Podium Presentations

Session I: Exposure I

Chairs: Suhbash Rakheja and Logan Mullinix

USING AN AIR BLADDER SEAT SHOCK ISOLATION SYSTEM TO PROTECT MILITARY VEHICLE OCCUPANTS FROM MINE BLASTS

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Introduction

Landmines are a great threat to military vehicles and their occupants. Mine blasts can completely destroy vehicles and kill all the occupants or disable the vehicle and leave the occupants severely injured. Injuries sustained during a landmine blast come from fragmentation that enters the vehicle through a hull breach, hot gasses expanding through the vehicle, or shock created from the extreme pressure of the blast (Lafrance, L.P. 1998). Mitigating the high acceleration experienced by the occupants during survivable mine blasts is the focus of the research being addressed in this paper.

Method

The objective of the project reported in this paper was to prove the feasibility that pneumatic seat technologies that employ light-weight, foam-filled, inflatable air bladder seats and seat backs can be used to protect the crews of lightweight combat vehicles against the detrimental and injurious effects of mine blasts. This protection includes reducing the shock energy experienced by seated vehicle crews during mine blast initiation and at vehicle slam-down to below potentially injurious levels. Figure 1 shows a schematic representation of the proposed lightweight, foam-filled, inflatable mine blast attenuating seat. It will consist of specially designed interconnected seat and seat back lightweight, foam-filed, air bladders that are supported by a rigid frame.

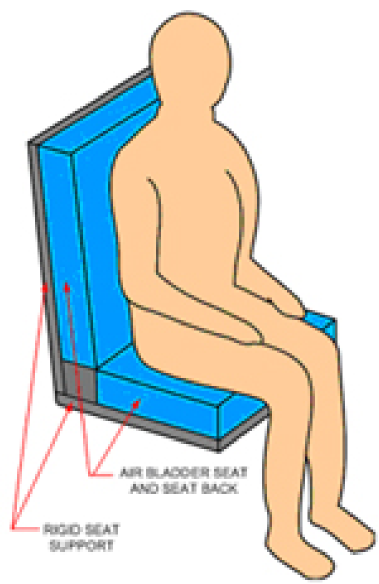

Figure 1 Schematic of Lightweight, Foam-Filled Inflatable Mine Blast Attenuating Seat

Results

Air gun tests and finite element analyses were conducted to determine the effectiveness of a light-weight, foam-filled, inflatable air bladder seat shock isolation system in isolating a vehicle occupant from the injurious effects of a mine blast. Figures 2 through 5 show analytical and experimental results associated with a 65.8 kg mass resting on an inflatable air bladder that is exposed to a shock input.

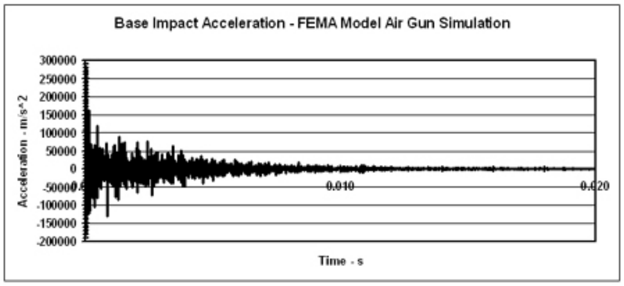

Figure 2 Simulated Air Gun Test Shock Input

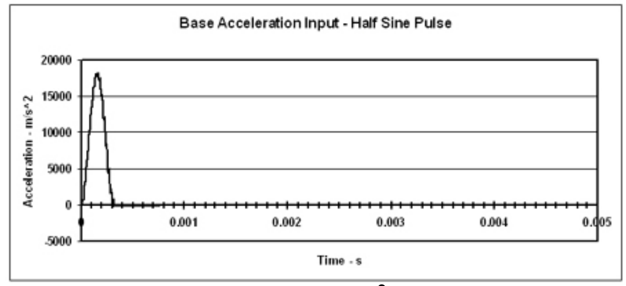

Figure 3 0.32 ms 8,000 m/s^2 Half-Sine Shock Input

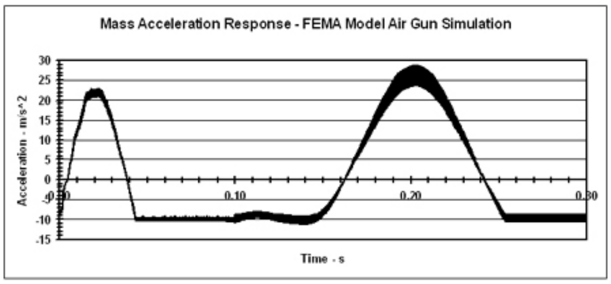

Figure 4 Supported Mass Acceleration – Air Gun Simulation

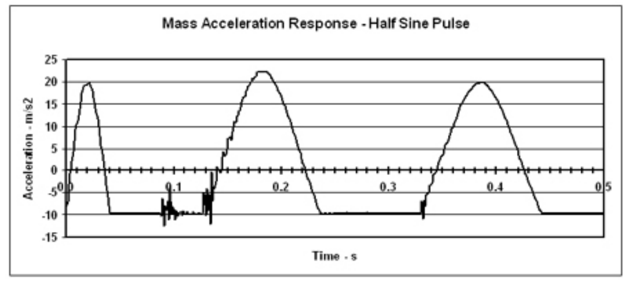

Figure 5 Supported Mass Acceleration – 0.32 ms 18,000 m/s^2 Half-Sine Pulse Input

Discussion

Table 1 shows that seat bladder reduced the peak acceleration response of the 65.8 kg mass relative to the peak shock input acceleration by three orders of magnitude for the air gun test and the half-sine shock pulse simulation.

The seat bladder shock isolation system has the potential when properly and fully developed to significantly reduce the injurious effects of mine blast shock inputs to seated individuals in lightweight combat vehicles.

Table 1 Seat Bladder Shock Attenuation Results

	Support Mass Impact Acceleration	**65.8 kg mass Peak Acceleration**	**65.8 kg Mass Acceleration/Support Mass Acceleration**
	m/s^2	m/s^2	
20 psi Air Gun Tank Pressure	34,000	47	0.001
Simulated Air Gun Test	28,000	25	0.001
0.32 ms Half Sine Pulse Seat Impact	18,000	23	0.001

References

Lafrance, L.P., 1998, "Mine Blast Protection Systems for Military Support." American Society of Mechanical Engineers, vol. 361 pp. 305-309.