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Abstract-1:

Occupant Injury Prediction Methods for Enhanced Passenger Safety for Range of Aircraft Seat Installation Layouts

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Abstract:

Certification of passenger seats for installation on Boeing commercial airplanes requires compliance to 14 CFR 25.562, which includes successful dynamic testing to show that both structural and occupant injury criteria are met. Proven advanced analytical methods are used at Boeing throughout the aircraft development, design and certification process to ensure all regulatory requirements are met, and to promote passenger safety. While seat structural integrity and occupant safety have been historically assured through physical certification testing, the same level of passenger safety might be achieved using analytical methods, due to recent advancements of modern computer modeling and simulation technology. Advisory Circular (AC) 20-146 provides the requirements and applicability of using dynamic simulation towards seat Certification by Analysis (CBA).

Dynamic simulations serve to verify structural integrity and passenger safety, as well as to improve design quality, predictability of dynamic responses, and to facilitate certification through smarter testing. Successful aircraft seat row-to-row Head Injury (HIC) and Neck Injury (Nij) compliance has in some cases taken many physical test iterations, which is time intensive, inefficient, and subject to testing variability. Both developmental and certification tests need to be repeated to account for a range of installation seat pitches, 5th, 50th and 95th percentile dummies, several required impact zones, and range of yaw angles to meet the regulatory requirements.

Use of simulation aids in understanding the occupant injury parameters, and in understanding testing variability. Use of testing devices such as the Free Motion Headform (FMH) and Pendulum provides greater degree of control in effectively predicting response of seat design for enhanced safety of passenger. Metrics-driven building block component testing and simulated row-to-row injury predictions for HIC and flailing can help with early design concept development. Simulations aid in evaluating energy absorption devices and breakaway mechanisms, and can reduce the number of testing iterations needed for design and certification.

The objective of this paper is to present potential processes and methods for injury prediction, such as use of Free Motion Headform (FMH), and which could aid in certifying the seat installation by evaluating the desired performance of the seat design. The proposed focus would be on simulation and component testing to design seats and installations that yield the required final performance outcome (HIC<1000 and Nij <1.0).