Summary Report

Vibration and Pressure Mitigating Cushion

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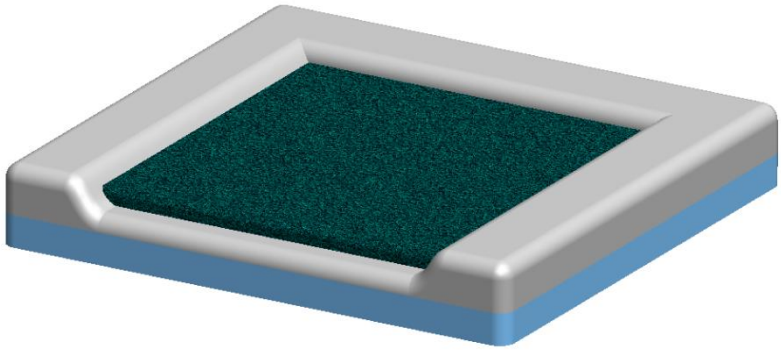
Discomfort and fatigue caused by sitting within ground combat vehicles reduces mission effectiveness and mission endurance in the short term, while the long-term health consequences of vibration exposure can reduce career endurance (the ability to complete a military career without medical disability). As the direct interface between the human and the vehicle, the cushion provides both pressure mitigation and a significant portion of the overall vibration mitigation (which also relies on vehicle design elements, such as the suspension or engine mounts). Cushions must also minimize the transmission of mechanical shock to the occupant when the vehicle is subject to a mine blast condition. Safe, Inc. (Safe) developed a cushion design that addressed these necessary elements of performance; both pressure and vibration mitigation without loss of shock protection. The design provided adjustability of damping characteristics to tailor the vibration response to meet specific goals for vibration transmissivity based on vehicle-specific environments. It used existing materials combined in a unique way to achieve this tailoring at low cost.



In early work, Safe assessed manufacturing methods and constructed cushion samples of varying configurations. Tests using a pressure mapping system revealed the specific characteristics of the design that led to effective pressure mitigation and demonstrated initial feasibility. The minimum effective thicknesses of materials were determined and the effectiveness of the side and rear bolsters was demonstrated. This work led to specification of final designs for several variations of cushions that were subjected to formal tests. Pressure mapping tests showed one configuration that mitigated pressure through lower peak and average pressure over a range of occupants and thigh angles. However, the design approach was generally not successful in providing pressure mitigation concurrently with a wide range of tailorability for vibration control while keeping within the established weight requirement. High-speed drop tests showed that all designs succeeded in minimizing dynamic overshoot related to spinal protection in shock events. Lessons learned on this project were incorporated into a revised design concept, which is recommended for evaluation in the next project phase.

The anticipated Department of Defense (DOD) customer is the U.S. Army for retrofit insertion of the cushion technology into existing ground combat vehicles. Other potential customers include the vehicle Original Equipment Manufacturers (OEM's) for integration into new vehicles and seat manufacturers for inclusion into new seat designs. The transition plan relies on generating enough interest within the DOD to make initial sales there. Generating such interest relies on demonstrating a substantial improvement in the recommended maximum duration for occupational exposure to vehicle vibrations when compared to existing cushions (work that is planned for the Option), while remaining within weight and cost objectives. Benefits to the customer include improvement in mission endurance and less-frequent and less-severe adverse health effects for soldiers caused by exposure to vehicle vibrations.