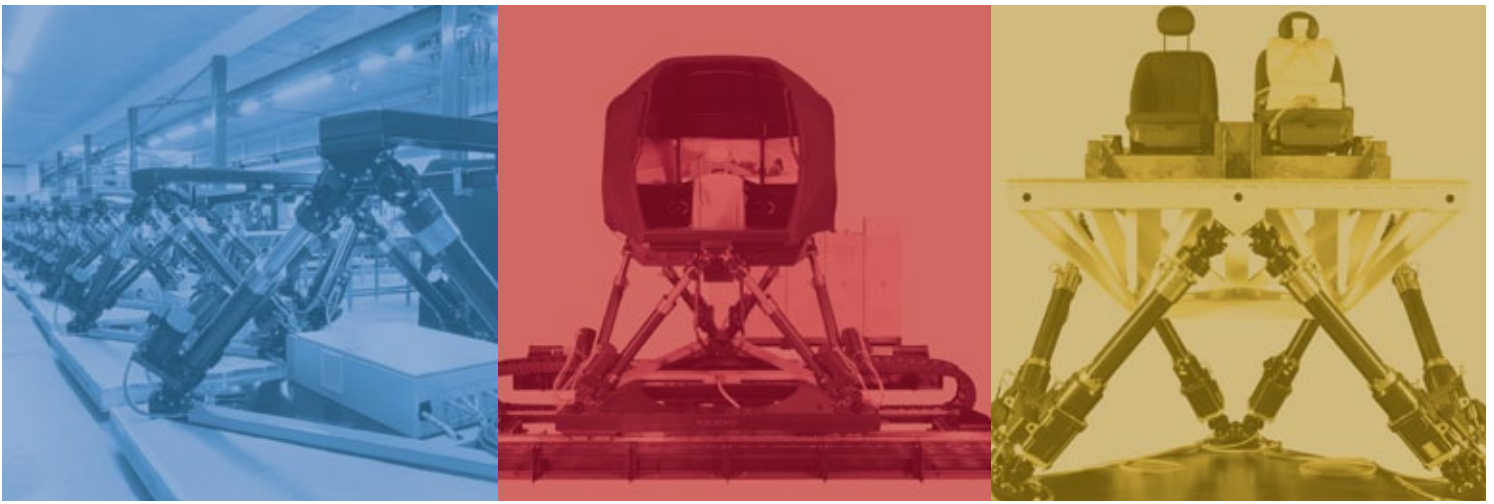




# ELECTRIC SIMULATION TABLE NEXT GENERATION TESTING

DESIGNED FOR HARDWARE AND HUMAN IN THE LOOP  
SIMULATION AND TESTING



# 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.

With global manufacturing and a worldwide support infrastructure, Moog has become a trusted partner of the world's leading manufacturers in aerospace, automotive, defense and medical industries. As a result we have supplied thousands of motion platforms to the marketplace, offering reliable system solutions that are highly supportable and add significant value for our customers.

The proven technology expertise of Moog combined with the world class performance of Moog Actuators,

Servo Valves, Servo Drives, real-time controllers and application software 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 time-to-market, managing increased regulatory pressures and maintaining cost efficiencies.

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

# A UNIQUE APPROACH TO OPEN NEW TEST HORIZONS USING ELECTRIC SIMULATION TABLES

An electric simulation table is a dynamic 6 DOF motion system designed to perform research and development tests and driver trainings.

Our experience in the design of hexapods and control systems enables us to provide customers with electric simulation tables capable of reaching frequency levels up to 35 hz.

Position, velocity and acceleration are controlled by the system through integrated control hardware and software. Depending on the configuration of the system, the simulation table can support payloads up to 23 tons, while requiring only a minimum of space in your test lab

Typical tests performed with the Electric Simulation Table are driving simulation, ride and comfort testing, qualitative evaluation for human response, vehicle components (e.g. fuel tanks), kinematics and compliance, NVH (noise vibration and harshness), BSR (buzz, squeak and rattle testing), functional testing (e.g. turret testing and antenna testing) and medical research.



## KEY FEATURES TO SUPPORT YOUR TESTING NEEDS

### KEY FEATURES

#### 6 Degree of Freedom motion

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

#### Stiff mechanical design

The stiff mechanical design of the actuators and test system configuration enables higher test frequencies and more accurate testing.

#### Degree-of-Freedom Control

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

#### Components

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

#### Software

Moog provides open architecture control software developed specifically for your unique test needs in both dedicated test application software and simulation, vibration, measurement and analysis.

### USER BENEFITS

#### New test applications

The Electric Simulation Table allows for both hardware and human in the loop testing, expanding the range of test applications compared to other types of test systems.

#### User friendly

Electric simulation tables feature relatively low power consumption, low noise and low maintenance cost and offer a clean working environment.

#### Cost effective

Minimal moving parts make the simulation table quick to install and commission, easy to maintain and user friendly when accessing the table and specimen.

#### User friendly

The design makes it simple to run tests efficiently through integrated control hardware and a user friendly test software GUI.

#### Minimal facility requirements

The compact small footprint makes it an integrated solution that is easy to position, run and control anywhere in your test lab.



Visit the Moog website to watch the [Electric Simulation Table video](#).

## STANDARD AND CUSTOMIZED SIMULATION TABLES

The overview below provides the performance specifications of four examples of standard simulation tables (for more standard systems go to [www.moog.com/products/motion-systems](http://www.moog.com/products/motion-systems)). Moog also offers customized solutions based on longtime successful experience and close customer collaboration.

### STANDARD MOTION SYSTEMS SPECIFICATIONS



Model *	MB-E-6DOF/ 24/1800KG	MB-EP-6DOF/24/2800KG	MB-EP-6DOF/40/10000	MB-EP-6DOF/60/28000KG
<b>Maximum single DOF excursion at neutral position</b>				
<b>Surge</b>	-0.44m/+0.56m(-17.0in/+22.0in)	-0.44m/+0.56m(-17.0in/+22.0in)	-0.73m/+0.81m(-28.0in/+31.0in)	±0.34m(±14.0in)
<b>Sway</b>	± 0.46 m (± 18.0 in)	± 0.46 m (± 18.0 in)	± 0.70 m (± 27.0 in)	± 0.32 m (± 12.0 in)
<b>Heave</b>	± 0.38 m (± 15.0 in)	± 0.38 m (± 15.0 in)	± 0.68 m (± 26.0 in)	± 0.36 m (± 14.0 in)
<b>Roll</b>	± 22.0 °	± 22.0 °	± 22.0 °	± 10.0 °
<b>Pitch</b>	- 22.0 °/ + 25.0 °	- 22.0 °/ + 25.0 °	± 21.0 °	- 10.0 °/ + 11.0 °
<b>Yaw</b>	± 24.0 °	± 24.0 °	± 22.0 °	± 9.0 °
<b>Maximum velocity at full payload</b>				
<b>Surge</b>	± 0.70 m/s (± 28.0 in/s)	± 0.70 m/s (± 28.0 in/s)	± 0.90 m/s (± 36.0 in/s)	± 0.95 m/s (± 38.0 in/s)
<b>Sway</b>	± 0.70 m/s (± 28.0 in/s)	± 0.70 m/s (± 28.0 in/s)	± 0.90 m/s (± 36.0 in/s)	± 0.90 m/s (36.0 in/s)
<b>Heave</b>	± 0.55 m/s (± 22.0 in/s)	± 0.55 m/s (± 22.0 in/s)	± 0.80 m/s (± 31.0 in/s)	± 1.00 m/s (± 40.0 in/s)
<b>Roll</b>	± 33.0 °/s	± 33.0 °/s	± 28.0 °/s	± 30.0 °/s
<b>Pitch</b>	± 34.0 °/s	± 34.0 °/s	± 26.0 °/s	± 29.0 °/s
<b>Yaw</b>	± 35.0 °/s	± 35.0 °/s	± 26.0 °/s	± 26.0 °/s
<b>Maximum acceleration at full payload</b>				
<b>Surge</b>	± 6.5 m/s <sup>2</sup> (± 0.65 G)	± 6.5 m/s <sup>2</sup> (± 0.65 G)	± 13.0 m/s <sup>2</sup> (± 1.30 G)	± 8.0 m/s <sup>2</sup> (± 0.80 G)
<b>Sway</b>	± 6.5 m/s <sup>2</sup> (± 0.65 G)	± 6.5 m/s <sup>2</sup> (± 0.65 G)	± 12.0 m/s <sup>2</sup> (± 1.20 G)	± 8.0 m/s <sup>2</sup> (± 0.80 G)
<b>Heave</b>	± 9.0 m/s <sup>2</sup> (± 0.90 G)	± 9.0 m/s <sup>2</sup> (± 0.90 G)	± 15.0 m/s <sup>2</sup> (± 1.50 G)	± 12.0 m/s <sup>2</sup> (± 1.20 G)
<b>Roll</b>	± 220 °/s <sup>2</sup>	± 220 °/s <sup>2</sup>	± 400 °/s <sup>2</sup>	± 300 °/s <sup>2</sup>
<b>Pitch</b>	± 220 °/s <sup>2</sup>	± 220 °/s <sup>2</sup>	± 400 °/s <sup>2</sup>	± 300 °/s <sup>2</sup>
<b>Yaw</b>	± 360 °/s <sup>2</sup>	± 360 °/s <sup>2</sup>	± 450 °/s <sup>2</sup>	± 400 °/s <sup>2</sup>
<b>Gross Moving Load (GML) up to</b>	1,800 kg (4,000 lb)	2,800 kg (6,200 lb)	8,000 kg (17,600 lb)	28,000 kg (61,000 lb)
<b>Indicative net payload</b>	1,500 kg (3,300 lb)	2,500 kg (5,500 lb)	6,000 kg (13,200 lb)	24,000 kg (53,000 lb)
<b>GML moment of Inertia about X-axis</b>	3,000 kg·m <sup>2</sup> (71,000 lb·ft <sup>2</sup> )	5,000 kg·m <sup>2</sup> (118,000 lb·ft <sup>2</sup> )	14,000 kg·m <sup>2</sup> (332,000 lb·ft <sup>2</sup> )	70,000 kg·m <sup>2</sup> (1,660,000 lb·ft <sup>2</sup> )
<b>GML moment of Inertia about Y-axis</b>	3,000 kg·m <sup>2</sup> (71,000 lb·ft <sup>2</sup> )	5,000 kg·m <sup>2</sup> (118,000 lb·ft <sup>2</sup> )	14,000 kg·m <sup>2</sup> (332,000 lb·ft <sup>2</sup> )	70,000 kg·m <sup>2</sup> (1,660,000 lb·ft <sup>2</sup> )
<b>GML moment of Inertia about Z-axis</b>	3,000 kg·m <sup>2</sup> (71,000 lb·ft <sup>2</sup> )	5,000 kg·m <sup>2</sup> (118,000 lb·ft <sup>2</sup> )	20,000 kg·m <sup>2</sup> (474,000 lb·ft <sup>2</sup> )	70,000 kg·m <sup>2</sup> (1,660,000 lb·ft <sup>2</sup> )
<b>GML CoG above moving platform centroid</b>	≤ 1.0 m (≤ 40.0 in)	≤ 1.0 m (≤ 40.0 in)	≤ 1.0 m (≤ 40.0 in)	≤ 1.0 m (40.0 in)
<b>Indicative frequency performance</b>	25 Hz	25 Hz	25 Hz	25 Hz

\* These are only examples. For more details, please contact [test@moog.com](mailto:test@moog.com).

This technical data is based on current available information and is subject to change at any time by Moog. Specifications for specific systems or applications may vary.

## CRITERIA TO SELECT A MOOG ELECTRIC SIMULATION TABLE

Moog offers a wide range of electric motion systems developed for specific applications that meet the motion requirements of customers. As a guide in defining relevant specifications when selecting a simulation table we have identified some key factors that influence the design of a system.

The three most important factors to consider are the gross moving payload, the type of application and the level of 6 DOF performance (frequency, acceleration, velocity and excursion).

Moog experts can assist you in the process of selecting the right system configuration for your needs.



### Case study

## MOTION SYSTEM AND SOFTWARE FOR DAIMLER LEADING-EDGE DYNAMIC DRIVING SIMULATOR

Daimler stands for pioneering automotive innovation for more than 100 years. With an average number of seven patents each day, they secure their leading technological position on a consistent basis.

### The request

To continue their product development tradition, Daimler sought a solution to realize high performance and realistic drive assessment with expert drivers. Daimler turned to Moog to create the solution.

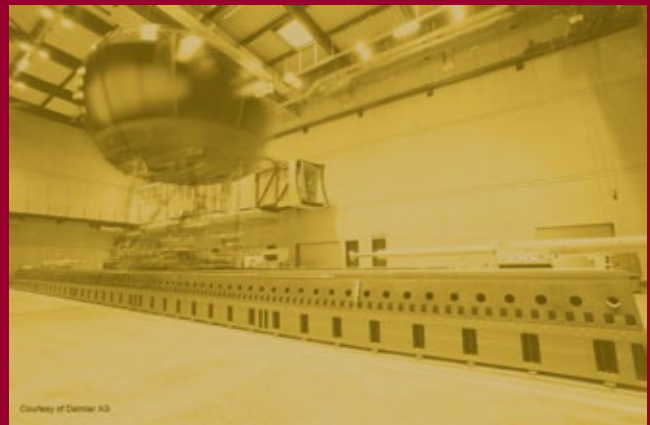
### The Solution

Moog supplied the Motion System and Software for a dynamic driving simulator. The electrical motion base, consisting of six moveable supporting legs, has six degrees of freedom (DOF): The top platform moves in x, y and z directions, and rotates over all three axes (pitch, roll and yaw). The entire motion system is mounted on the lateral rail, which adds the simulation of sideways movements such as lane changes that a hexapod on its own cannot simulate because of stroke limitations of the actuators. The Moog motion system is driven along the rail using linear motors. Inside the dome there is a full Mercedes-Benz car model where test drivers sit and view a 360° projection screen showing real-life traffic scenes, with moving pedestrians, oncoming traffic and buildings. The complete motion system is controlled by Moog real-time software. From the driver's input to the pedals and steering wheel, the Daimler vehicle models calculate position, velocity and acceleration

data. Moog software translates this information to movements in the hexapod and lateral rail to ensure the driver's sensory expectations are matched. Consequently, driving the simulator feels just like driving a normal car.

### The result

Moog's motion control expertise is part of the successful development of this dynamic driving simulator which will support the latest generation of test, research and assessment Daimler utilizes to develop its future car models and systems.



Courtesy of Daimler AG

# ELECTRIC SIMULATION TABLES AND THE APPLICATIONS

Moog provides electric motion bases that can be used for a wide range of test applications, such as testing of vehicle dynamics, vehicle components, turrets and antennas. Depending on the application a certain configuration can be proposed. Moog experts can assist you in finding the right solution for your application.

## AUTOMOTIVE TEST SYSTEMS

### Ride and Comfort Test System



6 DOF ride and comfort test system

### Driving Simulator with Lateral Rail



7 DOF driving simulator with lateral rail for vehicle dynamics research or advanced driver assistance

### Driving Simulator with Yaw Table



7 DOF motion base with yaw table to simulate city driving

## FUNCTIONAL TEST SYSTEMS

### Tank Turret Test System



6 DOF tank turret test system with pneumatic assist, capable of handling payloads up to 23 tons

### Fuel Tank Test System



6 DOF fuel tank test system

### Antenna Test System



6 DOF antenna test system

## INTEGRATED TEST SOFTWARE FOR THE FLEXIBILITY TO TEST IT YOUR WAY

Moog provides open architecture control software developed specifically for your unique test needs in durability and fatigue, simulation, vibration, measurement and analysis.

The Moog Integrated Test Suite offers a unique straightforward approach to inherently complex processes.

The Moog Integrated Test Suite provides access to different modules: Runner, Replication, Sinesweep and Random Vibration and to specific advanced features as required.

For example, Moog Replication makes simulation of vehicle movements as recorded on the test track using iteration easy and fast to use.



## MODULES BASED ON THE INTEGRATED TEST SUITE

The same module can be used for different test systems in your test labs and test data can be centrally accessed, dramatically reducing time.

The Integrated Test Suite gives access to all modules: Runner, Replication, Sinesweep and Random Vibration and to specific advanced features as required.

### Runner Module

Run and control your durability tests.



### Random Vibration Module

Realize a predefined frequency spectrum using fully randomized time signals.



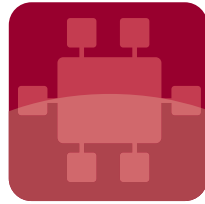
### Sinesweep Module

Investigate the resonance frequencies of your test specimen.

Run Sinesweep durability test.

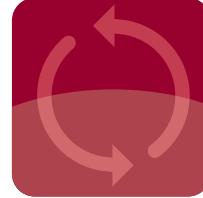


### Moog Integrated Test Suite



### Replication Module

State-of-the-art algorithms are at work to replicate time history files in an easy yet powerful way.



## A HIGHER LEVEL OF SUPPORT

### Moog engineering on call for you

Delivering world-class automotive test products and solutions means taking customer support far beyond the initial sale. It requires a dedicated approach to solving your problems, addressing your challenges and helping you achieve maximum productivity on a daily basis. In today's competitive test environment, system performance plays a significant role in determining your bottom line. Moog Global Support™ is key to achieving cost-effective operation, day in and day out.

### Actuator repair capabilities

Moog Global Support™ is designed to keep your critical test systems up and running at peak performance with only 100% genuine Moog replacement parts. Only Moog replacement parts can deliver the reliability, versatility and long life that you would expect from a world leader in motion control solutions. Each Moog part delivers essential components with precise dimensions, close tolerances and specific materials specifications. Because we understand the key role our parts play in the overall operation of your system, we carefully inspect and test each repair to identify only those components that need replacement.

### Take the next step

Isn't it time you worked with a partner who can offer both the world-class products and collaborative expertise you need to reach the next level of performance? Contact us today and see for yourself the difference the right partner can make.



# TAKE A CLOSER LOOK.

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

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Electric Simulation Table  
Moog/PDF/Rev.-, May 2012, Id. CDL35171-en