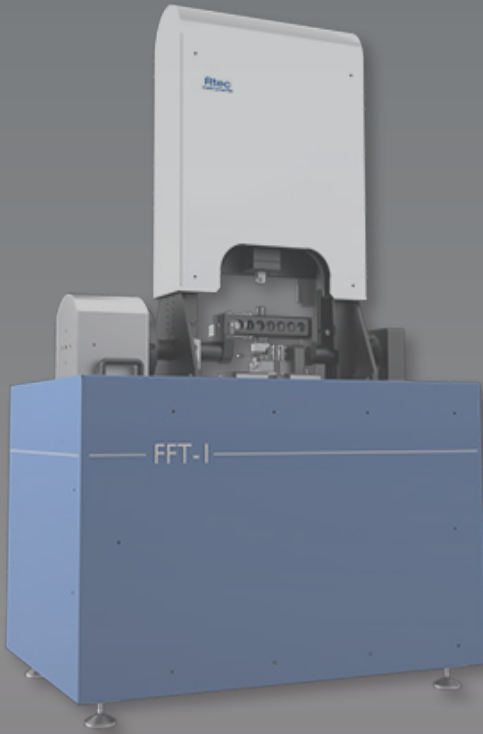
FFT Series

Fretting and Wear Tester with  
Environment Control

Highly Accurate Stroke Control, Rigid Design



# Fretting



## Voice Coil

Fretting test modules cover a wide test load range. Technology break through in voice coil control, high frequency signal processing algorithms are capable of running fretting wear tests with less than 10 micron stroke.

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

To simulate real life scenarios, the tests can be done in controlled environmental conditions. Easy to use and intuitive data interpretation makes this tester an ideal tool in hands of researchers or quality control engineers.

## Real Time Stroke Control

**The Smallest Controllable Stroke - less than 10  $\mu\text{m}$  to 2.8 mm, up to 500 Hz**

Real time stroke, frequency monitoring, and correction using LVDT.

## Environmental Control, Surface Electrical Measurement

Humidity, temperature, inert gas, and electrical measurements for real life simulation.

## High Reliability - Flexure Design

The flexural suspension guides the magnet assembly without bearings.

## High Frequency Response Force Sensors

Piezo based sensors that can measure friction force with ultra high accuracy at high frequency reciprocating test.

Unmatched Performance

# Fretting Tester Configuration



## A Down Force Control

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

## B Voice Coil

Electromagnetic actuators that imparts fretting motion. Dependent on the number of coils and coil power FFT series comes in 3 standard modules. FFT-M1, FFT-M2, FFT-1, 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 dynamic performance of system.

## D Environmental Controller

The environmental chamber allows to control and measure temperature and humidity. Dual high resolution thermocouple allows to measure heater temperature and the sample/lubricant temperature independently.

## E Unmatched Waveform Control

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

## F Friction Measurement

The tester comes with advanced piezo sensors to measure real time friction at high frequency. Ultra low noise amplifiers allows to detect minute changes in friction in real time with ease.

## G Additional In-line Sensors

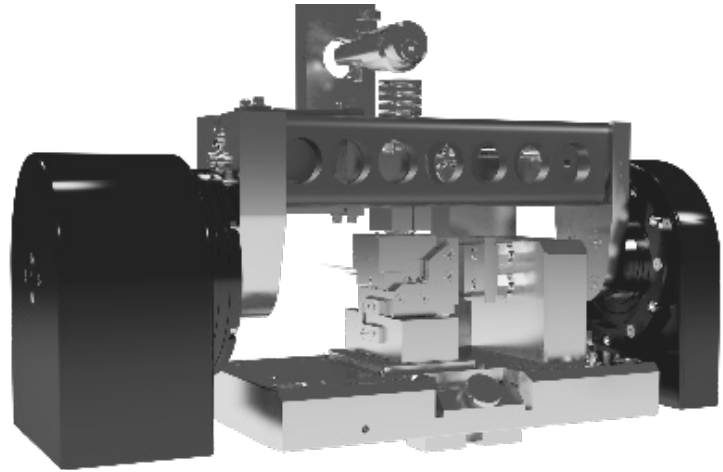
Sensors such as Acoustic emission to detect onset of cracks, ECR to measure surface resistance change allows to gain more insight on the material interface.

## H Liquid Containers, Sample Holder

Liquid and sample holder both for standard and non standard tests. The holders and liquid container are easy to customise based on specific application need.

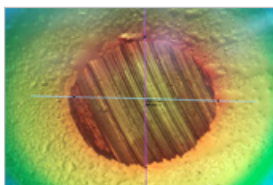
# Applications

Fretting nm to mm  
 Thick Coatings  
 High Temperature

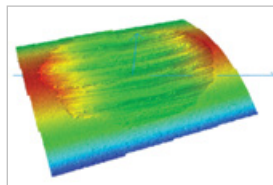


- Automotive
- Lubricant
- Aerospace
- Electronics
- Power Plants
- Coatings
- Composite
- Polymers
- Metals
- Components
- Biomaterials
- Medical

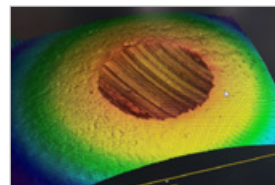
## Test Data



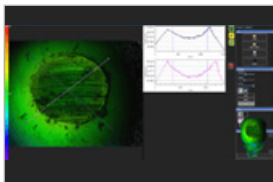
3D Wear Scar Mark



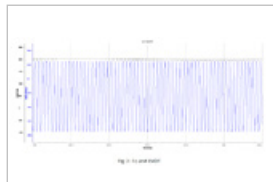
3D Wear Scar Mark



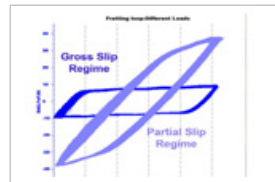
Volume Wear



4-Ball



High Frequency Data



Fretting Loops

# Any Size For Your Needs



## FFT-M Bench Top

Includes strokes from 10  $\mu\text{m}$ , 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 ease of use, flexure based design makes this tester highly reliable and repeatable.



## FFT-2

Double to force range with dual high power coils. Down Force up to 5'000 N. The high frequency piezo sensors measure real-time friction. The magnetic flexure based design provides sensitive test control. Customizable liquid and sample holders makes this instrument perfect for standard and non-standard tests.

# Fretting Fundamentals

## Fretting

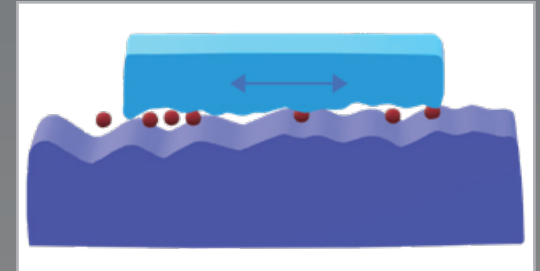
Fretting wear is a test where surface damage occurs between two contacting surfaces experiencing oscillatory displacement of a small amplitude.

## Debris

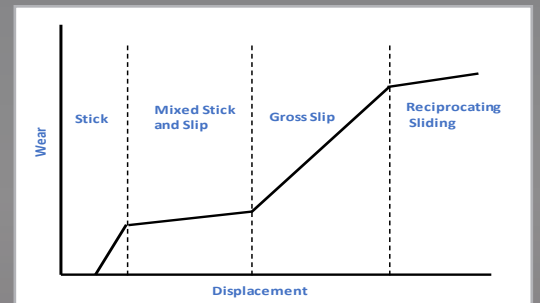
- Debris formation from asperity contacts
- Oxidation at contacting surface due to humidity, temperature, or chemical composition change
- Oil, lubrication starvation regimes causing wear
- Wear due to electric discharge
- Repetitive collision between surfaces
- Fatigue related cracks - onset of debris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

## Fretting Regimes

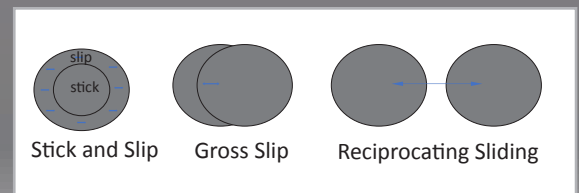
The tester can work across all fretting regimes stick, stick slip regime and gross slip regimes. The boundaries between these regimes are controlled by several fretting parameters including surface finishes, environment etc.



Sample under fretting motion

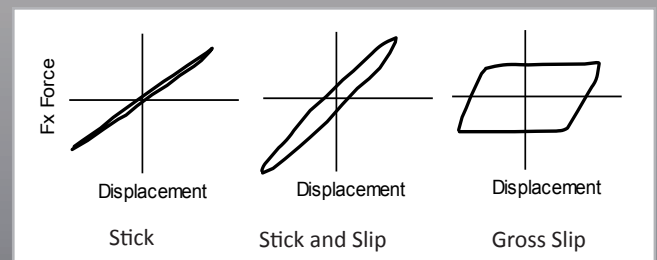


Regime Schematics



## Fretting Loops

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



# High Speed Controllers

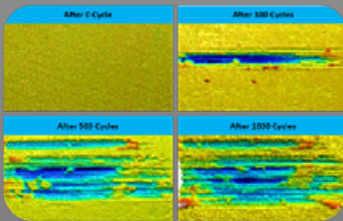
## Software

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

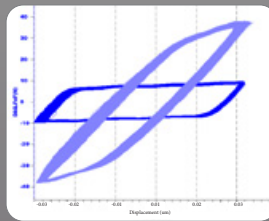
- Advanced control algorithms
- Intuitive and easy to use software
- Fully automatic motions
- Compliant with several standards
- Fast data reporting
- Set of features to analyze any kind of sample
- Automatic data analysis



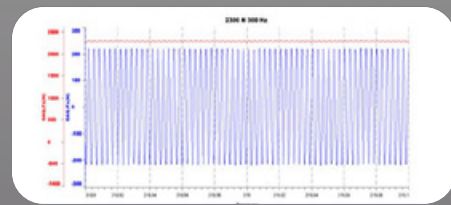
Test Programme



3D profiler wear track image



Fretting loop data



2'500 N, 300 Hz Data

## Specification Summary

FFT-M2 1'000 N Down Force  
FFT-M1 300 N Down Force

### Actuators

- Displacement 10  $\mu\text{m}$  - 2.8 mm
- Resolution: 0.1  $\mu\text{m}$
- 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

## About us

Rtec Instruments develops and manufactures advanced imaging and surface mechanical property measurement solutions for research and industrial applications. Based in Silicon Valley, we are the leading provider of testing instrumentation such as tribometer, optical profilometer, 3D scratch tester and micro/nano hardness tester.

We share a philosophy that embraces collaboration and partnership with customers, leaders in academia and industry, to ensure that our products answer real needs with innovative solutions.



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