Aging Aircraft Structural Integrity Research

In response to public concerns after the Aloha Accident, Congress passed legislation known as the Aviation Safety Research Act of 1988.

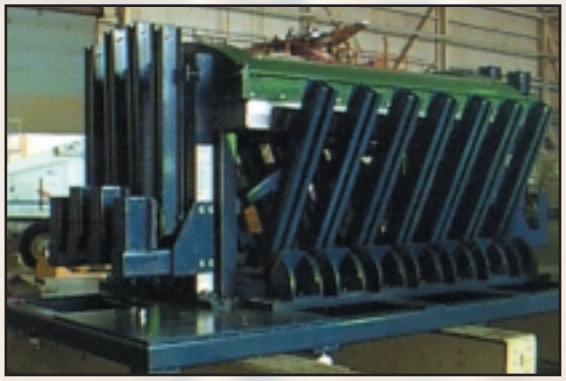
As a result of the Act and concerns relating to the increasing age of the air carrier fleet, the FAA developed the National Aging Aircraft Research Program (NAARP) to ensure the structural integrity of high-time, high-cycle airplanes.

The NAARP structural integrity program area includes three major elements: methodologies to assess the effects of widespread fatigue damage (WFD) to airframe structural integrity, a damage tolerance analysis (DTA)-based supplemental inspection program for commuter airplanes, and DTA-based airframe repair assessment.

Methodologies to Assess the Effects of WFD to Airframe Structural Integrity.
Widespread fatigue damage in a structure is characterized by the simultaneous presence of cracks at multiple structural components where the cracks are of sufficient size and density that the structure will no longer meet its damage tolerance requirement. The WFD evaluation includes crack initiation, crack growth and linkup, and residual strength.

To ensure that the residual strength of an aging aircraft is not degraded below limit levels due to the occurrence of WFD, methodologies to predict the onset of WFD during the operational life of an airplane have been developed. Methodologies identified to be suitable for WFD evaluations are currently being validated by test data from coupon tests, sub scale component tests, full-scale tests, and service experience.

To conduct the full-scale tests, the Full scale Aircraft Structure Test Evaluation and Research (FASTER) facility was established at the FAA William J. Hughes



Technical Center, Atlantic City International Airport, New Jersey. The FASTER test fixture (shown above) has been designed to test full-scale curved, stiffened panels under pressure, biaxial, and shear loading conditions.

Proper characterization of multiple site damage (MSD) is a major factor in the assessment of the residual strength of airframe structures. Comprehensive teardown and inspection of operational airplanes can provide invaluable insights in characterizing MSD under actual in-service conditions. Teardown inspections and the resultant data are essential to ensure the integrity of airframe structures and thus aircraft safety.

A comprehensive teardown and inspection of a Lockheed L-1011 is being initiated as a joint effort between the FAA and industry. Structural sections at locations including fuselage, wings, horizontal stabilizer, and aft pressure bulkhead from a retired L-1011 (shown on the next page) will be removed from the airplane. These sections will be tested and studied in detail to collect data that will be analyzed to study crack initiation, identify small cracks, and evaluate crack growth behavior.

Supplemental Structural Inspections for Commuter Aircraft
Increased utilization, longer operational lives, and the high safety demands imposed on currently operating air carrier airplanes have indicated that there is a need for a program to provide for a high level of structural integrity for all airplanes in the commuter transport fleet.

Safety

Supplemental Inspection Programs (SIP) have been used successfully to provide this level of safety in the large transport segment of the industry.

To extend this concept to commuter category airplanes, the FAA proposed changes to require all airplanes operated under CFR Part 121, all U.S.-registered multiengine airplanes operated under Part 129, and all multiengine airplanes used in scheduled operations conducted under Part 135 to undergo inspections after their 14th year in service to ensure their structural integrity. The proposed rule would also require that damage tolerance (DT)-based SIPs be developed for these airplanes before specific deadlines. This proposal represents a critical step toward compliance with the Aging Aircraft Safety Act of 1991. It ensures the continuing airworthiness of aging airplanes by applying modern DT analysis and inspection techniques to older airplane structures that were certificated before such techniques were available.

Many commuter airplane manufacturers and operators do not have the large engineering staffs, budgets, or fleet sizes to support a program as extensive as the large transport program. To provide the commuter industry with proper guidlines to develop Supplemental Inspection Document (SID)-based DTA methodology, the FAA developed SIDs for two small airplane models, Cessna 402 and Fairchild Metro SA226/SA227. Based in these two SIDs, a generic SID development handbook is being developed. The SID handbook will provide general guidlines to the entire commuter industry to develop SIDs for other aircraft models while the technical reports from the two specific SIDs will serve as step-by-step examples.

Airframe Repair Assessments

A critical issue identified by the aviation industry (civilian and military) is the need to examine the effects of repairs on the structural integrity of aircraft. The use of damage tolerance methodologies in the maintenance and repair practices of aircraft is

required in order to ensure their continued airworthiness and operational safety. The resources needed for damage tolerance designs of repair are lacking for small operators, independent repair facilities, and military repair depots. In an effort to address this need, a task was undertaken under the joint sponsorship of the United States Air Force (USAF) and the FAA to develop a new, user-friendly software tool, Repair Assessment Procedure and Integrated Design (RAPID), capable of static strength and damage tolerance analysis of fuselage skin repairs. Version 2.0 of RAPID, which can analyze repairs on an aircraft fuselage, has been released; future work will focus on commuter category aircraft.

To find out more about the National Aging Aircraft Research Program, contact:

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Safety