TEST METHOD DEVELOPMENT FOR THE EVALUATION OF HEAD BORNE EQUIPMENT WITH A BLAST SIMULATOR

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ABSTRACT

Personal protective equipment for military applications must protect against the most prevalent and injurious threats. Historically, military helmets have primarily been designed for protection against ballistic threats. However, as a result of recent conflicts, understanding the interaction of blast overpressure with head borne equipment has become necessary. The US Army has interest in developing the ability to assess the performance of helmets and eyewear against overpressure threats in a relevant, repeatable laboratory environment. This effort pursued the development of an Advanced Blast Simulator (ABS) with a test chamber large enough for evaluation of a head form with helmet. The patented ABS design had demonstrated the ability to produce wave dynamics more closely related to an expanding spherical shock wave versus that of a traditional cylindrical shaped shock tube typically utilized in laboratories (Ritzel, 2011). Computational modeling and free-field blast testing were used to guide the development and evaluation of the simulator. Computational fluid dynamics (CFD) modeling was utilized to identify the minimum cross-sectional area required to test a head form and helmet with a minimal amount of anomalous flow disruption or perturbation from the side walls. These interference mechanisms can cause discrepancies in the pressure profiles of smaller shock tube designs when compared to those recorded in free-field blast exposures. The result of the CFD analysis was the construction of a scaled up ABS, with a 0.91 x 0.91 m test section, capable of achieving 180 kPa (26 psi) peak incident overpressure using a compressed gas driver. Free-field blast testing was conducted to establish the characteristic flow parameters of a free-field exposure for comparison with ABS performance. This paper discusses the salient points of this effort and describes the final design of the apparatus developed.