OCCUPANT RESPONSE IN OBLIQUE AIRCRAFT SEAT ENVIRONMENT

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ABSTRACT

To enhance occupant comfort, in first and business class, while maximizing seating density, the airline industry has begun to design and install new and novel seating systems at angles that are oblique with respect to the aircraft centerline. Epidemiology-based field injury data do not exist for airplane crashes, however, typical impact scenarios have been determined and safety standards addressing fore, aft, and side-facing seats have been levied by the FAA. The potential for injury and their mechanism in this seating environment is unknown, however testing at the Federal Aviation Administration's Civil Aerospace Medical Institute indicate that the risks could be a worst case combination of fore and side facing impacts. The impact scenarios defined in the standards can be used to study likely injuries and injury mechanisms using Post Mortem Human Surrogates (PMHS) and an FAA Hybrid III Anthropomorphic Test Device (ATD) in a controlled laboratory environment using a matched pair test scheme. Occupants were seated upright with Frankfurt plane horizontal in a custom designed seat configured to simulate potential aircraft environments and restraint geometries. A scaled (100% and 60% deltaV) Part 25.562 Emergency Landing condition for horizontal impact was used as the dynamic test input. Pre and posttest x-rays and CT's were obtained and autopsies were conducted. Occupants were instrumented to measure triaxial linear accelerations and triaxial angular velocities at the head, T1, T6, T12, and sacrum. Retroreflective targets were placed at these anatomic locations to measure the 3-d kinematics using a motion capture system. Injuries to the PMHS for the 100% tests were severe in the spine and varied by level depending on condition; rib fractures were observed as well as injuries to the pelvis. No injuries were seen in the 60% pulse tests. Sacrum accelerations showed general agreement between PMHS and ATD in both phase and amplitude. PMHS accelerations tended to lag the ATD moving from superior to inferior due to the decoupled nature of the human head and torso. Under the matched pair test scheme, the ATD lumbar spine loads at the 60% pulse suggest a preliminary injury tension threshold of 5.2 kN. Although the study is of a limited sample size, it suggests the need for further testing to develop standards that provide a similar level of safety for occupants in obliquely mounted seats as in forward/aft facing seats in aircraft.