Multi-Degree of Freedom - Blast Effects Simulator (MDOF-BES)

AT A GLANCE

WHAT IS IT?

The Multi-Degree of Freedom - Blast Effects Simulator program (MDOF-BES) aims to develop methods and hardware that will allow for the independent laboratory evaluation of the occupant and seating response to underbelly blast effects at local effects up to 20 m/s.

HOW DOES IT WORK?

- An Elastic Multi-Axis Fixture (EMAF), developed to simulate the in-cab response of a specific vehicle, is placed on the testing platform.
- Crew and seating protection concepts under evaluation are installed and instrumented with an anthropomorphic test device.
- Machine-controlled pneumatic cylinders then accelerate the global impactors into the test platform to generate a velocity change of up to 20 m/s.
- The test platform will rise to a predetermined height -- between 3 and 30 inches -- where it will impact the platform arrestors. The arrestors will decelerate the test platform via momentum transfer.
- New crew protection concepts can be evaluated using established protocols.

WHAT WILL IT ACCOMPLISH?

- MDOF-BES will allow multi-axis testing capability in a single simulation that is representative of in-theater events for the development of crew protection systems.
- The MDOF-BES will allow for testing at local effect rates up to 20m/s.

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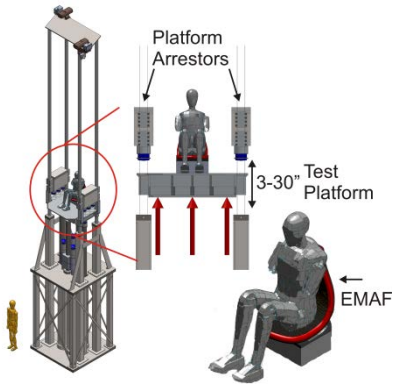
The Multi-Degree of Freedom - Blast Effects Simulator (MDOF-BES) is a science and technology program sponsored by the Maneuver Thrust Survivability within ONR's Expeditionary Maneuver Warfare and Combating Terrorism Department.

The program is focused on using theater and live-fire knowledge base to develop reliable, repeatable, laboratory testing capabilities to evaluate crew and seating response to underbody blast effects.



The Multi-Degree of Freedom - Blast Effects Simulator program will develop the ability to synthesize representative underbody blast effects on ground vehicles. This will enable modeling and laboratory testing of developmental and upgraded occupant-centric protection concepts and devices under controlled laboratory conditions, thereby accelerating transfer of reliable protection technology to the warfighter.

The current approach for laboratory simulations of underbody blast effects to crew relies on vertical loading of the seating system and occupant using various mechanical shock generating devices, such as the Crew Seats Blast Effect Simulator (CSBES).

MDOF-BES will allow for the simulation of the multi-axial (up to six degrees of freedom) accelerative loading to the seating system and occupant. The Elastic-Multi-Axial Fixture (EMAF) will replicate the velocity-time profile at the seat input, induced by the local structural response. MDOF-BES has been designed to provide local velocity change of the test platform up to 20 m/s with a platform capacity of 600lbs. This is a significant increase in performance in the vertical direction over the incumbent CSBES.

Upcoming milestones…

- Final detailed design of the MDOF-BES
- Finite element model development for verification of Elastic-Multi-Axis Fixture concept
- Facility preparation and acceptance of MDOF-BES at Army Research Lab, Aberdeen, Md.
- Development of initial M&S methodology for MDOF-BES with EMAF

Research Challenges and Opportunities:

- Development of methods to simulate the multi-axial (up to six degrees of freedom) accelerative loading to seating system and occupant
- Development of methods needed to replicate the velocity-time profile at the seat input, induced by the local structural response of the vehicle ("local effects")
- Development of testing methodology and equipment that will allow for testing at the highest threat qualification requirements of rates up to 20 m/s (vertical) with robust payload requirements
- Inadequate simulation could lead to failures during live-fire testing or premature failure in theater