

Microelectronics Testing Solutions

Ultra High Precision Testing Systems



Mechanical Testing for Microelectronics

R&D and Production

The microelectronics industry places heavy demands on the performance and reliability of testing equipment to validate new designs, tune manufacturing processes, and guarantee reliability of finished products. As the world's leading supplier of materials testing systems, Instron® offers unmatched experience in the field of mechanical testing and a reputation for quality, reliability and service. Working with Instron you can be confident that your test system will be capable of the most demanding tests and delivering the most accurate and consistent data.

Instron's MicroTester™ testing system for microelectronics is designed to deliver accurate and consistent results in the most demanding test environments. Designed for both static and dynamic testing, the MicroTester performs tensile, compression, flex, shear and cyclic tests on a variety of materials, specimens and components. The system includes powerful software for control, analysis and reporting as well as specialized fixtures and accessories for a wide range of microelectronics tests. It is a flexible, highly efficient solution to meet your current and future microelectronic testing challenges.



▲
Stud pull test fixture

Microelectronics Device Testing

Mechanical device testing plays a key role in verification and validation of modeling, reliability and life prediction (accelerated life testing), process control and development, failure analysis and quality assurance.

Ball, Die and Component Shear Testing

The shear fixture is suitable for solder ball, die and component shear testing. It incorporates features designed to minimize variables associated with this test method in order to ensure high quality data. Force capacities ranging from 5 N (1 lb, 500 gf) to 2 kN (400 lb, 200 kgf) are available. An optional hot plate is available to heat the test specimen.



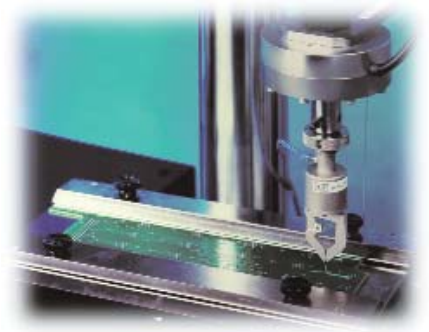
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Die-shear test

Stud Pull Testing

The stud pull method of bond strength testing requires accurate specimen preparation and test alignment. The self-aligning stud pull test fixture ensures excellent test alignment, while a specimen preparation fixture ensures correct specimen positioning.

Film Adhesion Testing

Instron can supply both fixed and variable angle fixtures for peel testing on a range of film types. In both cases the use of a special linkage system ensures a constant peel angle during the test.



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Peel test on copper tracks

Other Device and Component Tests

In addition to these featured tests, Instron equipment can support all other common mechanical tests (e.g. lead and component pull testing, fatigue of individual joints and assemblies, switch activation forces and durability and torsion testing). Contact us for the development of fixtures to meet special testing needs.

Microelectronics Materials Testing

Materials testing is used to determine the basic thermo-mechanical properties (e.g. modulus, yield strength, Poisson's ratio) needed for realistic modeling as well as the advanced properties (e.g. creep, fatigue and fracture mechanics) needed for life prediction. While many of the techniques used are based on traditional methods, the specimen sizes are usually small, requiring special fixtures.

Tension and Fatigue Tests on Fine Wires

Instron® equipment provides reliable gripping and precise measurement of extension and force needed when testing delicate wire samples. Specialized gripping devices ensure secure gripping during wire and lead pull testing.

Micro Bend Testing on Silicon Dies

In order to accurately measure the strength of silicon dies in a bend test, the fixture must be highly precise. The micro bend fixture incorporates a stepped upper anvil that engages with the lower supports, allowing separation and alignment of the lower anvils to be set precisely.



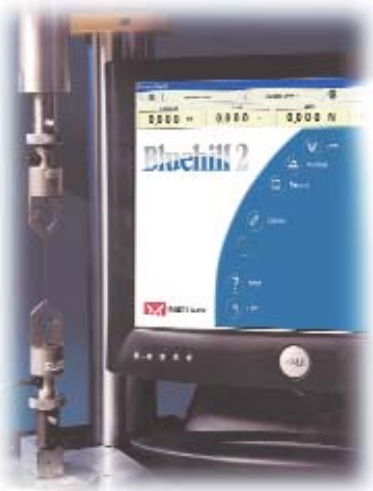
▲ Bend test on silicon die

Fatigue Testing of Solder Joints

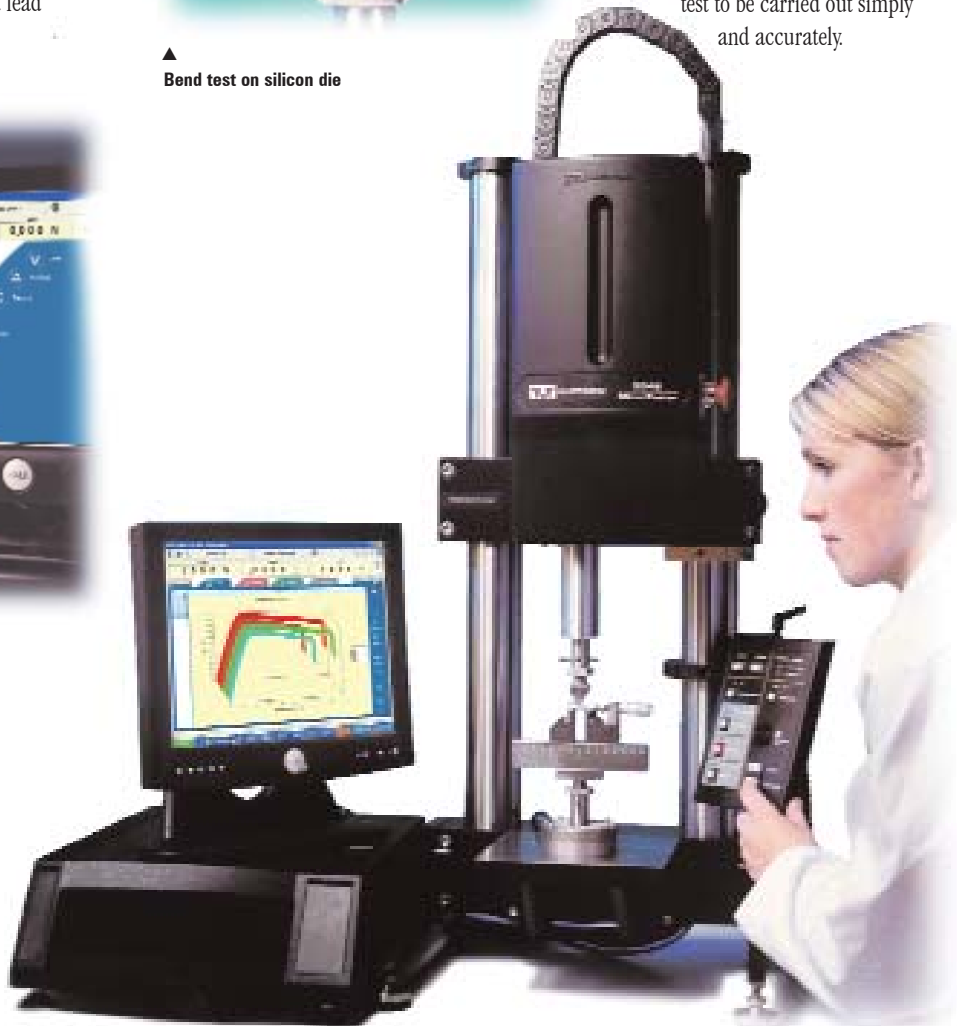
Mechanical test techniques can be used in place of thermal cycling for fatigue and accelerated life testing of system components. Compared to thermal cycling, mechanical cycling allows much shorter test times and independent control of temperature and humidity.

Determination of Interfacial Strength

The SEMI G69-0996 standard describes a fracture mechanics based test to determine the strength of an interface between a lead frame material and a molding compound. A precision bend fixture with the ability to locate the specimen position allows this test to be carried out simply and accurately.



▲ Tension test on fine wire



▲ 5548 MicroTester configured for bend testing

Engineered for Precision

Ideal for Microelectronic, Microcomponent and Micromaterial Testing

The Instron® MicroTester material testing system provides a comprehensive and versatile solution to the challenges of testing microelectronic and microcomponent specimens. Accurate testing of such specimens requires high precision displacement measurement, coupled with a load frame that maintains both alignment and high stiffness throughout its load range. Because of these factors, standard universal testing machines usually lack the precision needed for small deformation measurements.

The MicroTester system combines a very stiff loading frame with displacement measurement at submicron accuracy to ensure superior performance in a range of microelectronic and microcomponent tests. Offered with either Instron's 5500 series controller and Bluehill® 2 software for monotonic and simple cyclic applications, or the 5800 series controller and FastTrack™ software for complex or dynamic cycling, the MicroTester is ideal for tensile, compression, flex, shear and fatigue tests.

Superior Load Frame Design

The MicroTester load frame features two precision aligned columns fixed to a rigid support base and moveable upper crosshead. The design offers an extremely stiff reaction frame, ensuring accurate and repeatable deformation information and displacement control. By mounting the actuator at the front of the upper crosshead, a large unobstructed work space is created, ensuring that test fixtures, environmental chambers, or vision systems can be mounted to the frame without sacrificing versatility or ease-of-use. A special hinged base design allows the load frame to be positioned either horizontally or vertically, further increasing versatility and adding to the range of supported applications.

Unsurpassed Position Accuracy and Resolution

Through the use of a precision digital encoder mounted directly to the loading actuator, Instron guarantees a displacement accuracy better than $0.5 \mu\text{m}$ over short distances, and a resolution better than 20 nm. Instron control electronics, along with load measurement transducers designed and manufactured by Instron, provide flexible and accurate force measurement. In the case of the 5800 series controller, a load measurement accuracy of

0.5% of reading is guaranteed down to $1/500$ of the load cell capacity ($1/250$ with the 5500 series system).



▲ Instron MicroTester frame in vertical orientation.

Key Features

- Wide force range (< 2 mN to 2 kN)
- Unobstructed workspace
- Stiff reaction frame for accurate and repeatable testing
- Versatile horizontal or vertical positioning
- High precision drive system
- Submicron accuracy position measurement system
- No need for air or hydraulic supply
- Choice of software and controllers



▲ Instron MicroTester frame in horizontal orientation.

Versatile System for Static, Cyclic and Dynamic Applications

Choice of Control System and Software

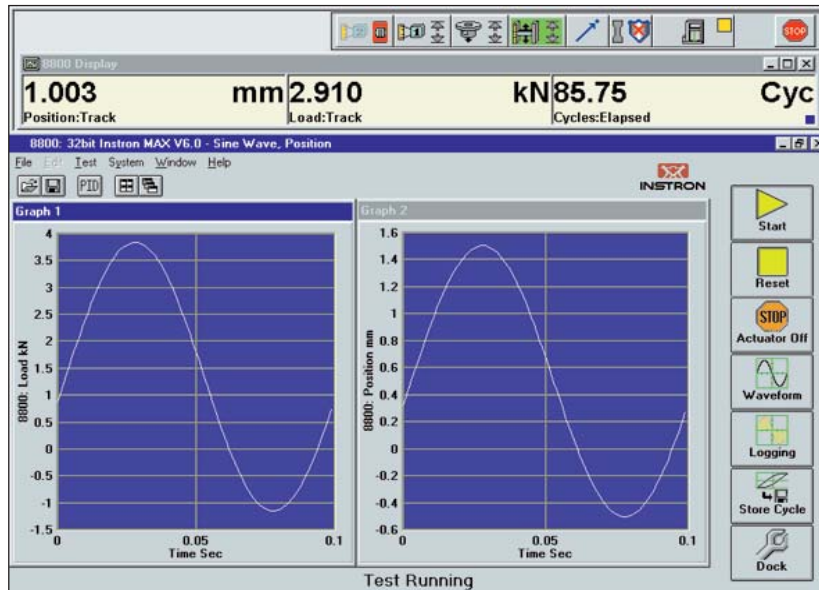
The Instron® MicroTester system can be configured with either 5500 or 5800 series control electronics. Both controllers are designed specifically for materials testing applications, and feature high data acquisition rates and closed-loop control systems for ultimate accuracy.

The 5500 series controller with Bluehill® 2 software is a flexible, easy-to-use control system designed primarily for monotonic and simple cycling applications. Standard features include 21-bit resolution, 500 Hz data sampling, and automatic transducer recognition. The Bluehill 2 software features six major application modules that provide full control of test method, data acquisition, results and reports.

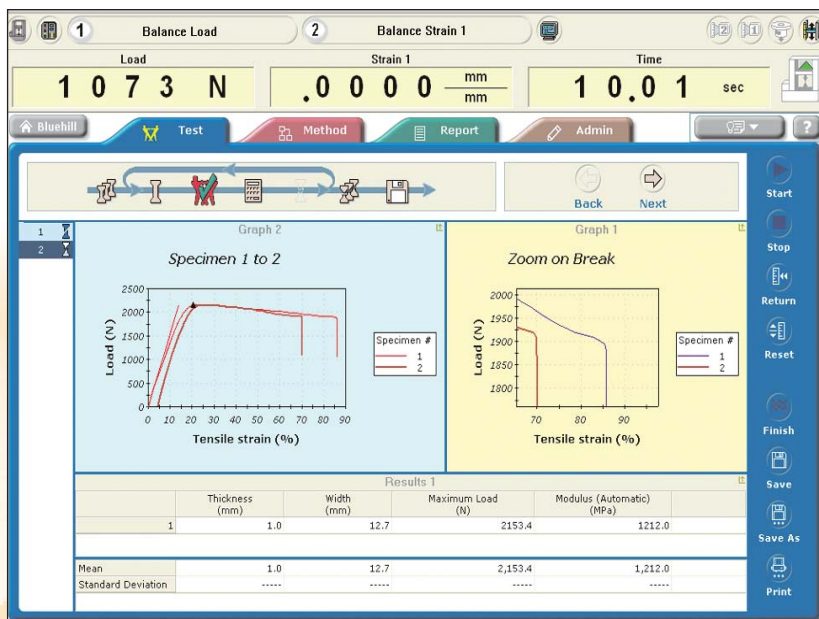
The Instron 5800 series control system is at the cutting edge of machine control technology and is suitable for monotonic, simple and complex cycling, and dynamic fatigue applications. Advanced DSP technology and a high-speed HS488® GPIB interface provide fast response, high accuracy and exceptional reliability.

An open architecture supports the LabView® graphical programming environment. The 5800 operates with a choice of application modules from both Bluehill 2 software and the FastTrack suite of testing software.

Auto loop tuning allows the control systems to be optimized to specimen properties. Both systems also come with an ergonomic handset for controlling basic machine functions. Machine jog controls include both coarse and fine adjustment, as well as frame status indicator lights.



Simple Cyclic - SAX™
Capabilities include constant amplitude cycles with standard and user-defined wave shapes, periodic data acquisition, live digital displays and up to four real-time graphs. Compatible with the 5848.



Bluehill 2 software features six major application modules tailored to address your unique application requirements and is compatible with both the 5500 and 5800 series.

Compact Unit Suitable for Clean Rooms

With a footprint of only 440 mm (17.3 in) deep by 410 mm (16.1 in) wide (in the vertical configuration), the MicroTester can be installed on any laboratory workbench.

The unit also features a servo electric actuator drive system that operates without hydraulic oil or compressed air, making it suitable for clean room environments.

Specifications

		5548	5848
Load Capacity (Static)	kN	2	2
	Kgf	200	200
	lbf	450	450
Maximum Speed	mm/min	1500	1500
	in/min	59	59
Return Speed	mm/min	600	600
	in/min	23.6	23.6
Position Control Resolution (Note 1)	nm	20	20
	μ m	0.8	0.8
Load Measurement Accuracy (Note 2)		$\pm 0.4\%$ of reading down to $1/100$ of load cell capacity	$\pm 0.4\%$ of reading down to $1/250$ of load cell capacity
		$\pm 0.5\%$ of reading down to $1/250$ of load cell capacity	$\pm 0.5\%$ of reading down to $1/500$ of load cell capacity
Total Actuator Travel	mm	110	110
	in	4.3	4.3
Frame Axial Stiffness (Note 3)	kN/mm	8.3	8.3
	lb/in	47500	47500
Maximum Vertical Test Space (Note 4)	mm	680	680
	in	26.8	26.8
Horizontal Space Between Columns	mm	190	190
	in	7.5	7.5
Weight	kg	80	89
	lb	176	194

Common Specifications

Position Measurement Accuracy:

$\pm 0.5 \mu\text{m}$ over $250 \mu\text{m}$ of travel
 $\pm 2.5 \mu\text{m}$ over 10 mm of travel
 $\pm 6 \mu\text{m}$ over 100 mm of travel

Actuator Speed Accuracy:

0.1% of set speed
(measured over 100 mm or 30 s
whichever is greater)

Operating Temperature:

$+10 \text{ }^\circ\text{C}$ to $+38 \text{ }^\circ\text{C}$ ($+50 \text{ }^\circ\text{F}$ to $+100 \text{ }^\circ\text{F}$)

Storage Temperature:

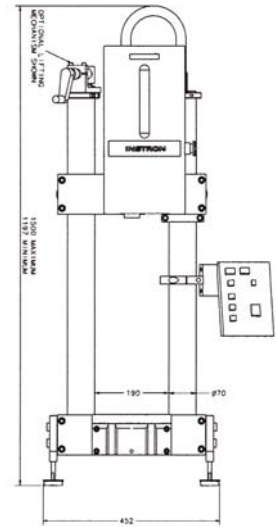
$-40 \text{ }^\circ\text{C}$ to $+66 \text{ }^\circ\text{C}$ ($-40 \text{ }^\circ\text{F}$ to $+150 \text{ }^\circ\text{F}$)

Humidity Range

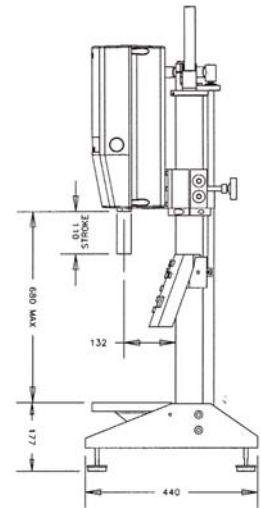
10% to 90% (non-condensing)

Notes:

- Valid for test speeds up to 200 mm/min (5 in/min)
- Load weighing system meets or surpasses the following standards: ASTM E 4, ISO 7500-1, EN10002-2
- Crosshead at mid point position. Does not include load cell deflection.
- Crosshead at furthestmost position, base to end of actuator, actuator fully retracted.



▲ MicroTester front



▲ MicroTester side

Accessories and Related Products

Instron® supplies a wide range of microelectronics test accessories to meet the requirements of designers and engineers involved in microelectronics packaging development and qualification. All accessories share a common interface, allowing the user to optimize the MicroTester system for any given test and reconfigure the unit quickly and easily. Available accessories include:

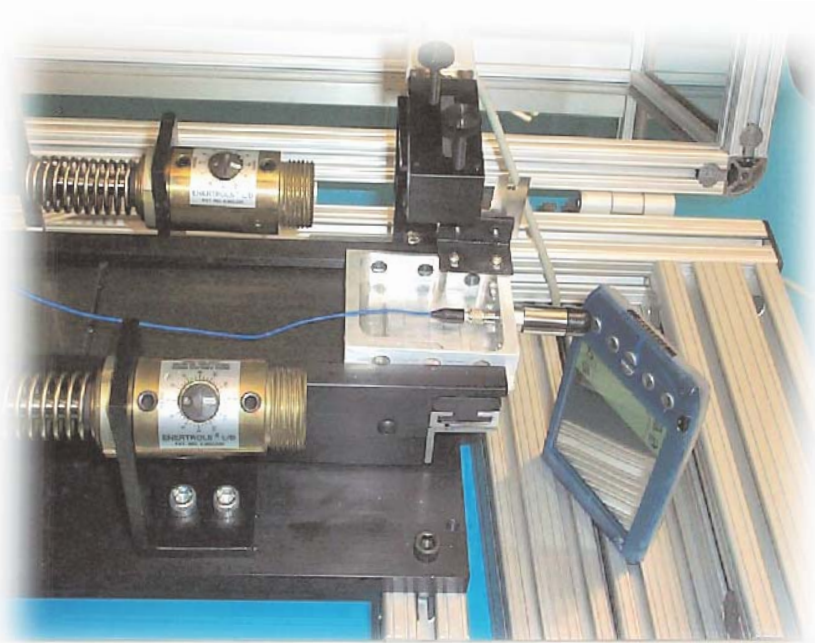
- Specialized fixtures
- Grips
- Clamping stages
- Peel fixtures
- Rotation stages
- Heating stages
- Environmental chambers
- Flexure fixtures

Environmental Chambers

Use of a temperature/humidity chamber allows tests to be conducted in a controlled environment. An environmental chamber operating together with the MicroTester can be used to evaluate the degradation of material due to moisture and/or thermal stresses. The heating/cooling plant is installed in a separate housing from the environmental enclosure, isolating the specimen and load frame from vibration effects.

Impact Testing

Electronic devices encounter impact loading during handling and operation. This can cause either failure or permanent deformation. The damage is product/design dependent. Instron offers a variety of systems for impact testing on materials and components with high speed data acquisition, analysis, and excellent repeatability.



▲ Horizontal impact testing on electronic devices

Other Microelectronics Products

In addition to the equipment featured here, we produce a range of thermal processing equipment for the semiconductor industry. For details, visit www.instron-sfl.com.



► Temperature humidity chamber mounted on a vertical MicroTester

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