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Authors:

Rick DeWeese
Civil Aerospace Medical Institute
Federal Aviation Administration
PO Box 25082
Oklahoma City, OK 73125-0082
Phone 405-954-7529
FAX 405-954-4984
rick.deweese@faa.gov

David Moorcroft
Civil Aerospace Medical Institute
Federal Aviation Administration
PO Box 25082
Oklahoma City, OK 73125-0082
Phone 405-954-5513
FAX 405-954-4984
david.moorcroft@faa.gov

M. M. G. M. Philippens,
TNO Safety
Schoemakerstraat 97
PO Box 6033
2600 JA Delft
The Netherlands
Phone +31 152696950
mat.philippens@tno.nl

Title:

Assessment of Head and Neck Injury Potential for Occupants of Typical Aircraft Seats and Interior Configurations During Forward Impacts

Abstract:

The risk to induce head-neck injuries was evaluated for certain aircraft seat and interior configurations in simulated forward impact loading. Two loading scenarios for the head-neck system were investigated: inertial (non-contact) loading in posterior-anterior and lateral direction using respectively a forward facing and side facing (couch) seating configuration, and contact loading through impacts of the head with typical aircraft interior components. The forward impact loading was simulated by sled tests conducted at the FAA Civil Aerospace Medical Institute (CAMI) using a FAA Hybrid III for frontal and an ES-2 ATD for side, seated in a rigid seat fixture. The ATDs utilized a unique 9-accelerometer array (NAP) bracket developed by TNO. Techniques were developed to derive rotational acceleration and velocity from the NAP. Head rotational

velocities were cross-validated using photometric techniques. Both ATDs were also equipped with upper and lower 6-axis neck load cells. The non-contact restraint configurations investigated were a forward facing passenger seat with a lap belt restraint, a forward facing pilot seat with a 4-point restraint, and a side facing passenger seat with a 3-point restraint. The contact load configurations utilized a forward facing passenger seat with a lap belt restraint and passenger seat backs, and simulated class dividers as impact surfaces. The neck injury potential was evaluated by the FMVSS 208 N_{ij} criterion, using the neck loads at occipital condyle level. The NAP data were used to evaluate head injury potential with Head Injury Criteria (HIC) limited and unlimited, Skull Fracture Correlate (SFC), and multiple brain injury parameters calculated using the finite element program SIMON (published by NHTSA). The injury risks associated with each seat and interior configuration was identified. The injury risks predicted by the evaluated injury criteria were compared to the risks predicted by the HIC currently used to certify aircraft interior components.