SIMULATION TABLE
NEXT GENERATION TESTING

Rev 2, 0709

DESIGNED FOR LEADING EDGE AUTOMOTIVE TESTING APPLICATIONS REQUIRING UNSURPASSED PERFORMANCE, RELIABILITY AND VERSATILITY

WHAT MOVES YOUR WORLD

MOOG

STATE-OF-THE-ART HEXAPOD DESIGN FOR WORLDWIDE TEST APPLICATIONS

Unsurpassed innovation and technological expertise combined with close customer collaboration make Moog a leader in the design and development of high-performance 6 Degree-of-Freedom (DOF) electric and hydraulic motion platforms.

The proven technology expertise of Moog combined with the world class performance of Moog Actuators, Servovalves and Digital Controllers deliver long-lasting solutions to meet your challenges today—and tomorrow.

Our total focus on meeting your unique test requirements means you can rest assured you're using the most flexible, highest performance test equipment available anywhere.

The application of the latest testing techniques has become a cornerstone for creating successful new designs, ensuring shorter vehicle time-to-market, managing increased regulatory pressures and maintaining cost efficiencies.

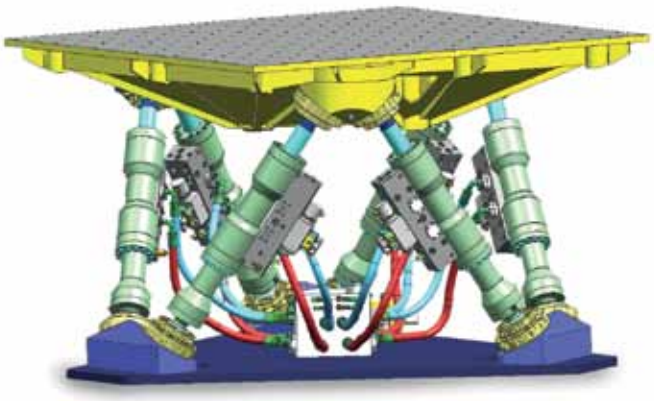
Wherever test and development engineers are pushing the limits of automotive design, the Moog Simulation Table is an indispensable tool throughout the vehicle development process.

MEETING THE CHALLENGE OF A NEW TESTING GENERATION WITH MAXIMUM VERSATILITY AND STIFFNESS

The hexapod configuration used by the Simulation Table is the optimum design to achieve simulation and test capability using acceleration, force and displacement inputs, and to reproduce data collected on proving grounds regardless of your test type, method or specimen.

By understanding today's test trends and challenges, and listening closely to the needs of customers around the world, we provide the right tools and proactive expertise to take automotive test applications further than you ever thought possible.

To meet the high demand for hydraulic Simulation Tables to accommodate loads up to 680 kg (1,500 lb), we developed a standard Simulation Table based on a new generation of hydrostatic actuators providing more stiffness and versatility.



KEY FEATURES TO SUPPORT YOUR TESTING NEEDS

KEY FEATURES

Recommended tests

Vibration, durability, squeak and rattle, noise and harshness.

6 Degree of Freedom motion

Translations: vertical, lateral, and longitudinal
Rotations: pitch, yaw, and roll

Working in synchronization

Six identical actuators performing synchronously for each motion resulting in higher forces and accelerations.

Degree-of-Freedom Control

DOF control allows you to simply put in the frequency and amplitude for a desired direction then the controller and kinematics take over to achieve the expected movement result.

Performance

The industry's most innovative engineering design incorporates proprietary software and digital control, along with the highest quality components to ensure optimal performance.

USER BENEFITS

High versatility

Specific architecture and design (for example, no bell-cranks or tie-rods) to reach higher test frequencies, providing significantly higher system strength and stiffness, so a wide range of tests can be run.

User-friendly

Minimal moving parts make the Simulation Table quick to install and commission, easy to maintain, and user friendly when accessing the table and specimen. The design also makes it simple to run tests efficiently through integrated control hardware and software.

Extremely small footprint

Using only one third of the space required by classic systems, this small footprint makes it an integrated solution that is easy to position, run and control anywhere in your test lab.

Maximum flexibility

Accommodates integration of environmental chambers for temperature and humidity testing in connection with vibration testing.

Increased productivity in a testing laboratory environment

The geometry of the assembly of actuators offers a convenient working height for the operator to mount and inspect the test specimen. (No work platform required.)

DESIGNED FOR YOUR UNIQUE REQUIREMENTS

Moog can also optimize designs to fit a client's unique need.

Our wide array of technologies and design expertise mean your Simulation Table can be tailored to meet your specific performance needs. Our solutions address your specific requirements whether it is higher frequency, payload, footprint, performance, climatic chamber, acoustic chamber, hydrostatic bolt joints or fixed based actuator design.

Detailed engineering, stress and model analyses are used to ensure that your specifications are realized in the final design.

PARAMETER	Standard Simulation Table	Example of a customized Simulation Table
System Payload	680 kg (1,500 lb)	600 kg (1,322 lb)
Table Mass	758 kg (1,670 lb)	742 kg (1,635 lb)
Total Payload (combined)	1,440 kg (3,170 lb)	1342 kg (2,950 lb)
Table Size (LxW)	2,175 x 1,870 mm (7.1 x 6.1 ft)	2,300 x 2,000 mm (7.5 x 6.6 ft)
Table Mounting Pattern	150 x 150 mm (5.9 x 5.9 in)	200 x 200 mm (8 x 8 in)
Table Mounting Hole Size	M12	M16
Actuator Peak Force	54 kN (12.2 kip)	53 kN (12 kip)
Degree of Freedom	6 DOF Stewart Hexapod	6 DOF Stewart Hexapod
Frequency	80 Hz	150 Hz
Excursion		
(Z) Heave (Vertical)	±122 mm (4.8 in)	+163/ -140 mm (6.4/ -5.5 in)
(Y) Lateral	±177 mm (7.0 in)	± 103 mm (4 in)
(X) Longitudinal	+216/ -177 mm (+8.5 / -7.0 in)	±118 mm (4.66 in)
Roll	±9 deg (0.16 rad)	±7.6 deg (0.13 rad)
Pitch	±8.5 deg (0.15 rad)	+7.2/ -8.4 deg (0.13/ -0.15 rad)
Yaw	±12 deg (0.21 rad)	±5.3 deg (0.09 rad)
Velocity		
(Z) Heave (Vertical)	±1.65 m/sec (65 in/sec)	±1,753 m/sec (69 in/sec)
(Y) Lateral	±1.62 m/sec (64 in/sec)	±1,218 m/sec (48 in/sec)
(X) Longitudinal	±1.65 m/sec (65 in/sec)	±1,405 m/sec (55 in/sec)
Roll	±113 deg/sec (1.97 rad/sec)	±95.6 deg/sec (1.67 rad/sec)
Pitch	±119 deg/sec (2.08 rad/sec)	±88.9 deg/sec (1.55 rad/sec)
Yaw	±99 deg/sec (1.94 rad/sec)	±62.5 deg/sec (1.09 rad/sec)
Acceleration		
(Z) Heave (Vertical)	±108 m/sec^2 (11 g)	+109/ -89.5 m/sec^2 (+11.1/ -9.9 g)
(Y) Lateral	±58 m/sec^2 (5.9 g)	±63.7 m/sec^2 (6.5 g)
(X) Longitudinal	±57 m/sec^2 (5.8 g)	±80.5 m/sec^2 (8.2 g)
Roll	±9,000 deg/sec^2 (157 rad/sec)	±4,175 deg/sec (72.9 rad/sec)
Pitch	±8,000 deg/sec^2 (139 rad/sec)	+4,210/ -5,130 deg/sec^2 (73.5/ -89.5 rad/sec)
Yaw	±6,000 deg/sec^2 (104 rad/sec)	±8,900 deg/sec^2 (155 rad/sec)

GENUINE COMPONENTS TO ENSURE BEST PERFORMANCE

Each Moog Simulation Table incorporates world class performance of Moog components along with proprietary software and digital controllers. Every element of the Simulation Table is thoughtfully integrated in the engineering design to offer unsurpassed performance, reliability and longevity.

As a result, the system transmits motion and vibration more efficiently to the subject with minimal loss of energy, including sound energy.

AUTOMOTIVE TEST CONTROLLER

One advanced control for all your tests, the Simulation Table utilizes the same Automotive Test Controller as other Moog solutions.

- Advanced control loop technology
- Unique control algorithm
- Function generator–Play out cyclic commands including sine, triangle, square wave and more.
- Random Wave–create random waveform that allows variable PSD with multiple break points across the frequency spectrum.
- Sweep function generator–sweep through a sine function with closed loop control of defined amplitudes at various frequencies.
- Random time history iteration and durability test playback.

OPTIONAL FOR MULTICHANNEL TESTING

Manifold Control Unit and Matrix Driver Unit

In case more than one Hydraulic Service Manifold (HSM) needs to be controlled independently and multiple station functionality is required, the Manifold Control Unit and the Matrix Driver Unit (MDU) can be used. The Manifold Control Unit (MCU) contains 4 connections for an HSM manifold (low/high pressure).

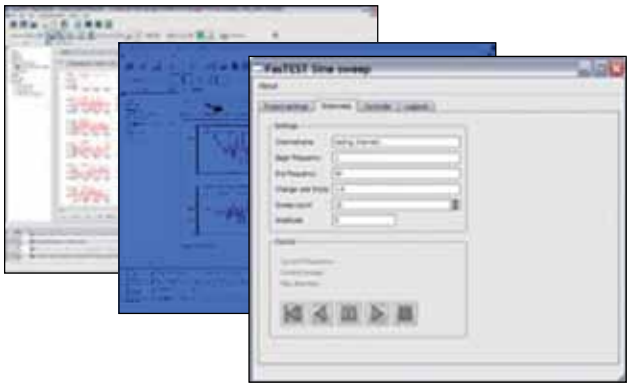
The Matrix Driver Unit can be used as a device to connect the safety systems for user defined configurations in stations of the Automotive Test system. In the Automotive Test system you can create your own station assignments and manage the associated safety system with the rotary switches on the MDU.

Channels	• 6 channels expandable up to 32 channels
Housing	• 19 inch cabinet 1.8 m (70.9 in) high • Integrated 17" full VGA color display • Climate controlled cabinet
Servocontroller	• Up to 2.5 kHz control loop (software selectable) • Integrated DOF control • Delta P compensation included • Moog unique control loop • Three variable control possibility (Velocity, Position, Acceleration)
Function Generator	• Frequency range 0.01 to 500 Hz • Waveforms: sine, sawtooth, block/square, ramp, rounded ramp, exponential • Analogue input can be used as command • Complex simulation spectrum support including spectral density (psd frequency definition) • Constant amplitude and phase matching
Standard Inputs (Per Channel)	• 2x high resolution (0.03 %) with selectable gain and bridge excitation. • Pot meter input (0.03 %) (+/- 5 V 5mA) or LVDT input (0.03 %) with LVDT excitation (5 V RMS @ 3.5 kHz) • Encoder, absolute (SSI) maximum 32 bit or relative 10 bit • 16 bit input (+/- 10 V)
Standard Outputs (Per Channel)	• 16 bits ± 100 mA valve driver output, with a limit in software from 0 to 100% or (hardware selectable) +/- 10 V output • 2 x 16 bit D/A converters, +/- 10 V
Optional Items	• Digital I/O board containing 8 inputs and 8 outputs • Analog input board containing 16 inputs • Strain amplifier board (6 channels, 1/4, 1/2 and full bridge 120/350 ohm) • Add onboard for 3 stage servovalve • Accelerometer input board 6 channels • Uninteruptable Power Supply (UPS)

TEST SOFTWARE

High-level test sessions can be set up quickly and easily using the test software application. Store or retrieve test configurations including identification, iteration, sequence editing and more. These features facilitate quick user feedback, total test flexibility and comprehensive test monitoring through dedicated algorithms, allows you to create drive files from road surface files that can be downloaded and played out.

The test software suite is totally compatible with all common data formats on the market today. In addition, the PC-based and our application-specific test software solutions use standard TCP/IP hardware to connect to our test controllers.



SERVOVALVES

The Simulation Table incorporates 6 three-stage Moog Servovalves (one per actuator). Moog Servovalves are known for their exact tolerances, high performance and durability. These three-stage servovalves were developed for applications that require high flow rates and performance. Our servovalves are the preferred choice of leading test engineers and set the world standard for hydraulic servovalve performance.

BALL JOINTS

Actuator joints ensure the smoothest possible movement and significant angular displacement via a spherical ball swivel joint on each actuator end. These ball joints are designed to allow large angular displacement with maximum stiffness and zero backlash.

Ball joint design

A "superbolt" or "multi-jackbolt tensioner" is used as a direct hex nut replacement. They spin onto your existing stud and provide an improved way to assemble the joint, as they are used to tighten the joint in pure tension. Ordinary hand tools are used to tighten.

TEST ACTUATORS

Six fatigue-rated actuators described as hydrostatic bearings hydraulic test actuators. They are engineered to deliver consistent performance over hundreds of millions of cycles for our next generation Simulation Table. They provide increased reliability, stiffness and increased side load capabilities. They have a robust design which offers low maintenance due to improved seal life (advanced rod coating), and improved cushion design (improved energy dissipation).

Hydraulic Actuator Design

Design Pressure	210 bar (3,000 psi)
Actuator Peak Force	54 kN (12.2 kip)
Total Stroke (Incl. Cushions)	272 mm (10.7 in)
Working Stroke	204 mm (8.0 in)
Cushion Length	15 mm (0.59 in)
Hydrostatic Bearing design	8 pockets

TEST MANIFOLDS

The Test Manifold is used to control the Simulation Table hexapod. It is fully integrated with the motion base, but includes a self-contained service test manifold for flexibility in installing the Simulation Tables. The hydraulic circuit logic and functionality can be engineered to meet your exact performance, safety and mounting requirements. Application specific circuits enhance machine performance, reduce system cost and increase safety.

The Moog Test Manifold systems deliver proven performance in a wide variety of test environments. These are designed to facilitate the use of multiple test rigs from a common hydraulic supply. They provide total flexibility and efficient operation in automotive test labs around the world.

A Manifold Control Unit can be used to control the manifolds, and a Matrix Driver Unit can be used to connect the safety systems for user defined configurations.

TEST DISTRIBUTION MANIFOLD

The Test Distribution Manifold is fully integrated into the Simulation Table assembly and creates an optimum configuration for the layout of the hoses to the actuators. Optional items can be connected to this Test Distribution Manifold for convenience and flexibility.

TEST SERVICE MANIFOLD

The Test Service Manifold used on the Simulation Table is capable of a peak flow of 1,140 lpm (300 gpm) at 210 bar (3,000 psi).

It contains a 3 micron filter in the pilot line, and 25 micron filters for the pressure line. Pulsation dampener accumulators are installed in the pressure, pilot and tank lines.

Control valves are used to control pressure and flow to ensure the system meets all safety requirements.

HYDRAULIC INTERFACES

Hydraulic Distribution System	
Oil Requirements	
System Fluid	Mobil DTE-25, Shell Tellus 46, or equivalent
System Fluid	Mobil DTE-24, Shell Tellus 32, or equivalent
Filtration Requirements	To prolong the operational life of active hydraulic components, the hydraulic fluid should be maintained at a cleanliness level of ISO 4406 (SAE J1165) 16/14/11.
Pressure	
Operating Pressure	210 bar (3,000 psi)
Maximum Return Pressure	14 bar (200 psi)
Maximum Drain Pressure	3.5 bar (50 psi)
Operating Temperature	Hydraulic oil temperature should be maintained between 24 °C (75 °F) and 57 °C (135 °F)

Hydraulic Manifolds for actuators	
Manifold Ports	SAE four bolt metric flange connection per ISO 6162 TYPE 1 SAE Straight Thread O-ring port - ISO 11926-1
Hydraulic Fitting Requirements Standard Fittings Optional Fittings	 SAE O-Ring Face Seal (ORFS) "Seal-Lok" ISO 8434-3 BSPP O-Ring 24" Cone Flareless "E02" - ISO 8434-4
Servovalves Standard Response High Response	 G761 Series or 079-100 Series G761 Series or 079-100 Series

TAKE A CLOSER LOOK

Moog designs a range of products that complement the performance of those featured in this catalog. Visit our Web site for more information and the Moog facility nearest you

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