Development of a Methodology for Substantiation of Replaced Seat Cushions, Phase I

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

Amanda Taylor
Civil Aerospace Medical Institute
Federal Aviation Administration
PO Box 25082
Oklahoma City, OK 73125-0082
Phone 405-954-0248
FAX 405-954-4984
amanda.m.taylor@faa.gov

Seat cushion stiffness can significantly affect the loads transmitted to aircraft occupants during vertical impacts. For seats meeting the dynamic requirements of § 2x.562, a combined horizontal/vertical test is conducted to evaluate the magnitude of force transmitted to the occupant's lumbar spine. The seat cushion is evaluated as part of the overall seat system during this test. Since seat cushions are subject to wear and tear, they are replaced periodically. Sometimes, the original cushion is unavailable due to manufacturing process changes affecting the materials, or data is unavailable to construct a cushion identical to the original one. In these cases, material substitution is necessary, and the affect that this new cushion design has on the force transmitted to the spine must be evaluated in some manner. Conducting full scale tests of the entire seat system just to qualify a new cushion is a very costly approach. Also, the data scatter between full scale tests can be significant, potentially masking the true difference in cushion response. To address this problem, the FAA has previously developed and approved a replacement method for cushions made from a single foam density. However, most aircraft seat cushions have multiple layers with different properties. Therefore, to ensure that replaced cushions provide the necessary level of safety, the FAA has conducted research with the goal of providing a replacement method potentially applicable to both single and multi-layer seat cushions for large and small aircraft.

The method developed compares the vertical response of the original cushion and the proposed replacement cushion by means of a full scale sled test using a rigid seat configured to support the cushion in a similar fashion to a real seat. This method is based on the hypothesis that if a cushion produces the same or lower lumbar load as the original design when both are tested in a rigid seat then it should also produce the same or lower lumbar load when tested in a real seat. Before the FAA can accept this methodology, it must be shown that the rigid seat and real seat trends correspond. This report outlines the results of the first phase of the project which included development of the rigid seat test method and evaluation of the effect of seat frame compliance on cushion response. The second phase (currently on-going) will evaluate the combined effect of seat pan stiffness and cushion stiffness variation. When completed, this research project should provide the data necessary to determine viability of the proposed method.