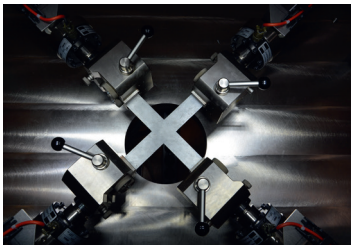
Biaxial Planar Testing Systems
Series LFM-BIAX and LFV-BIAX

During service engineering, components are often subjected to multiaxial stresses. For biaxial testing of materials, particularly composites, metals, textiles, biomaterials and plastics w+ supplies Axial-Torsional Test System, Planar Test System as well as Triaxial Test system. For Biaxial Planar Testing the samples are typically of a cruciform shape. Biaxial system is capable of independent control of load applied to cruciform specimen trough four actuators. The cruciform specimen avoids stress concentrations and provide a uniformly stressed test section.



Load application for the cruciform can be accomplished in a robust frame supplied with separate drives (either electromechanical or servohydraulic) and separate load cells to prevent the unbalanced loading. Depending on test conditions w+b offers Biaxial Testing Systems in different configurations adapted to multiaxial testing in creep, static strength, fatigue or high speed mode in different force ranges. The available systems are with electromechanical drives or with servohydraulic actuators.

What is Planar Biaxial Testing

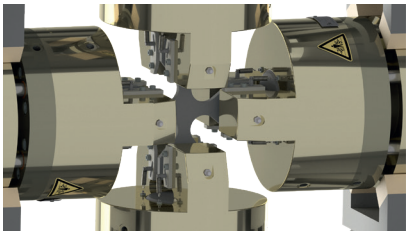
Planar biaxial tests apply a controlled tension-tension / compression-compression / tension-compression or the before mentioned loadings with additional torque moment state of stress and strain to specimens to help characterize anisotropic behaviour. The data produced provides inputs for constitutive modelling of materials and enables researchers to compare new advanced materials to existing or native materials. They can help assess anisotropy, nonlinear stress-strain relationship and viscoelasticity. Planar biaxial systems can be configured for static, dynamic and fatigue testing applications.
The machines are specially engineered and configured to meet specific customer specimen dimensions and test conditions. Four grips attach the test sample to the machine actuator along each of the flat specimen's four sides. The machine can be configured with two or four actuators that apply their load to the sample along two primary axes.

What is the Purpose of a Planar Biaxial Test

Planar biaxial tests determine the mechanical properties of the test sample that experiences biaxial states of stress. The stresses applied to a sample during a planar biaxial test represents the stresses the material will experience during actual service conditions, it can also be used for modelling purposes. Planar biaxial test data is superior to uniaxial test data if the material or end-product experiences stress in complex multiaxial configurations during its lifetime. Biaxial tensile strength, compressive strength, flexural strength, fracture properties and fatigue life can all be determined for a material using a planar biaxial test. Our planar biaxial test systems can perform tension-tension, tension-compression, compression-compression and tension-shear tests.

Tests Made Possible with a Planar Biaxial Tester

Our planar biaxial testers can be configured to serve a range of test samples with different load capacity, sample sizes, and sample elongations. Test configurations may include uniaxial tests that can be performed on the same sample. To apply a bi-directional load to a material it must be formed into a thin rectangular shape, also known as cruciform, and applied loads are then configured to be perpendicular to one another. The load applied to the sample may use one or more of the following stress methods: tension, compression, flexure, shear, fracture toughness, and/or fatigue.



Types of Materials Used in Planar Biaxial Tests

The most common planar biaxial tests are performed upon soft biological tissues, fibrous soft tissues, metal plates and sheet, hard foams, hyperplastic rubber, composite laminates, thin films, fibre reinforced polymer composites, silicone elastomers, textile materials, flexible material and rigid substrates. Soft biological tissue tests are common in the biomedical industry.

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Common Planar Biaxial Test Sample Geometries:

The most common sample geometry is cruciform, with four tabs that can be gripped and connected to the test actuators. Other geometries include in-plane tension-tension (IPTT) biaxial test geometry. Regardless of the test sample specifics, grips tend to be made to match the sample attachment options.

Common Applications

- Planar Biaxial Tester for Biological Soft Tissues
- Planar Biaxial Tests of Collagenous Soft Biological Tissues
- Biaxial Tension Tests of Sheet Metal
- Biaxial Fracture Toughness and Crack Growth Tests of Metal
- Planar Biaxial Metals Crack Growth

Reliable & Durable

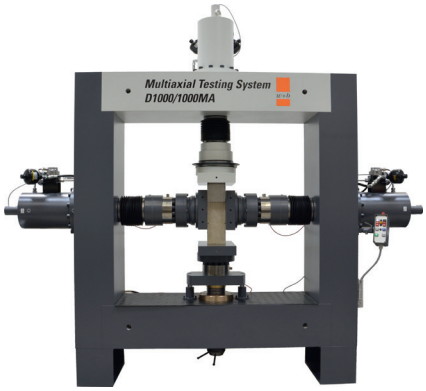
w+b Test Systems combines proven load-frame design with additional features for static to dynamic testing application using high quality components and assemblies coupled with a generous dimensioning.

Versatile

These test systems can be configured to different force capacities with a variety of grips & fixtures, extensometers, environmental simulation accessories and other components to meet the exact test needs from quality control to research and development.

Latest Control Technology

The Planar Test Systems are closed loop controlled through the latest high-resolution, high-speed digital control system **PCS8000**. The **PCS8000** ultra-high-speed closed loop control and data acquisition rate on all channels combined with 24-bit high resolution transducer conditioning rate is achieved by a 64-bit processor running at 1 GHz.



Advanced Closed-Loop Control

As control channel available are any connected inputs as well as virtual (calculated) channels that might open many new opportunities to your application. The versatile concept of the **PCS8000** is based on latest technology and supports applications with virtually no limits.

Operator Safety

Our Hybrid series of test systems fully comply with the safety requirements of the EC Machinery Directive and are supplied with the related EC Declaration.

Specimen Safety

Specimen protect function prevents your specimen from being damaged during setup and gripping.
The Test System is protected against overload and provide the ability to set limits for load, crosshead travel, strain or any other connected transducer preventing damage to your system, load cell and grip or fixtures. Mechanical end-stops and adjustable travel limits stop the crosshead at set points.

Machine Safety

Provides highest level of machine safety including overload protection of the frame, overload protection of the load cell, maximum and minim crosshead travel switches, two-channel safety circuit according to the machinery directive.

Expandable

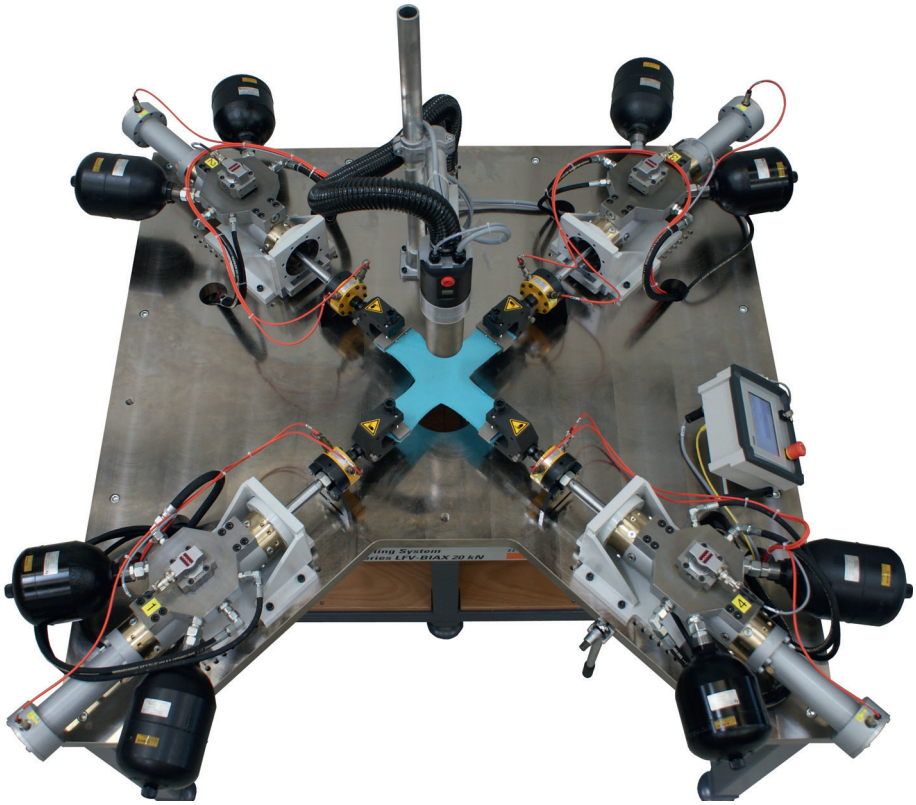
Testing Machines powered by **PCS8000** you will be ready for your test demands of today & tomorrow.
These test systems can be equipped with up to 26 amplifier cards for control or data-acquisition and up to 20 virtual channels operating at full rate. All physical and virtual channels can be used as data-acquisition as well as control channels. Additional 24 digital outputs and 16 digital inputs to control external devices are provided.

Specimen Alignment

Our Planar Biaxial Load Frame offers advanced system alignment to enhance test accuracy and minimize bending strain.
The frame is accurately machined with actuator mounting that allows to align the actuators in horizontal level. The spherical bearing alignment mechanisms which is integral to the load train offers fine alignment adjustment. It is used to align the concentricity and angularity of each axis. The spherical bearing assembly is located between piston rod and grip connecting detail. The adjustment is made by bolts. Additional grip pads protect the load train in the event of specimen failure.

The alignment fixtures are located between piston rods and force / torque transducers.

Actuators for Servohydraulic Planar Biaxial Test Systems



Integrated Servohydraulic Actuator

Double acting, double ended, equal are Servo Actuator with Hydrostatic Pocket Bearings in Round (no tie rod) design integrated in the lower part of the testing machine for dynamic fatigue testing.

Double ended, equal area linear actuator with hydrostatic bearings for the best friction free static and dynamic performance, allows high side-loads and emergency running, and provides virtually unlimited service life. They represent the high-end solution with virtually service-free operation.

Double Ended (Equal Piston Area) Construction

Unlike single rod cylinders, the surfaces for extension and retraction in the actuator with a through piston rod, called double ended actuator, are of the same size. Especially in combination with symmetrical regulating valves, surfaces of the same size allow realizing higher dynamic frequencies as equal oil flows to both actuator chambers occur with positive effect to the control accuracy and accumulator function. Additionally, they feature higher side load resistance than single ended actuators but are about twice the length of the single ended actuators.

Round Design

Round head cylinder design have rotationally symmetric parts and thus can be produced (manufactured) very accurate and are space-saving and rigid (stable). Compared with the simple constructed tie rod cylinders which are equipped with long screws, so-called tie rods, which connect the two covers over the entire length of the cylinder the round design extend the actuators life time because of lower stress on the guides.
The simple tie rod construction requires uniform pre-stressing of all tie rods to prevent straining and deformation of the entire cylinder. The longer the cylinder, the more important this gets. Deformation due to incorrect mounting will reduce the cylinder's life time because of excess stress on the guides.

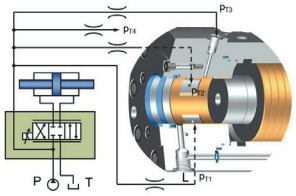
Hydrostatic Pocket Bearings

Servo Actuators with hydrostatic bearings are used where the highest dynamic response, accuracy and radial force loading can appear.
They are the high-end solution for service-free operation.
An important feature of these servo actuators is low friction as only the viscous friction of the oil in the seal clearance is present at the servo actuators piston. By optimising the installation space required for the seal (at zero pressure) between the bearing oil drain and the outside, the friction here is also kept extremely low within the tolerance range.

If radial forces (as possible by component testing) act on the piston rod, these are absorbed by the servo actuator, the piston rods of which have hydrostatic pocket bearings.

Hydrostatic bearings are primarily used because of the following characteristics:

- High loading permissible
- Considerable static rigidity and high damping
- No starting friction and very low friction at low and high speeds
- No wear
- Little heat produced



Hydrostatic bearings are supplied with system pressure independent of the relative movement between the piston rod and the bearing. Four (4) pockets are situated in the bearing bush. Each pocket is bordered by a bearing land. When under pressure, fluid is continuously fed to the pockets. Fluid flows to the bearing ends via the clearance between the piston rod and the bearing lands. In a bearing under no load, the fluid pressure is about the same in all pockets. Hence the clearances at the bearing lands in the pockets are also about the same. The piston rod is centred in its mid position.

Once the bearing is under load, the piston rod is moved from its mid position in the direction of the load. Hence, the clearance in one pocket becomes larger and the resistance to the flow lower. The clearance in another pocket is forced to become smaller and the resistance to flow increases. If the flow to the individual pockets is kept more or less constant, the pressure will then increase in one pocket, whilst it decreases in the other pocket. As a result of this pressure difference the external loading is absorbed.

The material pairs for bearing and piston rod or piston and cylinder housing are carefully selected and proved through our long-term experience. The clearance between piston rod and pocket bearings or between piston and housing is designed so that no metal-to-metal contact occurs.

A prerequisite for high radial loading is that the bearing diameters are of sufficient size. Larger cylinder strokes require a larger piston rod diameter to buckling.

The oil supply for the pocket bearings is provided from the hydraulic oil supply (hydraulic power pack).

Actuator End Cushioning

The actuator has integrated cushioning.
Cushioning of some sort is required to decelerate a cylinder's piston before it strikes the end cap. Reducing the piston velocity as it approaches the end cap lowers the stresses on cylinder components and reduces vibration transmitted to the machine structure.

Sealing System functional oil seal

An especially low-friction functional oil seal is installed behind the functional oil port, which seals the rod from the inside. A wiper ring completes the system. Since in this system the seal is only pressurized with the functional oil pressure, the effect of the actuator's friction behaviour is negligible. Thus, this seal is subject to very little wear.
This special seal system does not require the installation of a suction pump to remove the leak-oil. The leak-oil port can simply be connected to the hydraulic power pack tank by suitable sized leak oil hose.

Precision

The piston rod of a hydraulic cylinder moves in the cylinder tube and cover. Reliable functioning requires sufficient guide clearance between the component parts. The guide clearance must be sufficient to allow for the expansion of components parts caused by temperature differences during service. Too much clearance on the other hand would permit too much tilt. This would increase the stress on the guiding elements and thus the wear and tear of component parts. The perfect guide clearance for the hydraulic actuators is reached with ISO standard tolerance grade IT7 in combination with high degrees of roundness of piston rod and actuator tube as made possible by cross-hatching or honing.

Advantages of Cross-Hatching of Piston Rod

- Best lubricating properties for the sealing elements
- No dry-running
- Little wear
- Low friction
- Long life time

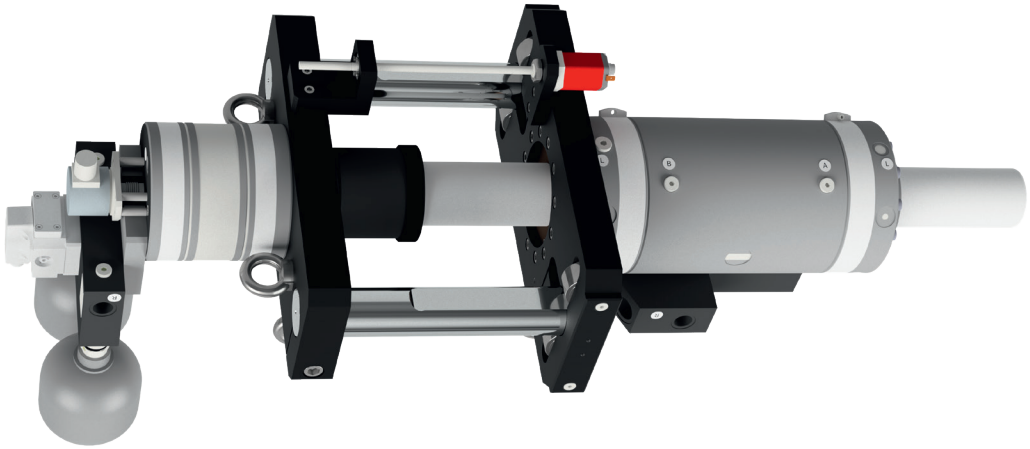
Internal Digital SSI Displacement Transducer

The actuator is equipped with coaxial integrated, digital SSI positional transducer as standard. Using this system, the actuators stroke (position) is measured and then fed as an actual signal via the measuring amplifier to the digital controller for position data acquisition or acquisition and control signal.

Close coupled accumulators to minimize hydraulic pressure fluctuations are mounted direct on the servo-valve manifold direct at the actuator. Processes with a high dynamic response require the use of membrane accumulators of sufficient size in the pressure and return lines in the direct vicinity of the servo valve. The optimal size of the installed accumulators in the pressure and return line varies with the actuator and hydraulic power pack size.

Optionally with Additional Torque Drives

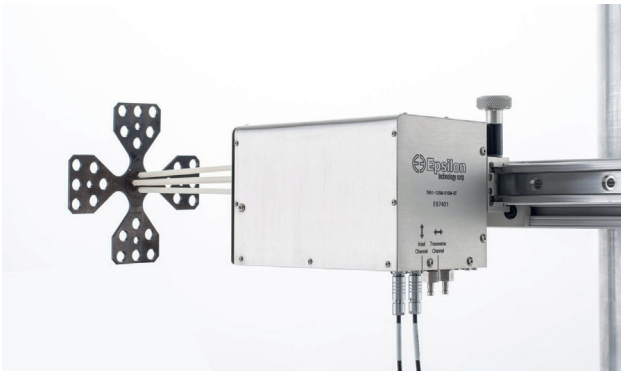
This option upgrades your Planar Biaxial Test System with additional torque loading through two (2) Fatigue Rated All-Hydrostatic Servo Hydraulic Rotary Actuator mounted "Inline" with axial actuator.
Torsion drive with hydrostatic bearing and hydrostatic coupling withstand the high radial and axial loads associated with rotational / biaxial testing at lowest friction and virtually service-free operation. The torsional actuators have two wings with torsional working angle and additional hydraulic cushions.



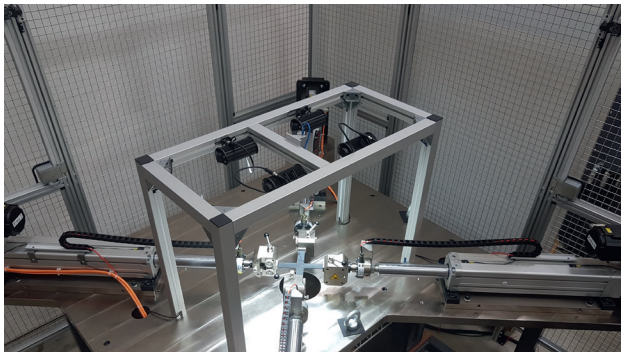
The construction of the actuators with hydrostatic bearings provides high control accuracy optimised for static to high-speed high frequency dynamic loading.

XY Planar Biaxial Extensometer

Extensometer extensometers measure combined in-plane strains in flat cruciform specimens tested in machines capable of simultaneous X and Y (perpendicular) axial loading and on standard flat samples tested in pure tension. All models are capable of bi-directional displacement in both axes and may be used for strain-controlled fatigue testing under fully reversed load and strain conditions at frequencies up to 10 Hz.
All 7651 models mount rigidly on the load frame and incorporate slide mounting to bring the extensometer into contact with the specimen. The gauge length is set automatically before mounting on the test specimen. These units are specifically designed to eliminate crosstalk between axes and to provide high accuracy, high resolution measurements. They incorporate capacitive sensors for low operating force and include electronics with programmable filtering and multi-point linearization for improved performance and accuracy. The overall design minimizes, and in many cases virtually eliminates, any influence from common lab environment vibrations.



With related extensometer or optical system the mid-point control can be realized.
We are also offering the interface to **GOM Aramis 3D Measurement System.**



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