CALIBRATION AND EVALUATION OF A HEAD INJURY CRITERIA (HIC) TESTER FOR ALUMINUM SHEET PANELS

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ABSTRACT

Full-scale sled tests, which are currently required as part of an aircraft interior certification, often requires several seat articles to be destroyed in order to develop and engineering solution, and to demonstrate compliance with the Head Injury Criteria (HIC) for a particular design. The inherent variations in the dynamic environment of the sled tests may also result in excessive HIC scatter. The certification of aircraft frequently requires engineers to demonstrate that a head strike into anyone of a several cabin furnishings complies with the HIC requirements specified in Federal Aviation Regulations 14 CFR 23.562 and 14 CFR 25.562. One problem in the certification of 160 airline seats, referred to as the front-row HIC problem, occur for seats located directly behind bulkheads or cabin class dividers. These structures are typically both stiff and strong and therefore produce very high HIC values during head impacts. The airline industry has experienced high costs and significant schedule overruns during the development and certification of 16G seats because of the difficulties encountered in meeting this requirement. In many cases, the airlines have removed one row of seating in order to address this problem, resulting in loss of revenue.

This research will provide an alternate method to develop a component test apparatus that effectively supports the design and certification of aircraft seats to meet the HIC requirements. This device will minimize the need for full-scale tests and reduce the associated time and costs for development and certification of aircraft seats without consuming a seat during each test. The device produces less scatter of the HIC data and is appropriate for identifying critical impact parameters.

In this thesis, the component HIC tester that has been designed and fabricated at the National Institute of Aviation research (NIAR) is calibrated and pressure-velocity calibration charts developed. The pressure-velocity charts enable the component tester to achieve the desires head impact velocity by setting the required actuator pressure. The component tester is also evaluated using aluminum bulkhead for a range of head impact angles. The HIC window and HIC values obtained using aluminum sheet panels are very high and the component tester is evaluated using these panels as they represent the worst-case scenario. Full-scale sled tests are conducted initially to obtain the data for different head impact angles and velocities. Tests are then conducted on the component tester using similar setup configurations of the sled test. The data

from the component tests are analyzed, compared and correlated with full-scale sled test data. The agreement between the component test data and the full-scale sled test data are studied and the component HIC tester is evaluated for both the operating modes. From the test results obtained, it is observed that the component tester gives reasonable correlation with the sled tests for aluminum bulkhead for a range of head impact angles and for slitted continental bulkheads for a particular head impact angle. Based on the test results and observations, recommendations are made for future work to evaluate and enhance the operating performance of the component HIC tester for a wide range of head impact angles and using different types of bulkheads.