DESIGN OF A PROPELLANT-DRIVEN MINIATURE SHOCKTUBE FOR WEARABLE BLAST DOSIMETER TESTING

Jeffrey Levine, Clint Hedge, Jean-Philippe Dionne, Aris Makris

Med-Eng Holdings, 2400 St. Laurent Blvd., Ottawa, Ontario, Canada K1G 6C4

Key words: Smokeless propellant, Gunpowder, Shocktube, Blast Dosimeter Testing

With the objective of better characterizing the increasing blast overpressure threat encountered in training and combat operations, wearable blast dosimeters are being considered for large military population segments potentially subjected to explosive blast and firing of crew served weapons. An inexpensive, efficient, and easily available way of testing these pressure sensors housed within these blast dosimeters is necessary to characterize their response and reliability under blast loading. Given their reproducibility, shock tubes may serve an integral role in calibration and testing of wearable blast dosimeters. In the wearable sensors case, the peak pressures to consider are limited to the human injury thresholds (typically P_{max} < 70 psi). Moreover, given the limited size of wearable dosimeters (approximately 10 cm x 5 cm x 1 cm), a small shocktube is preferred, to limit test costs and allow for quick testing times. To address this need, a 3D-printed shocktube was iteratively optimized designed, developed, and optimized. This shocktube is driven by a small propellant i.e., blank gun shell cartridge filled with smokeless gunpowder. A wide range of representative peak pressures, impulses and rates of rise were generated through the selection of different gun shell cartridges. The current study details the design features and performance characteristics of this test apparatus. Tests were conducted to compare the performance of blast dosimeter sensors to reference sensors mounted to the shocktube, in terms of peak pressure and maximum impulse recorded. A limited number of high explosive (C4) tests were also conducted in a larger blast chamber, to compare with the results obtained with the 3D-printed shocktube. In addition, equivalent scaled distance, charge size and standoff distance generated by this miniature shocktube were compared with what is typically achieved using full-scale explosives and larger shocktubes. This new shocktube proved very convenient towards optimizing the development of blast dosimeters (dosimeter geometry, use of physical and digital filters, sampling rate, etc.). Moreover, the concept of the a shocktube has been adapted using the flexible, 3-D printing technology and applied successfully to efficiently evaluate blast dosimeter designs and performance.