MTS GROUND VEHICLE SOLUTIONS

Booth 8310

Automotive Testing Expo Europe 2023

Adapt to Evolving Test Demands

OEMs and suppliers worldwide rely on MTS Systems for the testing technologies, expertise, and support they need to meet the challenges of electric and autonomous vehicle development and thrive in an intensely competitive global market. Visit Booth 8310 and explore how the growing array of MTS solutions can help you adapt to rapidly evolving test and simulation demands.

Technology Forum

New NVH damper test system for structure-borne noise assessment

Presenter: Byron Saari
Principal Staff Engineer
MTS Systems

Date: Wednesday, June 14

Time: 14:40

Place: Hall 8

Learn more on page 2

Electric & Autonomous Vehicle Testing Solutions

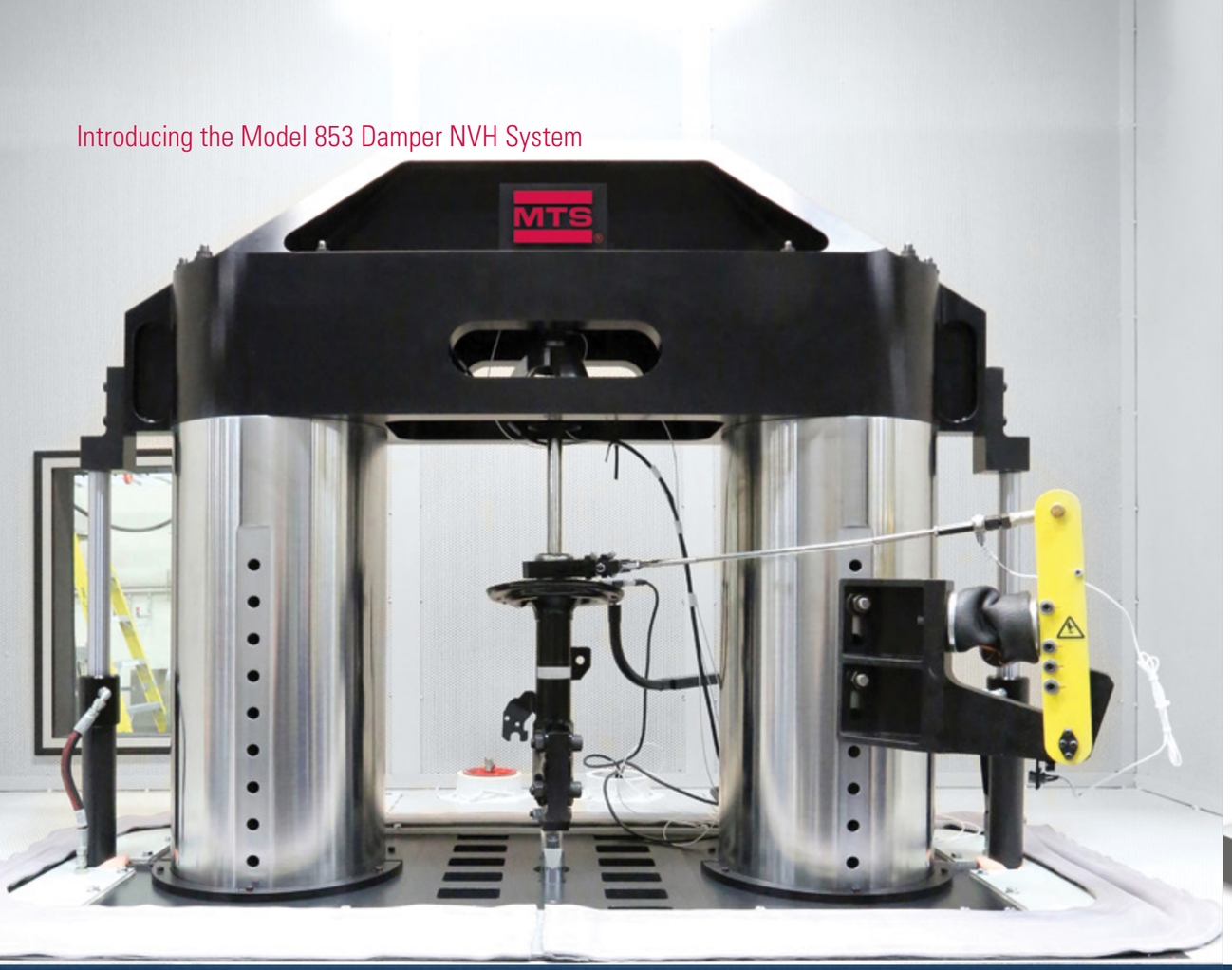
Photo courtesy of CTAG

With a proven portfolio of laboratory-based testing solutions for materials, components, subsystems, and full vehicles, MTS is uniquely positioned to help vehicle OEMs and component suppliers confront the myriad challenges posed by electric and autonomous vehicle development.

Learn more on page 4

be certain.

Introducing the Model 853 Damper NVH System



Purpose-engineered to address the entire range of damper noise phenomena, including the elusive structure-borne Chuckle.

The advent of electric and autonomous vehicles has created a need for more capable damper NVH solutions. The lighter, thinner materials making up the chassis of these vehicles create an environment where not only air-borne "swish" and "squeak," but also, structure-born "chuckle" noises threaten to compromise ride comfort and quality.

To study these phenomena, the innovative Model 853 draws from both MTS damper and elastomer testing technologies The system employs high-bandwidth transducers - typically used in high-frequency elastomer testing - to perform damper NVH measurements with fidelity and accuracy up to 800 Hz.

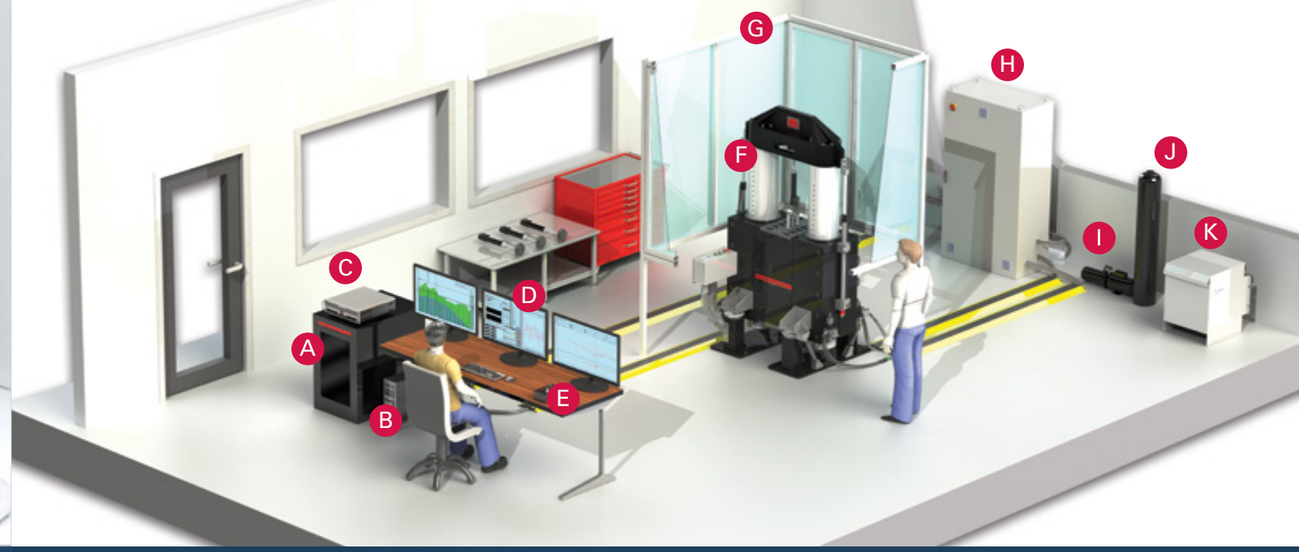
It also features an elastomer system's high-stiffness load frame, along with larger diameter columns, a thicker crosshead, and a more robust base to avoid the resonant modes that can corrupt measurements. Linear electromagnetic actuation technology provides the clean sinusoidal input and low total harmonic distortion (THD) the system requires for effective chuckle testing.

The Model 853 employs full-featured MTS Damper software and is driven by a versatile FlexTest® controller capable of reproducing virtually any type of signal, making it suitable for basic damper characterization, and even elastomer testing.

Integrated Damper NVH Lab

A. FlexTest Controller
B. System PC
C. Data Acquisition Console
D. MTS Damper Test Software
E. Mode Switch/E-Stop
F. Model 853 Damper NVH System
G. Safety Enclosure
H. Electrical Console
I. Hydraulic Power (Crosshead Lift)
J. Nitrogen Supply (Static Support)
K. Power Transformer

Total Harmonic Distortion (THD):	<1% up to 50 Hz excitation frequency
Measurement bandwidth for vibration testing:	up to 800 Hz
27 kN actuator:	20 kN at 3 m/s
18 kN actuator:	15 kN at 3 m/s
Noise Level (typical):	< 60 dBA without acoustic chamber < 45 dBA with acoustic chamber



Structure-borne Chuckle Testing

Chuckle originates as a mechanical vibration in the body of a shock absorber. Impedance coupling in the upper mount transforms the vibration to acoustic noise in the vehicle cab. As such, chuckle is model- or platform-dependent, making it very difficult to identify and resolve at the component level.

Meaningful analysis of chuckle phenomena at the component-level requires an exceptionally high-performance test bench featuring:

A. High-bandwidth measurement transducers and accelerometers

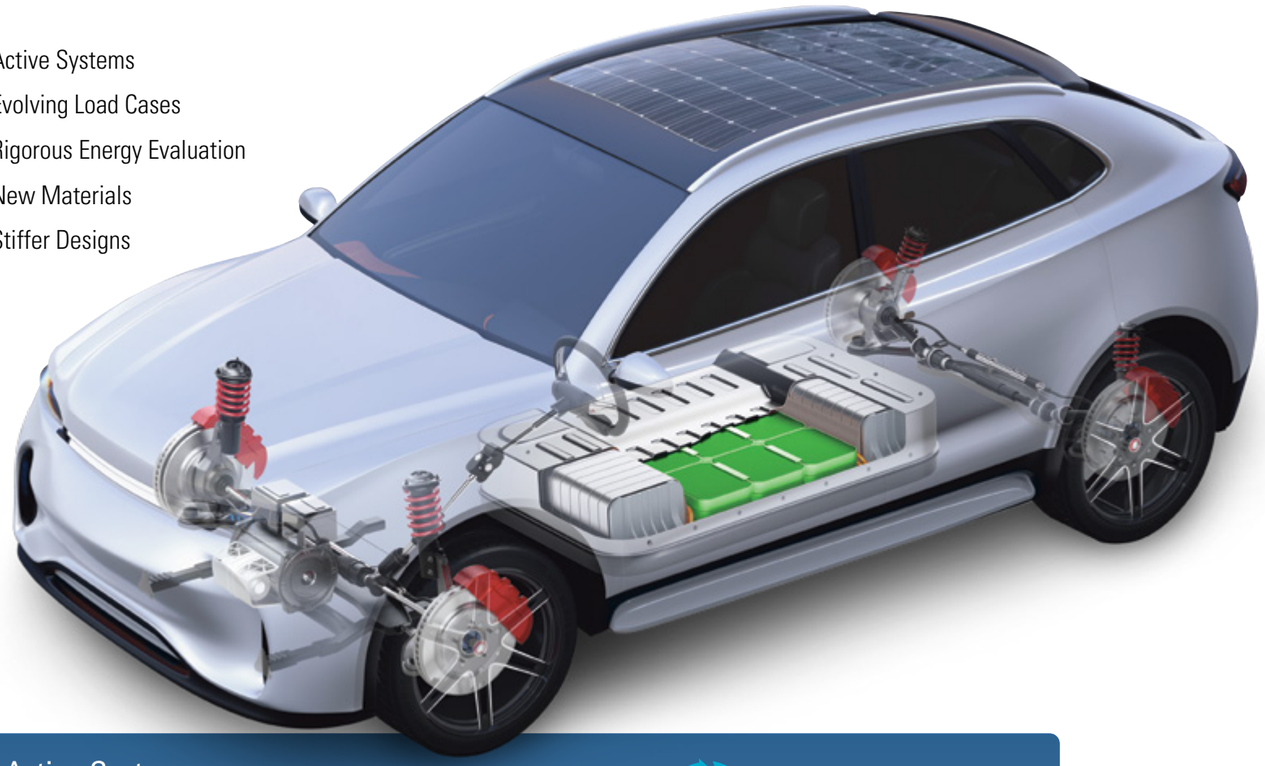
B. High-fidelity actuator Input, characterized by clean sinusoidal input and low THD

C. High-stiffness Load Frame that exhibits no mechanical vibration

Electric & Autonomous Vehicle Testing Solutions

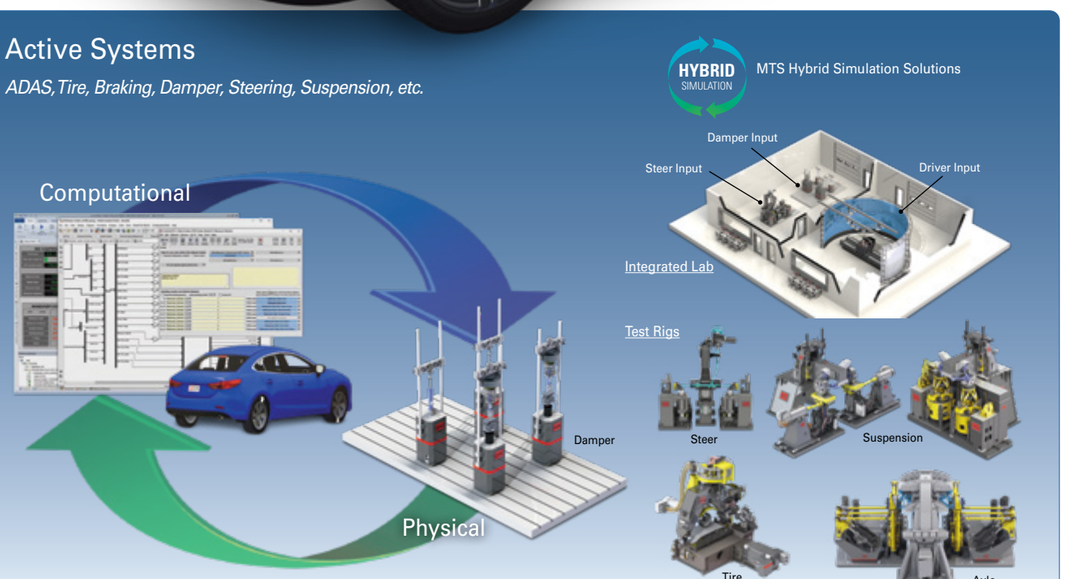
With a proven portfolio of laboratory-based testing solutions for materials, components, subsystems, and full vehicles, MTS is uniquely positioned to help vehicle OEMs and component suppliers confront the myriad challenges posed by electric and autonomous vehicle development, including:

- Active Systems
- Evolving Load Cases
- Rigorous Energy Evaluation
- New Materials
- Stiffer Designs



Active Systems

ADAS, Tire, Braking, Damper, Steering, Suspension, etc.



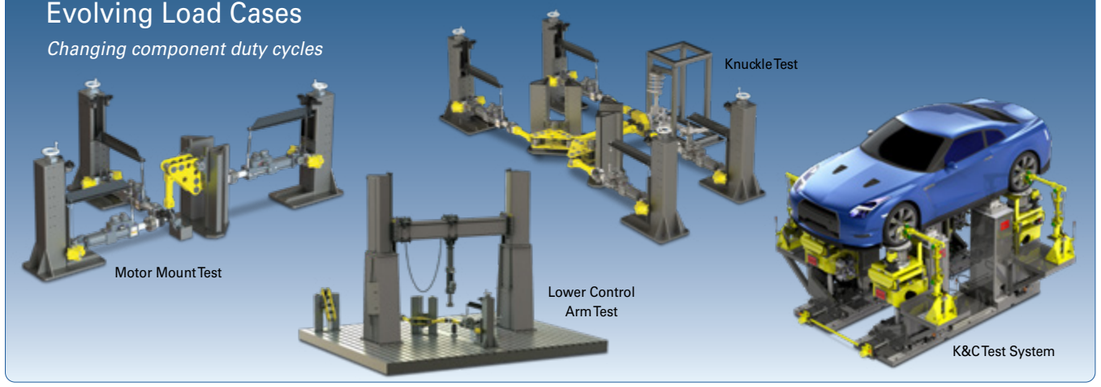
HYBRID SIMULATION — MTS Hybrid Simulation Solutions

Integrated Lab

Test Rigs

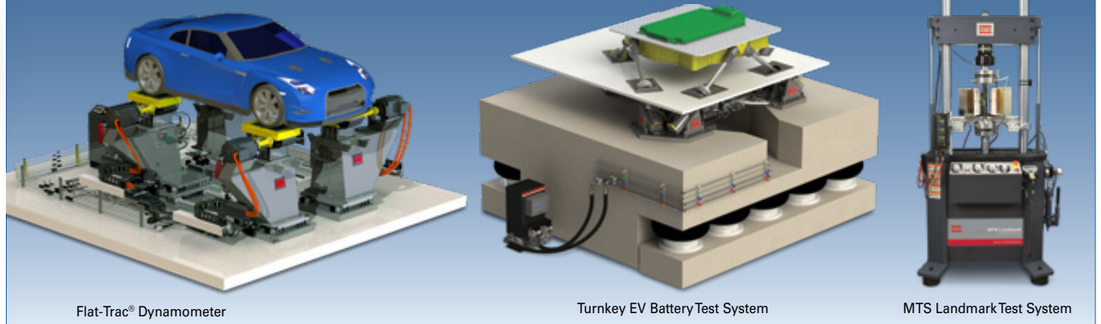
Evolving Load Cases

Changing component duty cycles



Rigorous Energy Evaluation

Aggressive consumption and loss targets



New Materials

Changing body structures and dynamics

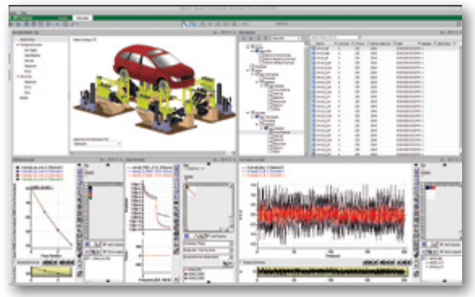
Stiffer Designs

Higher frequency duty cycles, NVH, Ride Comfort

State-of-the-art 6DOF Road Simulation

The new Model 329i Spindle-couple Road Simulator integrates the latest in MTS hydromechanical, controls, and software innovation to achieve new levels of durability test fidelity and productivity.

- Optimize road simulation accuracy
- Maximize test system throughput, eliability, and operational efficiency
- Integrate seamlessly with active vehicle systems and CAE models



RPC Connect Software

Architected to optimize durability test efficiency and productivity:

- Productivity-enhancing user interface
- High-throughput Test Stage
- Supports advanced iteration methods and hybrid simulation

Refined 329i Kinematic Design

Engineered to maximize test accuracy, throughput, and rig longevity:

- Up to 80 Hz road input
- New, robust wrist joint design
- High-fidelity, long-lasting MTS DuraGlide linear actuators
- Available in passenger car and light truck configurations

FlexTest Elite Performance Controllers

Equipped with significantly increased processing power to address evolving test and simulation requirements:

- Higher channel counts for more DAC and monitoring
- Increased computational power for hybrid simulation and calculations-in-the-loop
- Faster test system rates for optimal rig performance
- Superior closed loop control with minimal latency
- Digital interfaces via EtherCAT, CAN bus and more

Advanced HPU System Management

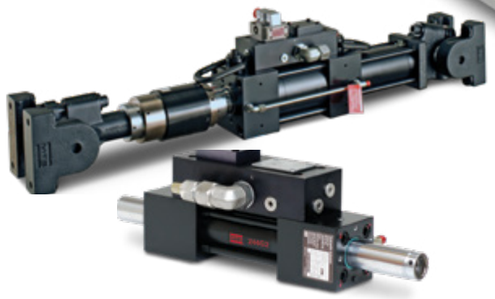
MTS Multi-Pump Control Manager (MPCM) provides the ability to monitor and control multiple HPUs as a single system to improve lab operating and energy efficiency and prolong equipment life.

MTS SafeGuard™ Ecosystem

Maximize Test Lab Safety, Efficiency & Longevity

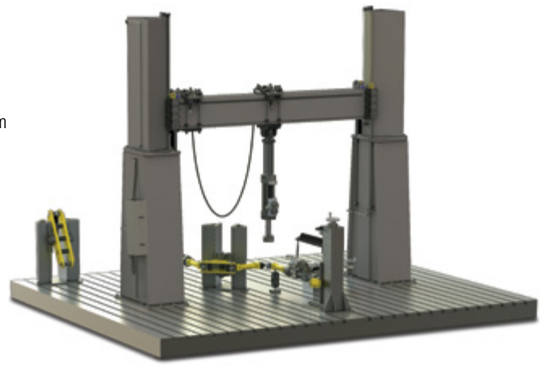
1. State-of-the-art Hydraulic Distribution

The **MTS Series 295 Isolation Hydraulic Service Manifold (ISHM)** provides smooth, controlled transitions of hydraulic pressure between the hydraulic power unit (HPU) and the test system to enhance safety and predictable control of the hydraulic system. The manifold meets Performance Level c (PLc) requirements for human safety and is able to incorporate MTS SafeGuard™ Technology to upgrade to PLd and PLe.



2. Durable, High-fidelity Test Actuation

MTS DuraGlide® Hydraulic Actuators are engineered to meet the unique precision and dependability demands of automotive testing. Featuring MTS SureCoat™ Rod Finishing Technology, they deliver longer performance life, higher test fidelity and increased energy efficiency.



3. Modular, Reconfigurable Test Rigs

MTS TestLine™ Solutions comprise a versatile set of modular components for creating cost-effective component and subsystem test rigs that can be easily reconfigured as requirements change. Precision-engineered for seamless integration, the TestLine portfolio includes a selection of durable load bearing components and MOCOKIT® portal frames.

4. Accessible System Service Information

MTS SmartService™ technology provides access to test system maintenance, repair, calibration, technical manuals and other critical service information at the test system. The MTS SmartService package includes near-field communication stickers for storing test system information, and a tablet for accessing and reading the information.

5. Advanced HPU System Management

MTS Multi-Pump Control Manager (MPCM) provides the ability to monitor and control multiple HPUs as a single system to improve lab operating and energy efficiency and prolong equipment life. An intuitive touchscreen interface enables close monitoring of HPU system fluid demand and precise management of fluid supplies and distribution.

6. Energy-efficient Hydraulic Power Generation

SilentFlo™ 515 Hydraulic Power Units (HPUs) feature high-efficiency motors and improved cooling circuits to achieve significant improvements in energy efficiency – up to 8% – over earlier SilentFlo models. SilentFlo 515 HPUs are easy to operate and maintain with fewer parts, accessible controls and improved filtration.

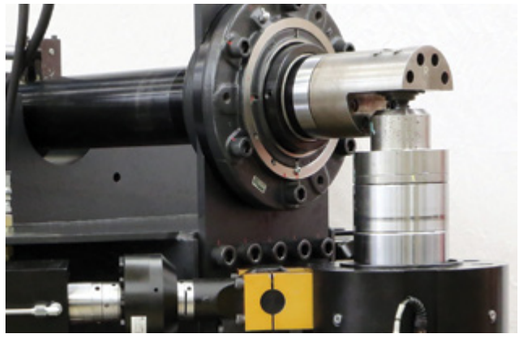
Durability Solutions

Proven, Reliable Lab-based Assessment Solutions

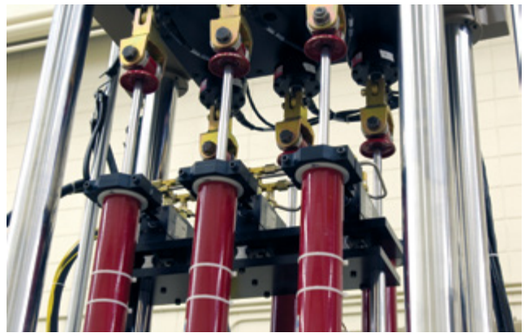
MTS sets the standard for providing highly accurate and repeatable correlation between the proving ground and the lab with a broad array of proven durability testing solutions. Comprising a variety of robust, multi-degree-of-freedom test rigs and industry-renowned RPC® Connect software, the MTS portfolio includes all the tools you'll need to accurately evaluate the durability of components, subsystems and full-vehicles, ranging from motorcycles to passenger cars to heavy trucks and agricultural equipment.

The MTS durability portfolio features:

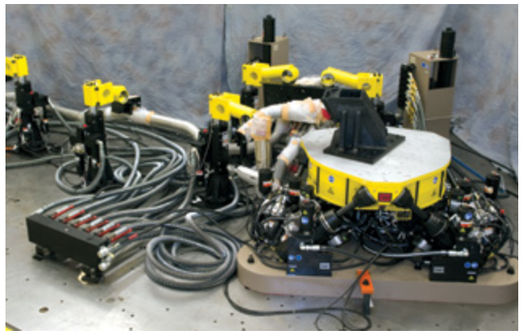
- Model 329i Spindle-Coupled Road Simulators that provide up to six degrees of measurement and control at each of the vehicle spindles to deliver the most efficient, accurate and repeatable reproduction of even the most challenging proving ground road surfaces, maneuvers and events.
- Model 320 Tire-Coupled Road Simulators for both early stage testing and full vehicle assessment
- Versatile multiaxial simulation table (MAST™) systems for general component and subsystem testing
- Numerous subsystem-specific testing solutions
- A variety of elastomer, damper, bushing and materials test solutions
- Leading-edge hybrid simulation solutions



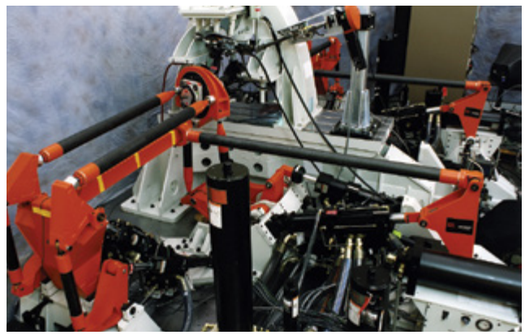
Ball Joint Test System



Damper Test Systems



Multiaxial Simulation Table (MAST) Systems



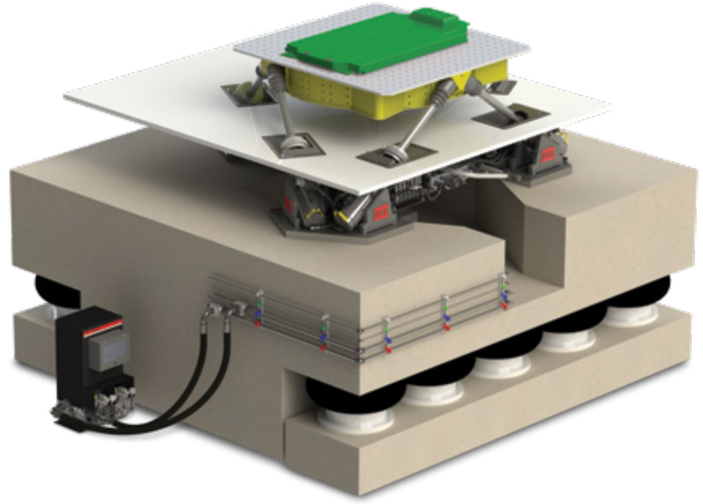
Axle Test Systems

Tire-coupled Road Simulators

Spindle-coupled Road Simulators

Expanding MAST Capabilities

MTS is responding to evolving test requirements for electric and autonomous vehicles, commercial trucks, and agricultural equipment with MAST systems capable of high frequencies and payloads, an array of advanced compensation tools to optimize system fidelity, and dual-mode system upgrades that enable safe, compliant switching between durability and human-rated ride comfort testing.



High Frequencies - Models 353.20, 353.50 & 354.20

Address emerging electric vehicle battery testing needs and comply with various international standards.

- Test up to 200 Hz when performing Power Spectral Density (PSD) tests and Time History (TH) replication
- Apply force and motion in full six-degrees-of-freedom
- Streamlined integration with third-party environmental chambers, battery cyclers - or battery management systems - and specimen monitoring systems
- Functional safety per ISO 13849-1:2015 (Safety of machinery – Safety related parts of control systems)

Model 353.20

High Payloads - Models 353.50 & 354.20

Test larger, heavier electric vehicle, commercial truck and agricultural vehicle components, assemblies, and subsystems.

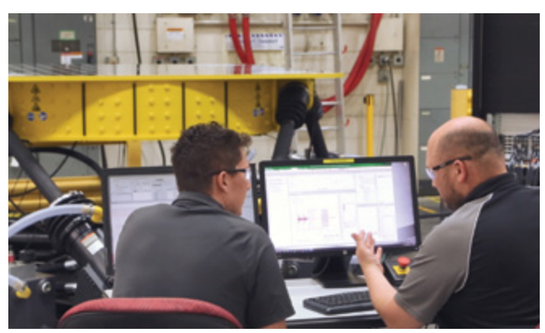
- Test specimens up to 3000 kg (353.50) and 2000 kg (354.20)
- Choose from a variety of standard and custom table sizes/ configurations (largest: 2.5 x 2.5-meter square)

Model 354.20

Advanced Compensation Tools - FlexTest Software (793)

Achieve the highest levels of MAST system controllability and fidelity to accelerate RPC drive file convergence.

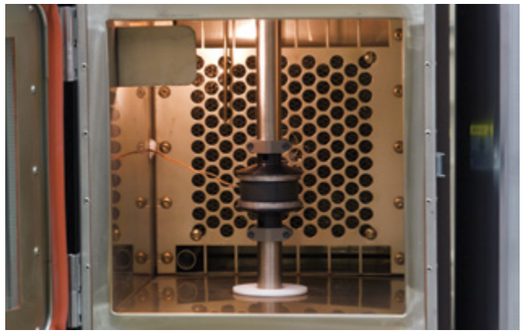
- Degree of Freedom Control establishes a coordinate space where actuators work in 6DOF concert
- Three-Variable Control enables simultaneous control of displacement, velocity, and acceleration variables
- Amplitude Phase Control (APC) compensates for errors between command and feedback sine waves
- Adaptive Harmonic Cancelation (AHC) removes distortion and generates clean sinusoidal inputs in conjunction with APC



Vehicle Dynamics Solutions

MTS offers a broad selection of test & simulation solutions designed to help you gain precise measurements earlier in the development cycle, enabling more efficient optimization of component, system and full-vehicle performance. The MTS vehicle dynamics portfolio features:

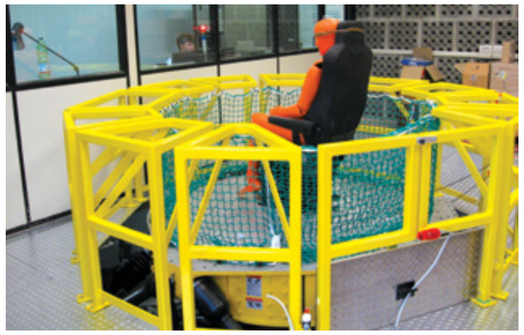
- Flat-Trac® Roadways, which combine tire-coupled road simulation and flat-belt roadway technology to create a realistic laboratory environment for evaluating noise, vibration transmissibility, suspension performance, and fuel economy
- MTS Kinematic & Compliance (K&C) systems for quickly and efficiently measuring key suspension parameters
- Dynamic Kinematic & Compliance (DK&C) systems for simulating rough road inputs and transient maneuvers
- State-of-the-art single and multi-belt wind tunnel rolling road systems for evaluating vehicle aerodynamics
- Numerous subsystem-specific testing solutions
- Robust and efficient tire force and moment measurement, rolling resistance measurement and tread wear simulation systems
- A variety of elastomer, damper and materials characterization solutions
- Leading-edge hybrid simulation solutions



Elastomer Test Systems

Tire Force & Moment Measurement Systems

Steering Test Systems



Multiaxial Simulation Table (MAST) Systems

Dynamic Kinematic & Compliance (K&C) Systems

Dynamic Flat-Belt Roadways

Next-Generation K&C System

The latest addition to MTS' K&C portfolio is purpose-built for precise and repeatable passenger car and SUV suspension measurement. Smaller, lighter and easier to install than its predecessors, this new system performs the full spectrum of kinematics and compliance deflection measurement applications, including suspension and steering characterization, benchmarking and target setting, model verification, evaluating design changes, and diagnosing problems. Ideal for characterizing fast-evolving electric vehicle designs, this K&C system features re-engineered steer input assemblies with increased torque and angle, new high-fidelity wheel motion sensors, new highly adjustable body clamping, and a new operator's pendant for safe test vehicle installation.

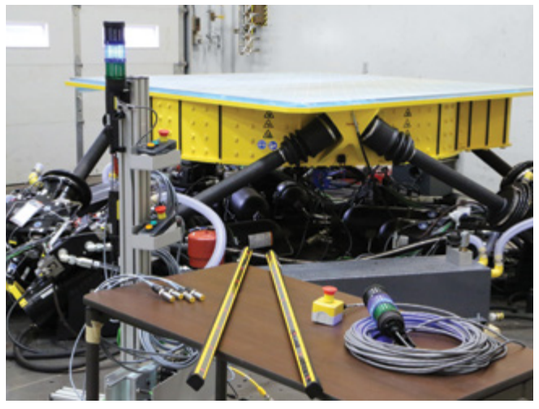
Expanding MAST Capabilities...*continued*

Dual-Mode MAST System

Electric and autonomous vehicles are driving an intensified focus on occupant ride comfort, prompting increased need for human-rated, 6DOF vibration simulation capabilities. To help meet these demands, the new Model 353.20 DM (Dual Mode) MAST delivers an expanded application range that includes both durability and NVH testing, and occupants-on-the-table ride comfort evaluation.

Driven by ISO 13849-1:2015 (Safety of machinery – Safety related parts of control systems), the 353.20DM integrates advanced MTS Safety PLC technology, new hydromechanical manifolds, an array of human interfaces and test space monitoring devices to ensure safe and efficient switching between full-performance durability testing and reduced-performance ride comfort evaluation.

Available via turnkey system or 353.20 field upgrade, MTS Dual Mode MAST technology is purpose-engineered for conducting human-rated vibration simulation that complies fully with ISO 13090-1 and ISO 2631-1.



MTS Elastomer Testing Portfolio

Uniaxial


MTS Acumen System


MTS Landmark System


MTS Landmark System


Model 830 System


Model 831 System


Model 834 System

Multiaxial


Model 832 System


Model 831 Biaxial System


Model 833 System

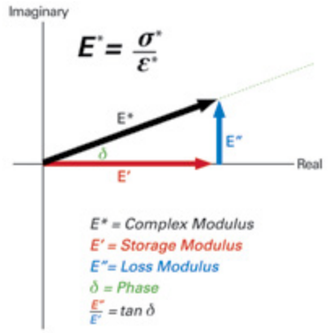

Model 836 System

MTS Acumen® Test Systems

Ideal for automotive elastomer characterization and materials lightweighting, MTS Acumen Electrodynamic Test Systems deliver superior precision and ease of use for dynamic and static testing. Energy-efficient electrodynamic actuation enables these flexible systems to be installed quickly with minimal impact in your facility.

ELASTOMER CHARACTERIZATION

Measure the static and dynamic behaviors of tire materials, suspension components, and engine and exhaust mounts.



LIGHTWEIGHTING

Determine the static and dynamic properties of plastics, composites, metals, fasteners and adhesives.

The Evolving MTS Damper Portfolio

The MTS damper testing portfolio continues to evolve, adapting to meet more challenging test requirements and growing demands for improved test system efficiency. Once exclusively servohydraulic, this expanded portfolio now features both high-performance electric and servohydraulic systems to fulfill a complete range of test applications, spanning quality, characterization, friction force, noise and durability.

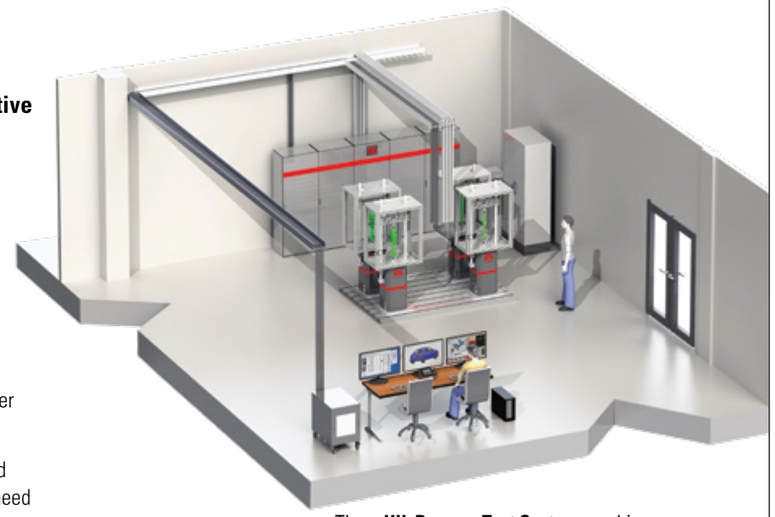
HYBRID SIMULATION

mHIL Damper Test System

Accelerate Active & Semi-active System Development

Use proven mechanical Hardware-in-the-Loop (mHIL) technology to create a real-time, vehicle-level simulation environment for testing semi-active or active damper, suspension, and body control systems.

- Enhance CAE model development
- Conduct accurate simulations earlier in vehicle development
- Dramatically reduce proving ground dependency, validation costs and need for prototypes



The **mHIL Damper Test System** combines a physical sub-system of components with a vehicle model adapted for damper and spring inputs.

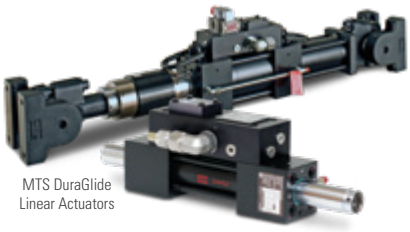
Modular TestLine™ Solutions

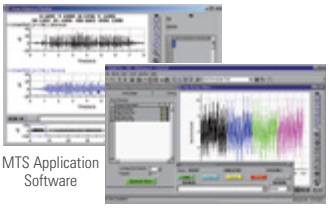
Precision-engineered components for building your test stand right the first time

TestLine Solutions comprise a versatile and reliable set of modular test components and standard hardware and software tools that enable you to create cost-effective test systems that can be reconfigured as your needs change. You supply the in-house design capability and imagination, MTS provides the premium-quality products and components to help build your test solution right the first time.

Precision-engineered to the highest quality and designed for seamless integration, the modular components and the standard hardware and software used in TestLine Solutions are the same as those integrated into the most advanced MTS custom test systems.

MTS Standard Products


MTS DuraGlide Linear Actuators


MTS Application Software


MTS DuraGlide Rotary Actuators


252 Servovalves


Load Cells


293 Hydraulic Service Manifold (HSM)


295 Isolation Hydraulic Service Manifold (IHSM)


SilentFlo™ Hydraulic Power Units (HPU)


FlexTest® Controllers

MTS TestLine Components


MOCOKIT® Portal Frames


Universal Struts


Bell Crank Assemblies


Lever Assemblies

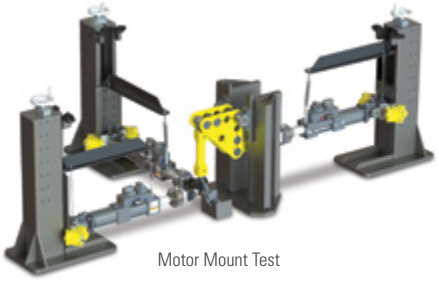

Reaction Stand Weldments

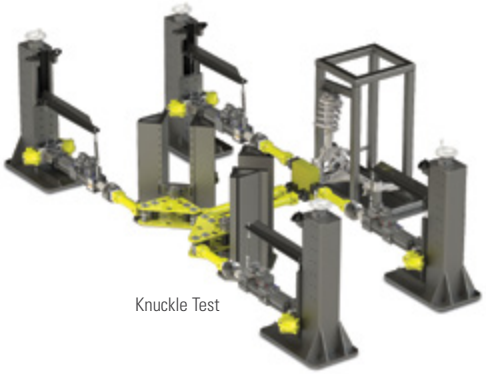

Rod End Spacer Assemblies

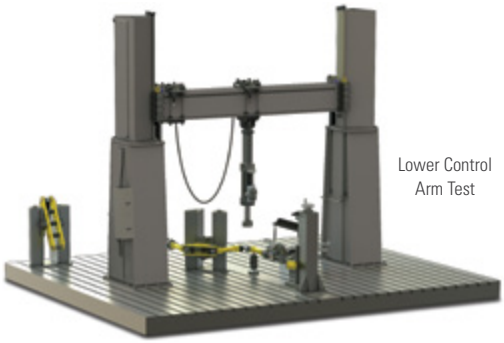

Rod End Block Assemblies

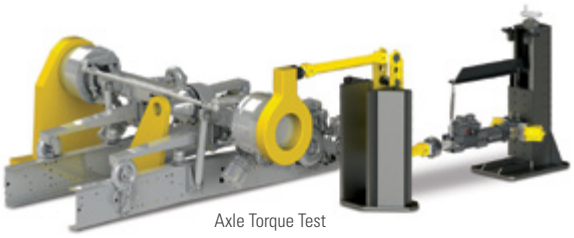

Rod End Spacers


Pillow Block Bearings


Motor Mount Test


Knuckle Test


Lower Control Arm Test


Axle Torque Test

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