

xZ 500 Extended Displacement

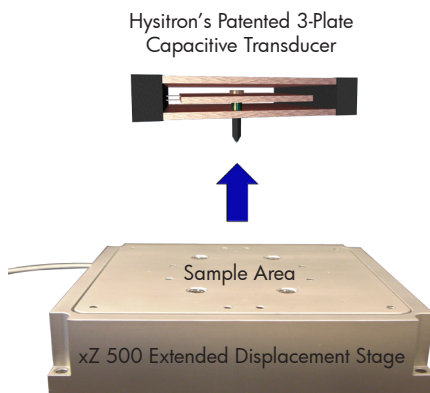
500 μm Displacement Capability for Testing Soft and Compliant Material Systems

Reliable nanomechanical testing of relatively soft and compliant material systems often times requires instrumentation that can provide a unique combination of:

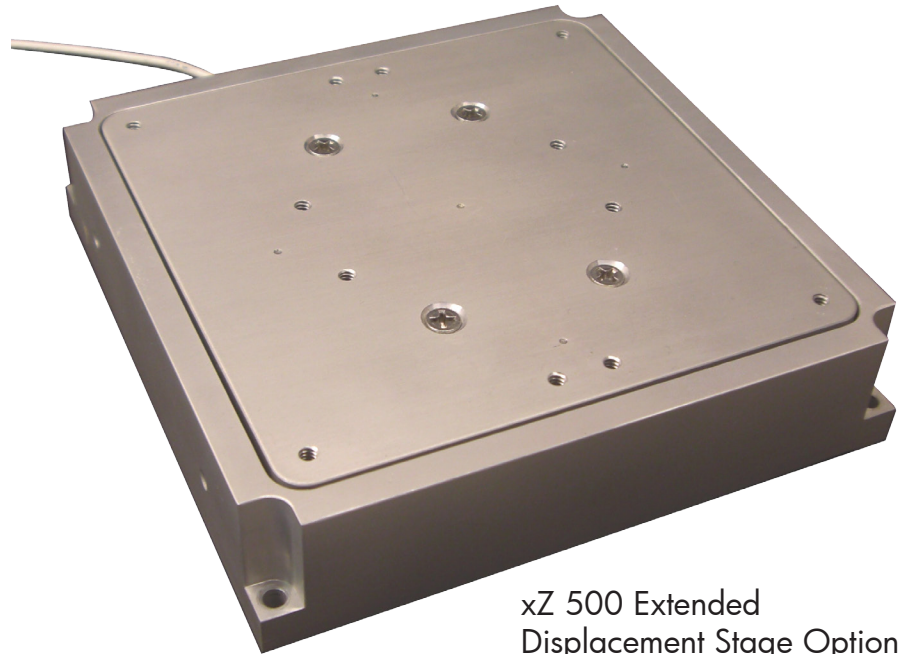
- Ultra-low force-sensing
- Low displacement noise floor
- Large displacement actuation range
- Accurate zero-point determination

Previously, commercial nanoindenters have been able to achieve an ultra-low force-sensing capability with a small displacement noise floor, but not combined with a relatively large displacement actuation range.

The **xZ 500 Extended Displacement** option for Hysitron **TI Series** instruments with the *performech*[®] advanced control module provides this unique combination of capabilities required for testing soft and compliant material systems, and cannot be found on any other commercial mechanical test system available today.



Schematic of **xZ 500 Extended Displacement** stage operation. Samples are mounted on the stage, and the stage is actuated in the Z-axis direction up to 500 μm with a ~ 1 nm displacement noise floor. Hysitron's patented 3-plate capacitive transducer simultaneously senses and measures ultra-low forces with its industry-leading <30 nN force noise floor.



xZ 500 Extended Displacement Stage Option

OPERATION

Hysitron's patented three-plate capacitive transducer operates in parallel with the **xZ 500 Extended Displacement** stage.

The decoupled test operation combines force sensing by the transducer and indentation axis actuation by the stage, and **allows for a <30 nN force noise floor and ~ 1 nm displacement noise floor over the entire 500 μm displacement range.**

A key feature of the 500 μm displacement range is the ability to specify the zero displacement point. This enhances testing capabilities by ensuring that pre- and post-contact adhesion can be fully characterized, and can allow for the design of adhesion or pull-off tests that would normally reach negative displacement limits of nanomechanical testing instrumentation.

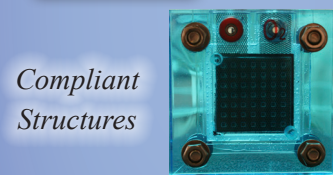
Enhances Testing Capabilities for Researching:



Ultra-Soft Materials

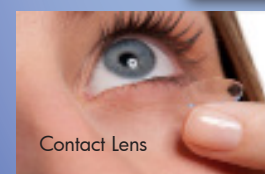


Red Blood Cells



Compliant Structures

Fuel Cell Membrane



Contact Lens

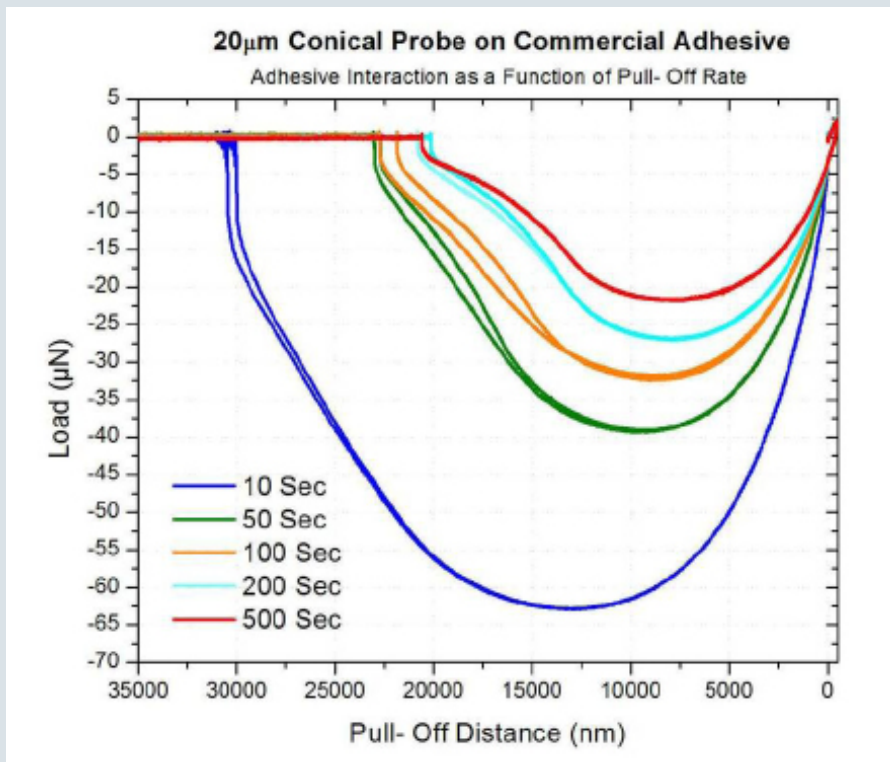
Pre- and Post-Contact Adhesion

EXAMPLE APPLICATION

Pull-off force for a commercially available adhesive as a function of pull-off rate

To highlight the capabilities of the **xZ 500 Extended Displacement** stage option, rate-dependent adhesion characteristics of a commercially available adhesive were investigated.

A diamond conospherical indenter probe with a 20 μm radius of curvature was utilized to measure pull-off force as a function of pull-off rate on a commercially available adhesive. The adhesive surface was initially identified with a 200 nN contact force. Next, the probe was displaced 500 nm into the adhesive in displacement control. Finally, the probe was withdrawn 35 μm from the adhesive at several different withdrawal rates in displacement control. Two tests were performed for each unique withdrawal rate. The maximum negative force measured during each test was defined as the pull-off force. Results are shown in the figure below.



Results clearly show distinctly different pull-off forces for each different withdrawal rate used. Test repeatability is also demonstrated by the excellent overlap of curves from tests performed using similar withdrawal rates.

HIGHLIGHTS

- <30 nN force noise floor and ~1 nm displacement noise floor over the entire 500 μm displacement range
- User-definable zero displacement point
- Easily interfaces with all Hysitron **TI 950 Series** and **TI Premier Series** instruments with the *performech* advanced control module

POTENTIAL APPLICATIONS

- Cartilage / tissue
- Contact lenses
- MEMS devices (stiffness, deflection, actuation force, etc.)
- Cantilever deflection and stiffness
- Fuel cell membrane
- Adhesion investigations
- Snap-to-contact adhesive interaction characterization
- Hydrogels and aerogels
- Medical stents
- Microcapsule compression
- Other relatively soft and compliant materials