PARAMETERS AFFECTING THE DYNAMIC CHARACTERISTICS OF AIRCRAFT SEAT CUSHIONS

By

Ahsan Faraz Ahmed

Fall 2002

ABSTRACT

The seat dynamic performance standards found in CFR 14, FARs Part 23, 25, and 27 require conduct of two dynamic seat tests and an evaluation of associated pass/fail criteria for aircraft seat certification. One of those tests is a combined vertical/longitudinal impact condition that measures among others the lumbar-column pelvic load in the Hybrid n anthropomorphic test dummy (AID). The maximum measured lumbar-column pelvic compressive load in the AID must not exceed the 1500 pounds pass/fail criterion. The seat cushion on a seat acts as a spring/damper that is located in the primary load path between the seat occupant and the seat structure. The seat cushion is considered a primary component in the seat system. It must be included and certified as part of the seat system during the seat dynamic test program. It has been demonstrated that the seat cushion's physical properties, if improperly chosen, can amplify the lumbar-column pelvic load of the seated occupant during a vertical impact condition. Any replacement of the seat cushion with another with different physical properties is considered a major change of the seat system and it requires recertification of the seat system. The seat manufacturers and the aircraft owners and operators have long sought a procedure that could be used to certify a seat cushion replacement without conduct of a full-scale seat dynamic test. Seat cushions deteriorate in service and need to be replaced. Often the original cushion foam material is no longer available. Suitable designs usually rely on trade-off made between lumbar load attenuation and comfort. There was no accepted procedure previously, short of full-scale seat dynamic tests that could be used to assess these typical scenarios. In this thesis, an effort has been made in developing a procedure for the replacement of seat cushion by conducting a series of static testing as well as the as the full scale dynamic testing. The data collected from these tests could be used for classification as well as replacement of aircraft seat cushions. This data has been collected by first acquiring the seat cushions from different aircraft companies. The classification of these aircraft cushions on the basis of their rate sensitivities is carried out with a series of Static tests called as Rate Sensitive tests. Once they are done, then load deflection tests are carried on the same test set-up. Dynamic Compression Index has been obtained with the help of these tests .Then the same cushion are dynamically tested on the Standard FAA, Test-I Condition by placing the Hybrid II dummy on them on the sled which is at an angle of 60 degrees with the ground. Lumbar load is obtained from these tests with the help

of Load cells placed at the desired points. In order to validate the methodology for replacing the seat cushion by static testing, a seat cushion model has developed in Madymo to validate the dynamic test results. The cushion model is placed under a Hybrid II Dummy. FEM Lap belt and Madymo Contour belts are used to run the simulations. Standard acceleration pulse of 15g is used for the simulations. The set-up of the model is in accordance with FAA Test - I Condition. The methodology for the simulation is to input the data in the cushion model from the actual Static tests to predict the Lumbar Load from the dynamic tests. Once the results from these simulations are obtained, they are plotted against the actual test results to get the variations. The variation between the simulation and the actual tests is minimal which is quite encouraging It will assists us in validating the methodology which could lead to the replacement of the dynamic tests.