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Topic:

Crash Dynamics – Component Testing

Title:

Use of a Head Component Tester to Evaluate the Injury Potential of an Aircraft Head-up Display

Abstract:

Federal Regulation 14CFR25.785 requires that seats and adjacent parts of the airplane be designed so that occupants will not suffer serious injury during an emergency landing as a result of expected inertial forces. FAA guidance material cites several component impact test methods for use in determining whether an item or surface is potentially injurious. While the

guidance material suggests that the test methods are applicable to all types of items, the specific procedures provided focus on evaluating seat back mounted accessories.

When presented with the requirement to assess the injury potential of a new Head-up Display (HUD) combiner unit glass display, the system developer proposed to make that assessment using a Head Component Tester (HCT) that had been developed at the National Institute for Aviation Research (NIAR) of Wichita State University. This proposal was based on an initial evaluation of the HUD design conducted by NIAR using a computer model of the HUD and the HCT which indicated that the glass display would not be classified as an injurious item. To meet the regulatory requirement, a test procedure complying with the intent of the FAA guidance material was developed to test the HUD using the HCT. The specific HCT used consists of an ATD headform on an arm that rotates about a pivot, which approximates the kinematics of a lap belt restrained occupant in a forward impact. This guided arrangement allows precise control of the impact point, vector of impact, and impact velocity. For the HUD test, the tester was positioned so that the arc of head rotation was perpendicular to the glass surface, and the headform center of gravity path intersected the glass display at its center. The impact velocity goal was 34 ft/s as specified in the guidance material. Tests conducted at the FAA Civil Aerospace Medical Institute (CAMI) with the HCT were successful in verifying the test procedure and determining that the HUD combiner glass design evaluated was not an injurious object as defined in Federal Regulations. The rational used in developing this test procedure was documented and may be useful in adapting the general test methods contained in FAA policy to other applications.

Subsequently, the computer model of the HCT impact into the HUD developed at NIAR was validated by The Engineering Institute using the CAMI test data. This validated model can now provide more accurate predictions concerning the injury potential of an item.