

# ALTERNATIVE DESIGNS OF AIRCRAFT CRASHWORTHY SEAT LEGS

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## ABSTRACT

The Federal Aviation Administration (FAA) is proposing redefined new dynamic seat test conditions for small commuter aircrafts due to their limited crushable sizes. FAA has issued a raise notice of proposed rule making ("NPRM") which would the impulse for vertical test from 15 G's to 32 G's for PART 23 commuter aircraft. No single seat design has yet able to meet this test condition with an accepted lumbar load value which was defined by FAA (maximum 1500 lbf). The variables to improve the safety of the seat are the seat pan cushion, the seat pan structure, and the seat legs which allow some amount of deformations during the impact. This thesis aims to reduce the lumbar load provided the seat with two types of energy-absorbing seat legs based on FAR test 1 condition (with 32 G's deceleration impulse). Computer models were generated to optimize the performance of the seat legs concerning the lumbar load injury of the anthropomorphic test dummy (ATD) due to the repeatability and flexibility. The non-linear finite element code, MARC, was used to study the static loading of the seat legs. The entire seat system was modeled with the code MADYMO (MATHematical DYNAMIC MOdel), to study the behavior of the seat leg structure and the ATD in the dynamic situation. Tests iterations, based on 50th percentile male ATD were first carried out on various thicknesses of the seat legs until the results of lumbar load were below the human tolerance level of 1500 pounds. In order to study the performance of the seat design for a range of occupant sizes, the seat legs with the accepted test results were then tested on two other extreme sizes of ATDs, 5th percentile female ATD and 95th percentile ATD. Scaling factors have been used to develop the lumbar load injury criteria for different sizes of ATDs. Final results show that lumbar loads less than 1500 pounds are achievable, and that the energy-absorbing seat legs reduce the lumbar load as much as 39% compared to the seat with straight seat legs.