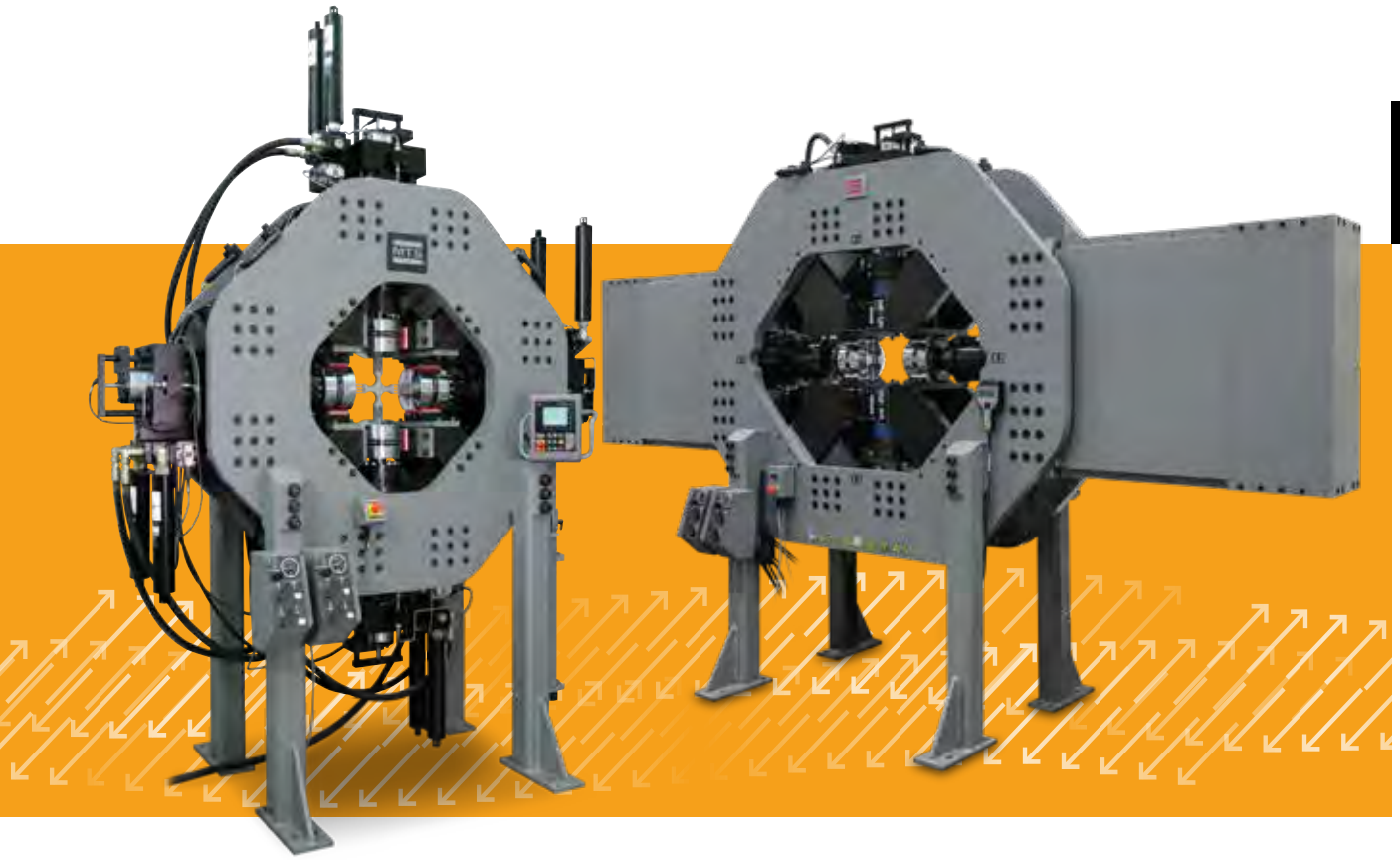


MTS Planar Biaxial Test Systems

Delivering a full spectrum of planar biaxial testing capabilities

be certain.

MTS PLANAR BIAXIAL SERVOHYDRAULIC TEST SYSTEMS ARE DEPLOYED WORLDWIDE TO CHARACTERIZE STRUCTURES, COMPONENTS AND MATERIALS SUBJECTED TO COMPLEX MULTI-AXIS LOADS FOR INDUSTRIES SUCH AS AEROSPACE, CIVIL ENGINEERING, RAIL, GROUND VEHICLES, AND MORE.

Meet a Full Spectrum of Planar Biaxial Testing Requirements

Planar biaxial mechanical testing is critical for characterizing complex design structures, components, and orthotropic and anisotropic lightweighting materials. Finding equipment that enables test engineers to simulate real-world conditions, however, can be challenging. This equipment needs to stress the specimen in multiple directions while allowing test engineers to exert a great deal of control over the process.

To meet these challenges, MTS offers a family of versatile servohydraulic test systems designed to deliver a full spectrum of static and dynamic planar biaxial testing capabilities to study material formability for:

- 2D planar studies of material property stress states
- 2D planar high-cycle fatigue and crack growth studies
- Fundamental materials science
- Simulation of environmental conditions with elevated temperatures.

MTS Planar Biaxial Test Systems are deployed worldwide performing mechanical tests within the transportation, power generation and civil engineering industries. Materials including metals (for example, high-tensile strength steels), metal alloys (aluminum alloys, magnesium alloys and titanium alloys), polymers, ceramics, elastomers, composites, textiles, concrete and advanced construction materials are tested for a wide range of applications.

- Ground vehicle – to validate new material models for sheet metal or composite components that are being used to meet more stringent fuel economy targets and increased safety requirements.
- Aerospace and power generation – to study engine turbine materials, like metal alloys, ceramics and composites, to allow them to operate at increasingly higher temperatures for improved efficiency.
- Construction – to study advanced materials that are increasingly used to allow more complex designs, to address security issues from natural and man made disasters and to meet environmental requirements.
- Oil and gas pipeline components – to allow exploration in areas that are difficult to reach.
- Large scale wind turbine structures – to allow them to be positioned in a harsh offshore environment.

MTS Planar Biaxial Test Systems combine modular self-reacting load frame technology, a broad offering of performance-driven hydraulics packages, innovative control methods, advanced alignment techniques and a full complement of integrated accessories, and numerous optional features and capabilities to effectively simulate the mixed mode loading environments and to measure in-plane stresses in both the X and Y axes of advanced materials and components.

A Comprehensive Portfolio of Planar Biaxial Load Frames

The MTS planar biaxial system family features a complete array of ultra-stiff, standard servohydraulic load frames, dynamically rated to deliver loads ranging from 25 kN per actuator to 500 kN per actuator.

The actuators are arranged orthogonally (X and Y axes) in a single plane and the frame stands vertically, so one sees the X and Y planes as a front view. The +/-50 mm stroke (100 mm total stroke) actuators used in the frame are specially designed for planar biaxial testing with low internal oil volume to increase system stiffness. Hydrostatic actuator bearings reduce friction and help ensure precise actuator positioning inside the cylinder. In addition, the system is designed with adjustable alignment apparatus in the load path that is used to remove specimen-bending strains.

MTS offers two frame sizes for each load rating. The systems with smaller frames are suitable for ambient testing or can be used with induction heating; the larger frames have a sufficient test area to accommodate environmental chambers or furnaces.

Key system attributes

- A highly stiff frame and large specimen mounting area
- Compact design
- Low friction actuators with hydrostatic bearings
- High lateral stiffness that provides accurate test results and very high frame natural frequency
- Optional over-travel protection in X, Y, Z planes for system protection
- Optional acceleration compensation for high frequency work

MTS Planar Biaxial 100 kN System with small compact frame design. Hydraulic grips are common and the grip controls are mounted on the left front leg. The structure with the red pads mounted to the frame between the silver colored hydraulic grips is the passive restraint system.

Normal orientation for the frame puts the Y axis vertically and the X axis horizontally. Reaction plates at the front and back of the system are precisely machined to provide excellent initial actuator alignment.

MTS Planar Biaxial 25 kN System, designed to meet elastomer test requirements.

MTS Planar Biaxial 25 kN System designed for mounting on a goniometer for presenting the specimen at variable angles and positions to a high-energy beam for High-Energy Diffraction Microscopy.

Superior System Alignment Capabilities

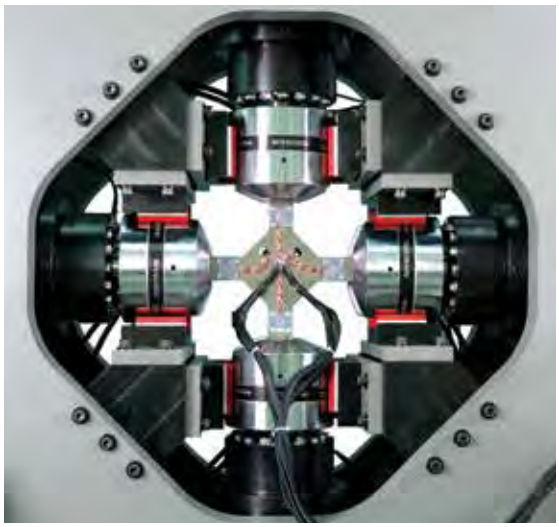
MTS planar biaxial load frames exhibit superior system alignment, which minimizes bending strain to enhance test accuracy and reduce data scatter. Proper alignment prevents unintentional bending stress that can put the specimen at higher risk of buckling or early failure. Minimizing potential specimen damage is important in many industries where the specimen can be very expensive to replace.

MTS Planar Biaxial Systems have spherical bearing alignment mechanisms that are used to adjust the concentricity and the angularity of the specimen grips to maintain precise in-plane loading. Additional, and optional, alignment hardware includes a specimen instrumented with 32 strain gages, eight on each cruciform arm, along with the necessary electronics and software that graphically shows the misalignment and guides the user to the correct adjustment.

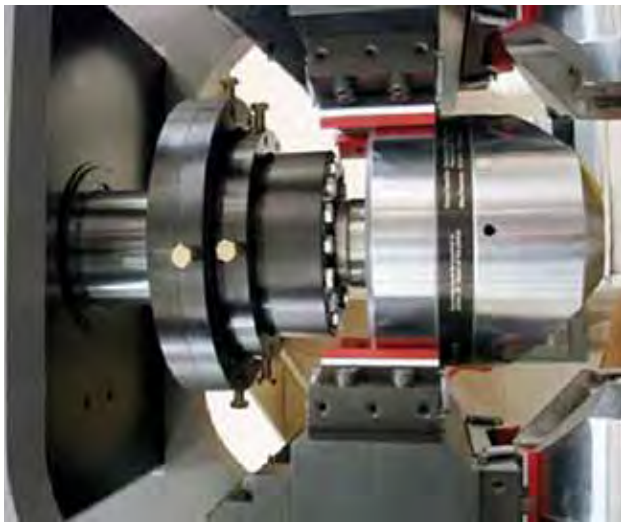
While MTS does precisely machine the actuators and their reaction-frame mounting locations to minimize bending strains there are still small misalignments that will affect the test; minor adjustments must be made regardless of how precise the machining work is done. The MTS spherical bearing alignment fixture, which is integral to the load train, makes it easy to perform fine alignment adjustments especially when used with the optional strain gaged alignment specimen to detect and measure any misalignment.

Instrumented specimen showing 4 strain gages on this side of one arm. There are 4 more strain gages on the other side of the arm, or 8 gages per arm with a total of 32 gages.

MTS Series 709 Alignment Electronics for conditioning the 32 strain gages mounted on the cruciform alignment specimen.



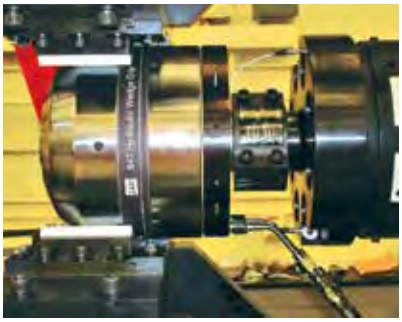
MTS 100 kN system shown with strain gaged alignment specimen. When used with the MTS Series 709 Alignment electronics and software, specimen alignment can be achieved within a few hours at most.



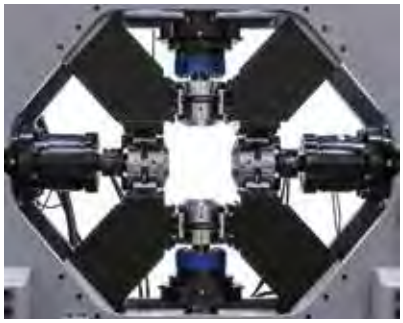
The spherical bearing alignment assembly is to the rear (left) of the grip. The concentricity and angularity adjustment bolts are gold color hex bolts protruding from the containment rings. The red polymer pads are part of the passive restraint hardware that protects the load train in the event of specimen failure.

Increased Safety Through the Passive Restraint System

Passive restraints are included on the systems to preclude actuator damage in the event of specimen failure that otherwise may force the actuator rod to bend. The restraints are sturdy structures integral to the reaction frame which surround the grip bodies. There are polymer pads positioned to clear the grip bodies (no contact) for normal operation by a fraction of a millimeter. In the event of a compressive specimen failure, the grips come into contact with the polymer pads and are restrained from any further out-of-plane movement, thereby protecting vital load train components from potential damage.



The white polymer pads are part of the passive restraint hardware that protects the load train in the event of specimen failure.

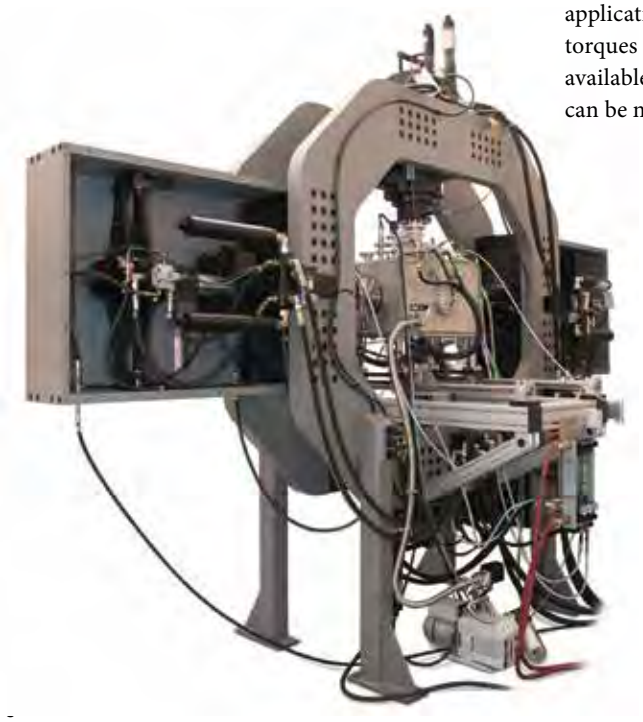


Passive restraint system with the support structures oriented 45° to the actuators provides grip guidance in the event of a compressive specimen failure.

Close-up showing the polymer pads (in this case, red) which restrain the load train components in the event of compressive specimen failure.

Rotation/Torque Options

All of the MTS standard planar biaxial systems also have torsional capabilities to allow for torque loading of a cruciform specimen or for better simulation of forces applied to a component. Each solution includes the necessary accessories, software, digital control technology and user interface to meet specific test application requirements. Rotation torques of 1100 Nm and 2200 Nm are available. Other torque requirements can be met on request.



Rear side of MTS Planar Biaxial System with torsion. The torsion actuator is visible in the left side of the picture about midway from top to bottom. In addition, a high temperature vacuum chamber is seen in the test area. There are rails mounted to the frame to locate the vacuum chamber and allow easy installation and removal.

MTS Planar Biaxial 100 kN System with large test area designed to provide space for an environmental chamber. Visible in this photo is the passive restraint system and MTS extension rods and hydraulic grips to fit inside the chamber (chamber not in picture). The grips are specially modified to remove extraneous material allowing them to get closer together and grip smaller specimens with shorter arms with no decrease in grip capacity.

A Full Range of Hydraulic Performance Options

Industry-leading hydraulic products enhance the performance of the planar biaxial system. Key components of the solution include MTS servovalves and SilentFlo™ Hydraulic Power Units (HPUs). MTS SilentFlo hydraulic power units (HPUs) help you power your test systems with superior flexibility and cost-efficiency. SilentFlo HPUs are specifically designed to handle the rigors of extreme, continuous-duty servohydraulic applications, and they perform reliably, year after year.

FEATURES

- Intuitive interface
- TÜV certified*
- Energy efficient
- Integrated cooling options
- Remote monitoring capability

**The SilentFlo product family is certified by TÜV Rheinland, a Nationally Recognized Testing Laboratory (NRTL). The "cTUVus mark" accredited test mark is proof of compliance with U.S. National and Canadian National standards in accordance with Occupational Safety and Health Administration (OSHA) and the Standards Council of Canada (SCC).*

Energy efficient

SilentFlo HPUs conserve valuable resources. Variable-displacement piston pumps ensure maximum hydraulic efficiency, even during times of reduced flow demand. And an innovative water-cooling system maintains the proper hydraulic fluid operating temperature. These pumps also offer optional water-shutoff valves to minimize water consumption.

Remote monitoring and control

The SilentFlo 515 HPU comes equipped to integrate monitoring options for easier access to HPU control and information about HPU condition. MTS Echo® Health Monitoring options allow you to monitor your HPU's operational and health status from your control room, office or mobile device. In addition, a Remote Human-Machine Interface (RHMI) lets you transfer tethered control of a single HPU to another location of your choice, with identical screens, functionality and full E-stop capability. Instead of leaving a test station and walking to the pump room to monitor or change HPU settings, test engineers can now perform such tasks from a far more convenient location, improving their productivity.

Designed for safety

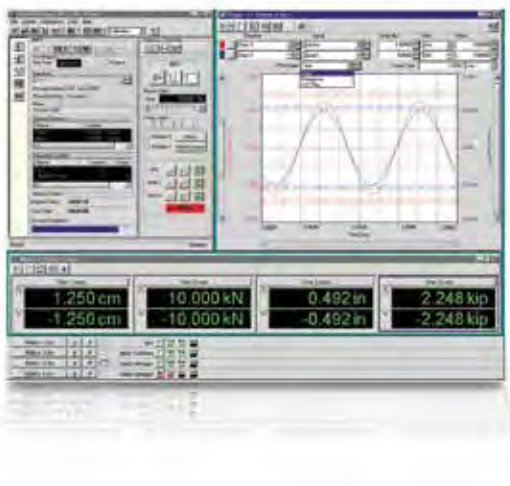
Automatic interlocks protect against inadvertent damage due to high temperatures or high/low fluid levels. For added protection, there are user-selectable shutdown limit and alarms for both temperature and fluid levels. The insulated enclosure keeps SilentFlo HPUs completely cool to the touch on the outside, even after hours of operation. This design helps prevent injury, while eliminating the need for costly ventilation systems.

Quiet, clean and compact

Depending on the model, SilentFlo HPUs run at 58-72 dB(A) – that's up to 30 dB(A) quieter than conventional HPUs – and are designed for extremely clean operation. SilentFlo HPUs require minimal floor space and are small enough to fit through standard doorways. With their quiet, clean and compact design, MTS SilentFlo HPUs can be placed directly on the test lab floor, eliminating the expenses associated with managing a separate pump room and transporting hydraulic fluid across the test facility.

State-of-the-art Digital Controls and Controller Software

Stable, precise system control, which is critical for conducting high-force fatigue testing, is provided by a state-of-the-art FlexTest® controller. FlexTest digital controllers equip users with all the tools needed to define and automate virtually any material, component or structural test. Versatile FlexTest controllers provide high speeds and channel densities to keep pace with evolving test demands, and share common hardware boards and user interface tools to simplify test standardization and optimization across test laboratories. FlexTest controllers support the full offering of MTS test application software, including MTS TestSuite™ Multipurpose software.



Planar Biaxial Servohydraulic System Centroid Control

MTS has decades of experience in multi-axis control. For multiaxial load application the effect of one channel of load or displacement onto the other channels needs to be considered also, the following scenarios exist:

- Rigid body motions, where the specimen moves but is not strained. This requires that opposing actuators are moving in the same direction.
- Mean or offset or pre-load application. Each axis of control can be pre-loaded (or strained) by commanding opposing actuators to move in the opposite direction of each other to a fixed position.
- Cyclic or fatigue loads are applied by commanding opposing actuators to move in the opposite direction of each other but with a time-varying amplitude.
- Centroid control is a control scheme where it is desired to displace or keep constant the location of the center of the specimen. The latter is a requirement for planar biaxial tests where the displacement of one axis is not permitted to introduce unwanted bending of the other axis and keeping the specimen centroid stationary makes visual monitoring possible.

Developing control schemes for each actuator without considering the impact of the other actuators will not work. MTS has developed a matrix control algorithm that allows specimen displacement with no loading (moving the specimen from side to side for example), or controlled deformation of the specimen while keeping the center of the specimen gage section stationary to allow for video extensometry or other optical measurements. MTS' ability to control multiple axes simultaneously is vital for making multi-axis testing both feasible and accurate.

Versatile, Easy-to-use MTS Application Software

MTS Planar Biaxial Systems leverage the power of MTS TestSuite Software to provide full-featured test definition, user-friendly operation, and powerful analysis and reporting capabilities.

Designed with extensive user input, the MTS TestSuite platform serves as the foundation for a growing set of easy-to-use material test modules. It has a visually intuitive interface to streamline and simplify the development of calculations and test workflows. MTS TestSuite Multipurpose Software features test modules for performing low-cycle fatigue, high-cycle fatigue, advanced low-cycle fatigue, fatigue crack growth, and fracture toughness applications.

The MTS TestSuite platform also features a host of innovative tools designed to extend testing power and increase productivity:

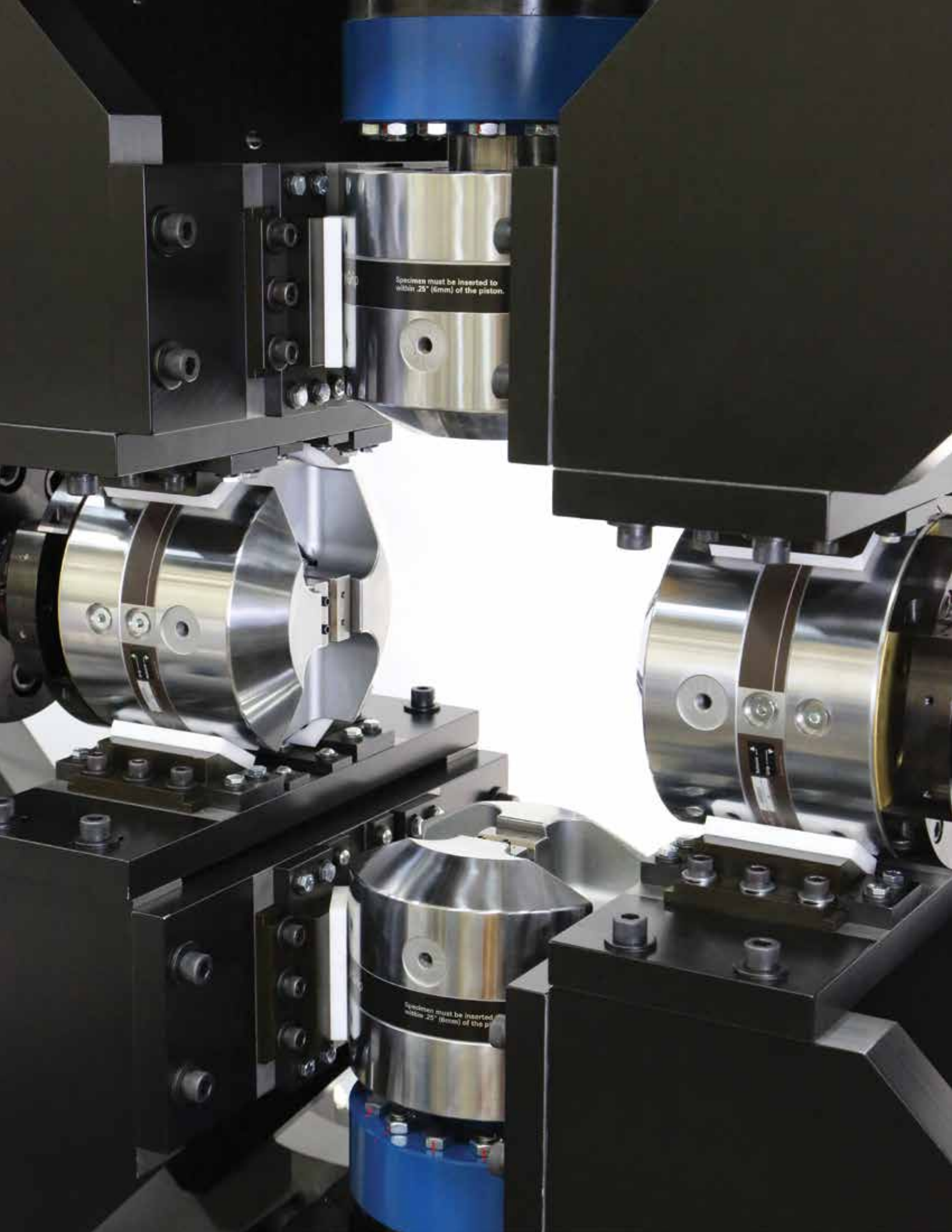
- Virtual Specimen allows you to accurately simulate specimen behavior before breaking any real test articles
- Point-by-point Monitoring allows users to perform calculations and make decisions on every data point rather than making decisions once per cycle
- Multichannel Control is used to create multi-axial loading conditions with enforced phase relationships between multiple channels

Real-time Remote Monitoring

The MTS Echo® Intelligent Lab provides the capability to track tests and monitor test equipment from any web-enabled device. Authorized personnel receive highly secure, on-demand access to critical information about the test lab, resulting in improved efficiency, better test results, lower operating costs and higher customer satisfaction levels.

The MTS Echo Intelligent Lab currently includes the following capabilities with more functionality coming in the near future:

- **Equipment Monitoring**
  Learn the status of any test at any time and from anywhere
- **Health Monitoring**
  Proactively maintain test systems with on-demand health updates
- **Test Tracking**
  Allow customers to easily track the progress of their tests online
- **Online Service Resources**
  Manage MTS software updates and version information from a single location


Specimen must be inserted to
within .25" (6mm) of the piston.

Full Complement of Test Accessories

MTS Force Transducers are compact, fatigue-rated devices specifically designed for cyclic operation in through zero tension/compression and monotonic testing applications. Models for the planar biaxial systems are available to measure tension and compression forces of 25 kN to 500 kN axial / 25 Nm to 5300 Nm torsional. These force transducers feature low deflection and a high degree of stiffness to give you better dynamic performance. They also feature a high degree of component concentricity and parallelism to give you greater accuracy during your test setup. They are manufactured for long, accurate service life using aircraft-quality steels, specially heat-treated to minimize distortion and ensure uniform hardness. There are no brazed or welded joints to fatigue or wear. MTS uses a proprietary wiring technique to reduce electrical noise, and then temperature compensates each unit to ensure stability.

MTS Model 661.XX Axial Force Transducers

These units provide excellent resolution and reading accuracy due to high output which is symmetrical between tension and compression for accurate through-zero testing.

Model 661.20-0X
Single Bridge
Axial Load Cell

MTS Model 662.10- 07/08/09 Axial/Torsional Force Transducers

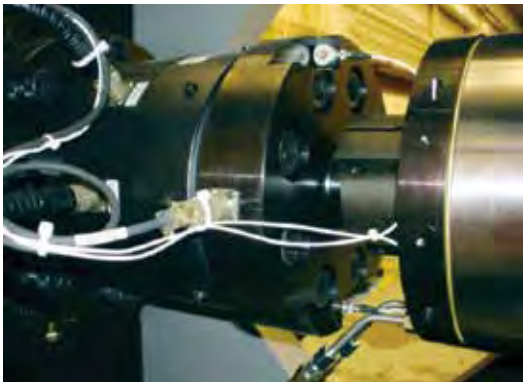
Special attention has been given to ensure low crosstalk interaction between the two axes. Accuracy is also enhanced by a design that features radially-oriented strain measurement beams. Beams oriented in this manner compensate for off-axis loads and moments.

Model 662.10-0X
Single Bridge Axial/
Torsional Load Cell

Acceleration Compensation

Integrated acceleration compensation can easily be added to the planar biaxial system for either axial only systems or for axial/ torsional systems. Acceleration compensation is an important technique to correct force readings for forces needed to accelerate fixturing mass, for dynamic tests with test frequencies larger than 10 Hz.

For torsional systems two additional piezo sensors that sense the torsional acceleration can be added to provide torque acceleration compensation.

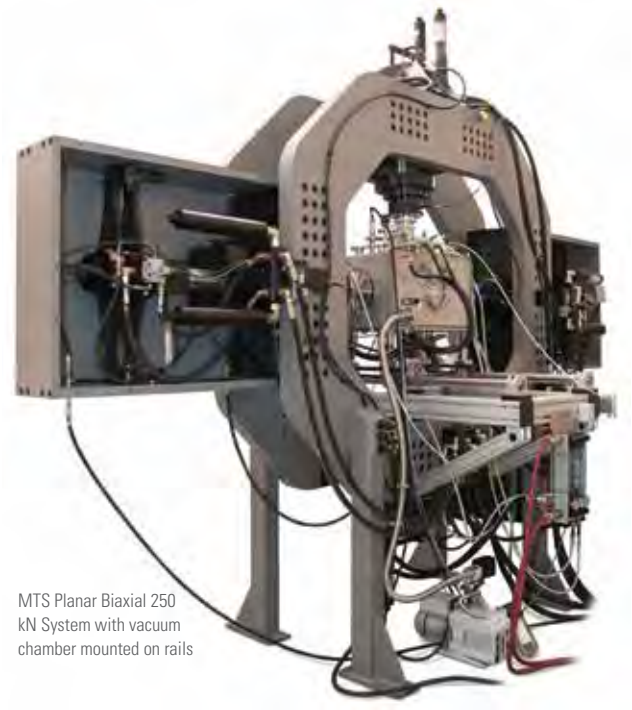


Configuration with horizontal torsion input. The electrical connection at the center of the photo is for the axial accelerometer. The two white wires through the center of the photo each connect to separate, dual accelerometers for compensation of the rotational channel.

Specimen example

Cruciform specimens are normally designed and built by the end user. Getting the stress or strain state desired in the specimen gage section is often accomplished using finite element methods and experimentation. Buckling in compression is a potential issue that must be addressed in the initial design.

Cruciform specimen with dished out center gage section used for materials testing in the planar biaxial system



MTS Planar Biaxial 250 kN System with vacuum chamber mounted on rails

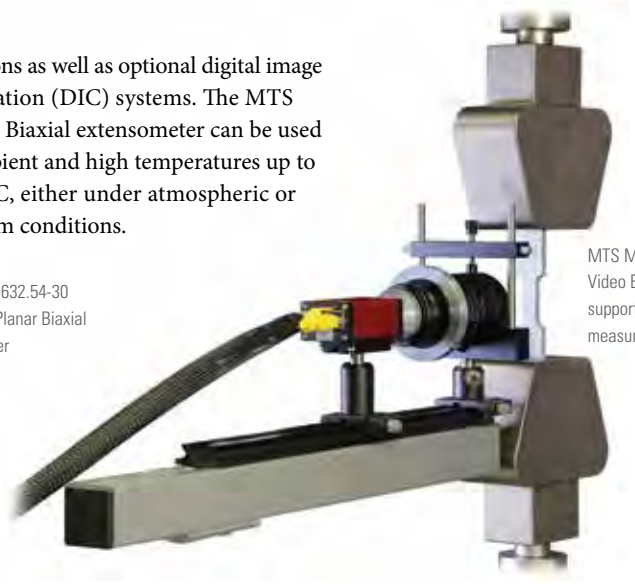
Environmental simulation systems

To support a full spectrum of environmental simulation for planar biaxial applications, MTS complements its planar biaxial system offering with a selection of environmental simulation systems to test materials and components under a wide variety of real world conditions. MTS has integrated a variety of environmental simulation systems into planar biaxial solutions to apply extreme temperatures, vacuum and humidity to specimens under test. For non-ambient testing, the planar biaxial frames can be outfitted with environmental chambers for testing at cold temperatures using liquid nitrogen (or other liquefied gases if required), inert atmospheres, vacuums, and both vacuum and high temperature using furnaces or induction heating inside of a vacuum chamber. High-temperature testing can also be accomplished in air using either furnaces or induction heating.

Contacting & non-contacting strain measurement

MTS offers a comprehensive selection of strain and displacement measuring tools for monotonic and dynamic testing. It includes displacement gages; a variety of axial and diametral extensometers; and both laser and video non-contacting solutions as well as optional digital image correlation (DIC) systems. The MTS Planar Biaxial extensometer can be used at ambient and high temperatures up to 1200°C, either under atmospheric or vacuum conditions.

MTS Model 632.54-30 Option 544 Planar Biaxial Extensometer



MTS Model AVX Video Extensometer supports multiple strain measurement points

Grips

To support a full spectrum of planar biaxial loading applications, MTS offers a selection of precision, side-loading hydraulic wedge grips for tensile, compression and fatigue testing (available with an optional hydraulic grip supply).

The Model 647 Side-Loading Hydraulic Wedge Grips are the recommended grips for the planar biaxial system. Test after test, MTS 647 Side-Loading Hydraulic Wedge Grips clamp specimen in exactly the same way for consistent, repeatable testing results. Their superior alignment and constant, lateral gripping force minimize the bending strains, vertical loading forces and slippage that can invalidate test results and consume time. The hydraulic pressure to these grips is supplied by an external grip supply and is adjustable. This allows the grips to be used for testing a variety of materials, including plastics and ceramics.

Specimen are also protected by the preload chamber which locks all moving grip parts in position, eliminating backlash when cycling between tension and compression. These grips can be mounted in environmental chambers for testing between –40 to +175°C when equipped with optional, high temperature hydraulic fluid and seals. Varieties of wedges are available for the Model 647 Grips and are sold separately. These grips are also available in axial-torsional models.

For higher temperature applications, the MTS Model 647 All-Temperature Grips can be operated within an environmental chamber at temperatures up to 540°C (1000°F). Two models are available. One has a range of from –130 to 315°C (–200°F to +600°F), the other from –130 to 540°C (–200°F to +1000°F). Because these grips are opened and closed remotely, there is no need to cool them down before changing specimens. Thus, specimen changeover is rapid and can be accomplished without touching the hot gripping device.

In addition, because the grip head operates within the chamber – at test temperatures – thermal gradients between the grip and specimen are minimized. When these grips are used within an MTS environmental chamber, gradients as low as 1.6°C (±3°F) can be achieved. As with all MTS hydraulic grips, these provide a constant, adjustable gripping force, regardless of the test loads applied. This prevents damage to soft specimens and specimen slippage during testing. When the specimen is gripped, all moving parts of the grips are hydraulically locked in place so the specimen can be cycled from full tension to full compression without backlash.

Wedges for these grips are available in a number of configurations for testing both flat and round specimens.

To minimize damage to your specimen shaft, you can order our flat wedges with an optional Surfalloy™ finish. This rough, tungsten-carbide surface coating provides firm gripping of even the most brittle composites without grip-induced failures.

Key Benefits

- Easy specimen insertion
  Side-loading lets you quickly and easily insert specimens.
- Excellent repeatability
  These grips clamp onto your specimen in the same position, test after test, to minimize the bending strains that can invalidate your test results.
- Tension & fatigue capability
  Use for both tensile and fatigue tests.
- Adjustable pressure
  Hydraulic pressure can be adjusted, allowing these grips to be used for testing a variety of materials.
- Wedge selection
  A wide variety of wedges are available to meet your requirements.
- Low thermal gradients for the All-Temperature Grips
  When used with MTS environmental chambers, you can achieve thermal gradients as low as 1.6°C (±3°F). This gives you accurate results on temperature-sensitive materials and minimizes any risk from thermal stress on your sample.

Model 647 All-Temperature Hydraulic Wedge Grips

Unparalleled MTS Service & Support

MTS Planar Biaxial Test Systems are backed by the global MTS Service & Support organization. This highly experienced team offers lifecycle management services for all MTS test systems and is committed to maximizing the uptime and operational efficiency of each system. With the expertise to support test equipment from pre-installation to decommission and at every point in between, MTS has the service solutions to meet needs for test schedule predictability, data integrity, system performance optimization and budget management.

Onsite services

MTS field service engineers have a worldwide reputation for applications expertise and will respond to requests for support or repair quickly and efficiently.

Engineering services

MTS offers a complete set of professional engineering services, including systems engineering, test consulting and facilities design services.

Training

MTS training programs are designed to improve operator efficiency and optimize system performance. Expertly led and completely customizable, these courses provide engaging hands-on learning experiences.

Calibration & alignment

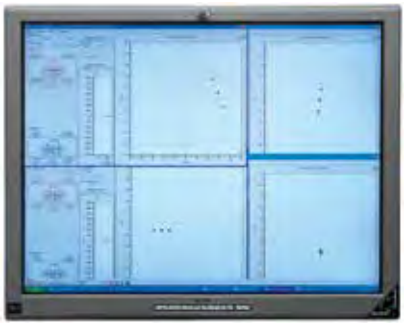
All test labs must calibrate their testing equipment to help ensure data accuracy. MTS provides top-quality, accredited calibration services and load frame alignment services to minimize data variance.

Maintenance & monitoring

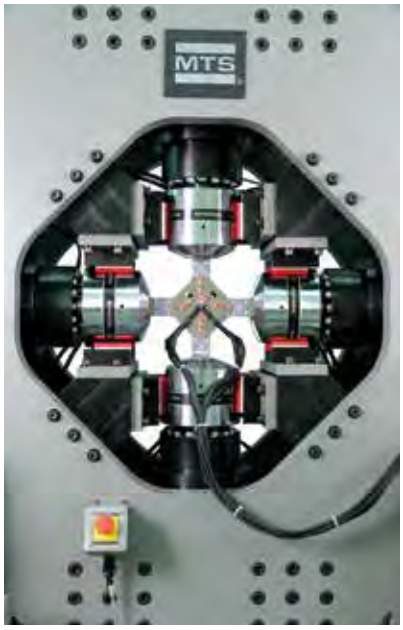
Based on decades of service experience, MTS has developed a set of well-defined routine maintenance offerings tailored for specific systems and components, to help extend equipment life.

Upgrade solutions

As technology improves, an upgrade is often the most economical way of expanding lab capabilities and extending the life of existing test equipment. MTS offers upgrades and replacements for mechanical components, controllers and software.



MTS Series 709 Alignment Software shows gage readings



MTS Planar Biaxial System shown with strain-gaged alignment specimen

MTS Series 709 Alignment Electronics with strain-gaged cruciform specimen

Planar Biaxial System Performance Curve

The following graph illustrates the dynamic performance characteristics of the 100 kN configuration available for MTS Planar Biaxial systems. Actual performance will depend upon the specimen under test and the particular grips, fixtures and components employed by your system. MTS can assist you in configuring a system to meet your specific test requirements.

The chart graphically demonstrates the influence specimen mass has on the performance of the configuration by plotting Specimen Displacement (mm) vs. Frequency (Hz) for four loading conditions. The configuration's usable performance range for a particular load is depicted as the area below its respective curve.

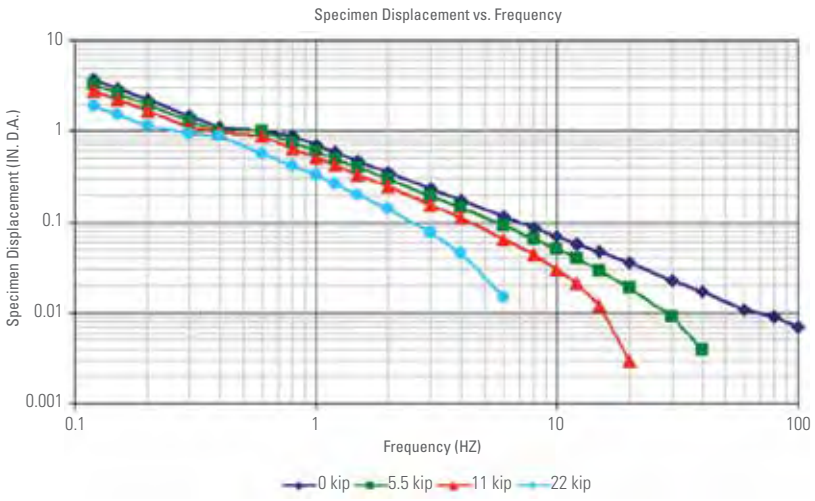
Within the chart, factors such as actuator size, actuator stroke and servovalve size are held constant. To demonstrate how system performance is dependent on these factors the performance can be plotted on multiple charts that vary by actuator and servovalve configuration.

While the chart assumes that available hydraulic power is not a limiting factor, it is important to note:

- Increasing the actuator size will provide more force, which in turn requires more hydraulic power to run the test at the same speed.
- Increases in performance are attained by increasing servovalve size, which also requires more hydraulic power.

This chart represents one of the available MTS planar biaxial family performance curves – contact your MTS sales engineer to review the full array of performance curves for each standard MTS planar biaxial system.

Model 100 kN: horizontal or vertical axis – linear only – 25 lpm hydraulic power unit*



** Systems profiled feature accumulation, pressure and return hoses selected to match the load frame system configurations. Hydraulic power supplies support 21 MPa (3000 psi). The performance curves depicted represent a mathematical prediction of system performance using appropriately sized hydraulic wedge grips holding a linear spring specimen.*

Planar Biaxial Load Frames Specification

Nominal Planar Biaxial System dimensions, weight and suggested floor space

Frame Description	Height	Width	Depth	Weight	Suggested Floor Space
25 kN compact	1.9 m (75.6 in)	1.0 m (39.4 in)	0.9 m (36 in)	550 Kg	3 m x 3 m
25 kN classic	2.3 m (91.5 in)	1.9 m (75.1 in)	1.3 m (52.62 in)	2000 Kg	4 m x 4 m
100 kN	2.8 m (111 in)	2.7 m (106 in)	1.3 m (52 in)	4500 Kg	5 m x 3 m
100 kN w/ Rot	2.8 m (111 in)	4.3 m (171 in)	1.3 m (51 in)	6500 Kg	6 m x 3 m
250 kN	4.1 m (163.5 in)	3.8 m (151.2 in)	2.3 m (93.9 in)	8000 Kg	5.5 m x 3.5 m
250 kN w/ Rot	3.7 m (146 in)	4.5 m (179 in)	1.3 m (50 in)	11000 Kg	6 m x 3 m
500 kN	4.2 m (167 in)	3.6 m (144 in)	1.3 m (50 in)	10000 Kg	5.5 m x 3 m

Dimensions are nominal. For dimensions of a system that better fits your needs, please contact MTS.

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100-335-067 PlanarBiaxial • Printed in U.S.A. • 09/21q