NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

August 16, 2004

MATERIALS LABORATORY FACTUAL REPORT Report No. 04-065

A. ACCIDENT

Place	:	Belle Harbor, New York
Date	:	November 12, 2001
Vehicle	:	Airbus A300-600, N14053
NTSB No.	:	DCA02MA001
Investigator	:	Brian Murphy, AS-40

B. COMPONENTS EXAMINED

Vertical stabilizer rear main attachment lugs from subcomponent tests 1 to 3.

C. ACCIDENT SUMMARY

On November 12, 2001, at approximately 0917 EST, American Airlines flight 587, an Airbus A-300-600, N14053, crashed into a neighborhood in Belle Harbor, New York, several minutes after taking off from Kennedy International Airport. The airplane was on a scheduled flight to Santo Domingo, Dominican Republic. All 260 persons aboard the airplane were fatally injured, as were 5 on the ground.

D. DETAILS OF THE EXAMINATION

Using loads derived from recorded flight data from the accident, three vertical stabilizer rear lug specimens were tested to fracture in a loading fixture that applied prescribed forces and moments to the lugs. Details of the test procedures and results are documented in the Structures Factual Report Addendums 6 (REV A), 8C, 15, 16, and 17. For more details of the overall structure and fractography of the vertical stabilizer main attachment lugs from the accident airplane, see Materials Laboratory Factual Reports 02-077 and 02-083.

This report documents the non-destructive inspections (performed both before and after testing), the post-testing fractographic and microstructural examination, and the materials testing of the detail test lugs. These inspections, examinations, and testing were completed by Airbus Industrie using a protocol developed by the Safety Board's materials laboratory staff and initially directly supervised by members of the Bureau d'Enquetes et d'Analyses and/or the Safety Board.

Before testing, each lug was examined for non-visible defects or damage using ultrasonic inspection. Results of these inspections are documented in Appendices A, B, and C. No defects were observed in the first test lug. Some damage was detected in each of the second and third test lugs near the lug attachment hole and in some areas in the lug fitting assembly transition area above the lowermost rib, however these lugs experienced in-service loads outside of the limit load design envelope. Following the tests, the lugs were examined again using ultrasonic inspection. The post-testing ultrasonic inspection showed that the preexisting damage in these lugs grew in size during the testing. Results of these post-testing ultrasonic inspections are documented in Appendices D, E, and F.

After completion of the testing and ultrasonic inspections, an examination of the fracture features and microstructure of each lug was conducted, and a sample from each lug was tested using modulated differential scanning calorimetry (MDSC). Results from testing using (MDSC) indicated that the cure for each test lug was sufficient. Results from the microstructural examination indicated the layup for each test lug was in accordance with the engineering drawings. Details of the examination and testing of each lug are documented in Appendices D, E, and F.

Overall views of the lugs from each test are shown in figures 1 to 4. Similar views of the accident right rear lug also are shown in figures 1 to 4. Unlabeled red arrows indicate where translaminar fractures intersected the inboard or outboard surfaces of the lugs, and an unlabeled large green arrow indicates the force vector for the horizontal and vertical loading components for each lug. The lugs from the first and second tests were left rear lugs, and as such, the orientations are mirror images of the accident right rear lug and the third test lug.

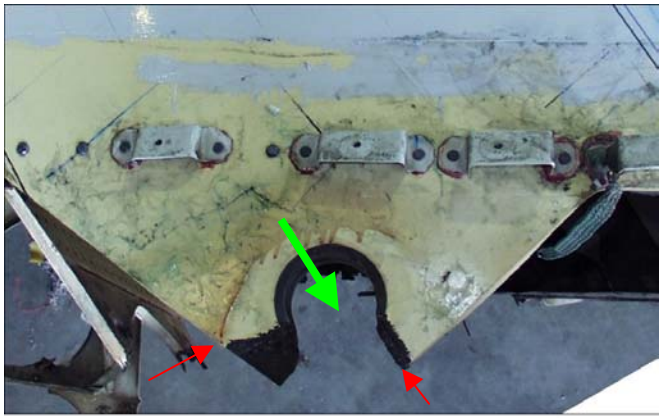
Results from the fractographic examination showed that fractures in the test lugs occurred at locations similar to those on the accident right rear lug. In the first test, loading was interrupted after fracture occurred as shown in figures 1, 3, and 4. The translaminar fracture was located at a position on the forward part of the lug in a plane nearly parallel to the loading direction, similar to one of the translaminar fractures in the accident right rear lug. Also, a delamination was present within the lug having an extent similar to that of the accident right rear lug and in a location through the thickness slightly outboard of that of the accident right rear lug.

Fracture features for lug tests 2 and 3 were similar. The outboard side of each of these lugs had a translaminar fracture on the forward sides of the holes in a plane nearly parallel to the loading direction and another translaminar fracture at the aft side of the hole in a plane approximately perpendicular to the loading direction, fractures similar to that of the accident lug. In addition on the outboard sides, a compression buckling fracture was observed on the forward sides of each lug above the fracture parallel to the loading direction, which is different from features on the accident lug but was attributed to constraints of the loading fixture.

On the inboard sides of lugs 2 and 3, fracture locations were as shown in figure 2, planes different from that of the outboard side of the lug. This change in fracture planes was similar to that of the accident right rear lug.

Delaminations were detected by ultrasonic inspection above the translaminar fractures in lugs 2 and 3, as are visible at the forward surfaces in figure 4. The locations of the delaminations through the thickness were similar to that of the accident right rear lug, but the extents of the delaminations in the test lugs were slightly less.

Matthew R. Fox
Senior Materials Engineer



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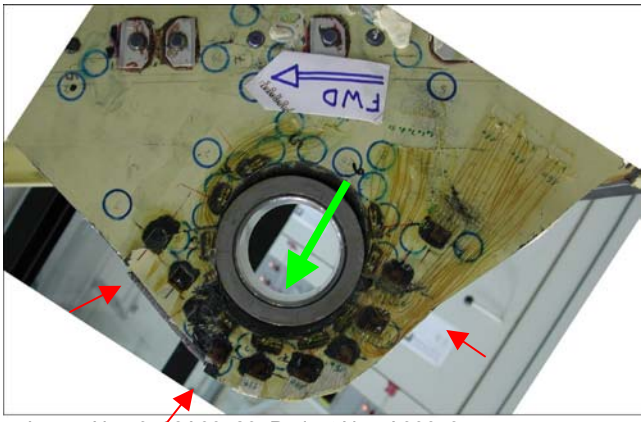

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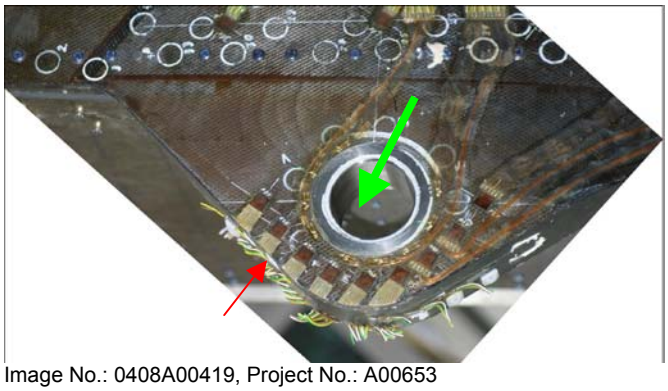

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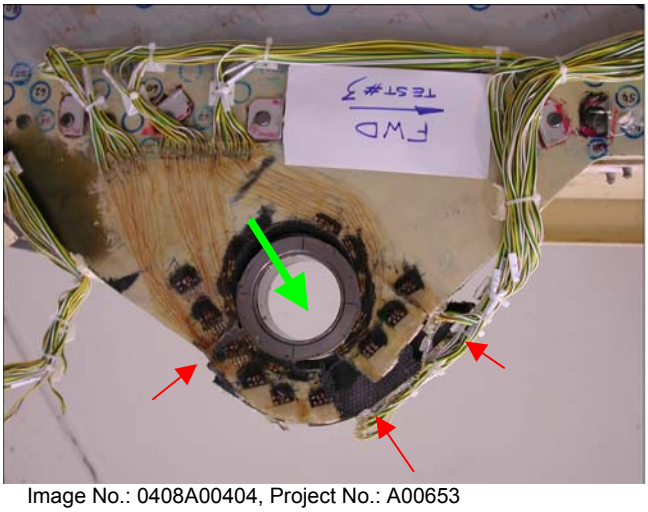

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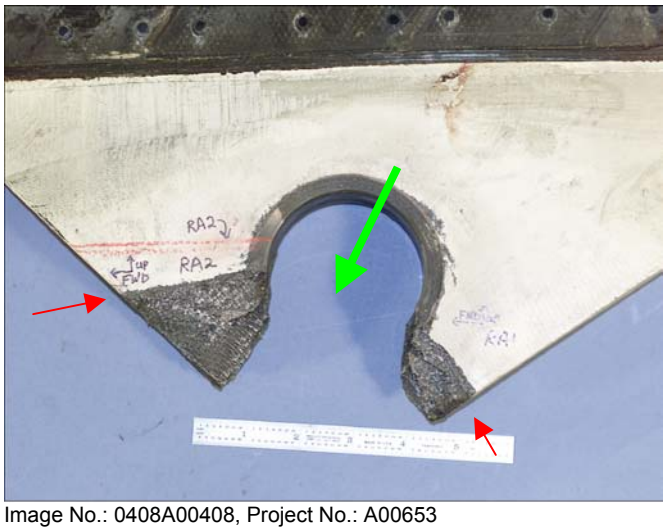
Figure 1. Overall view of the outboard sides of the accident right rear lug and the rear lugs from the three detail tests. Unlabeled red arrows indicate where translaminar fractures intersected the outboard lug surfaces, and unlabeled large green arrows indicate the approximate resultant force vector for the vertical and horizontal force components for each lug.



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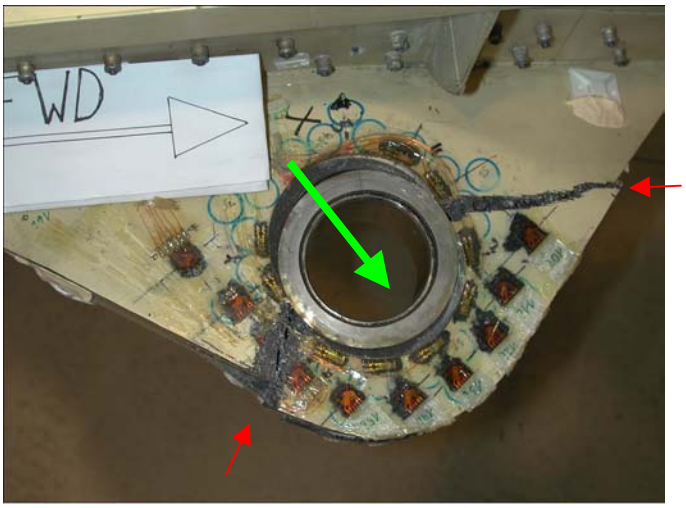

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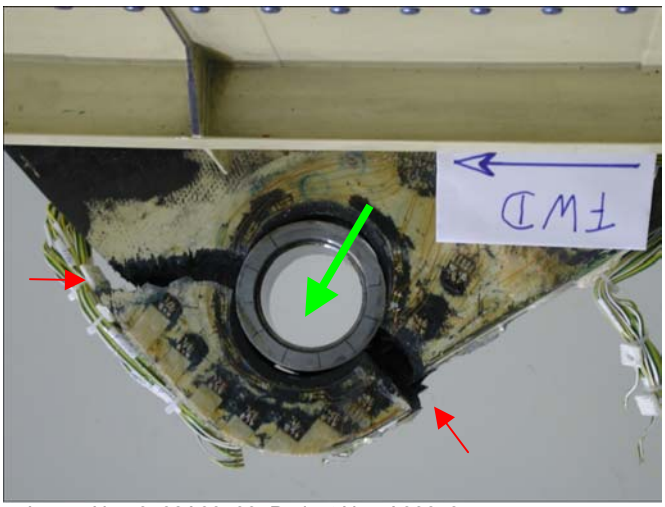

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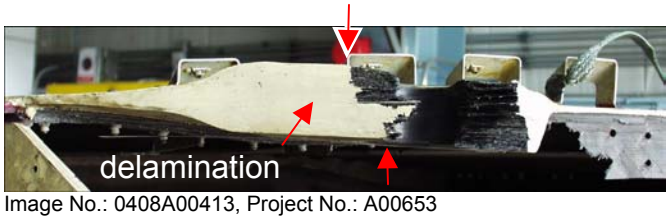
Figure 2. Overall views of the inboard sides of the accident right rear lug and the rear lugs from the second and third detail tests. Unlabeled red arrows indicate locations where translaminar fractures intersected the inboard surfaces, and unlabeled large green arrows indicate the approximate resultant force vector for the vertical and horizontal force components for each lug. No translaminar fractures intersected the inboard surface of the lug for the first detail test, not shown in this figure.



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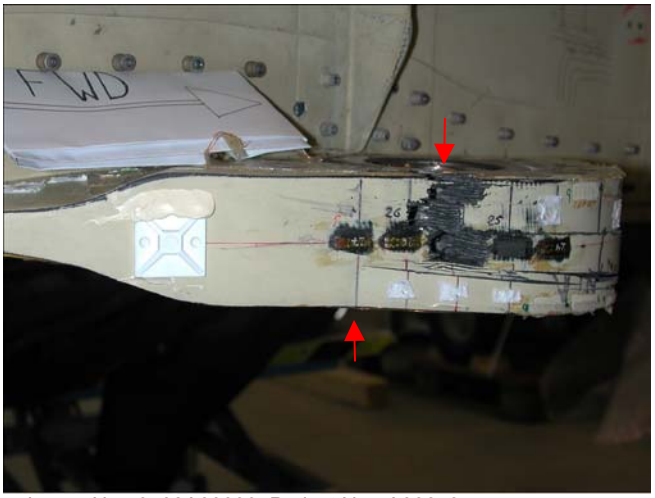

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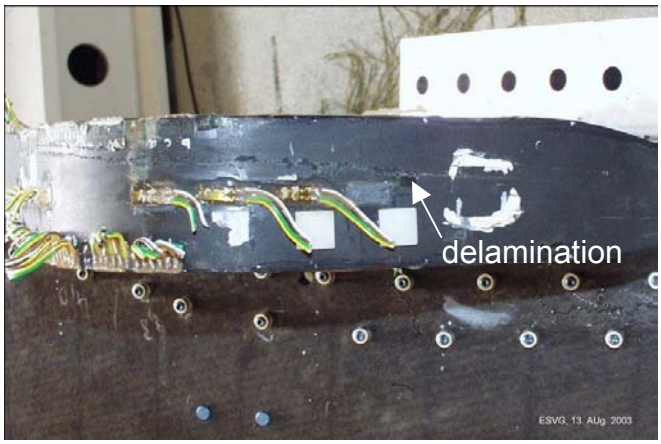

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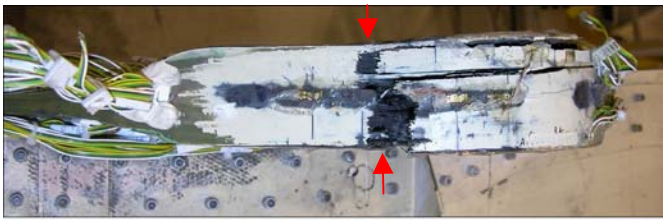
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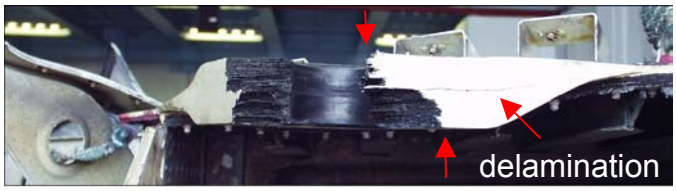
Figure 3. Views looking upward and forward of the accident right rear lug and the rear lugs from the three detail tests. Unlabeled arrows indicate locations where translaminar fractures intersected the inboard and outboard surfaces at the aft side of the lugs. For the first test rear lug, no translaminar fractures intersected the aft side of the lug. Also, delaminations above the translaminar fractures are indicated.



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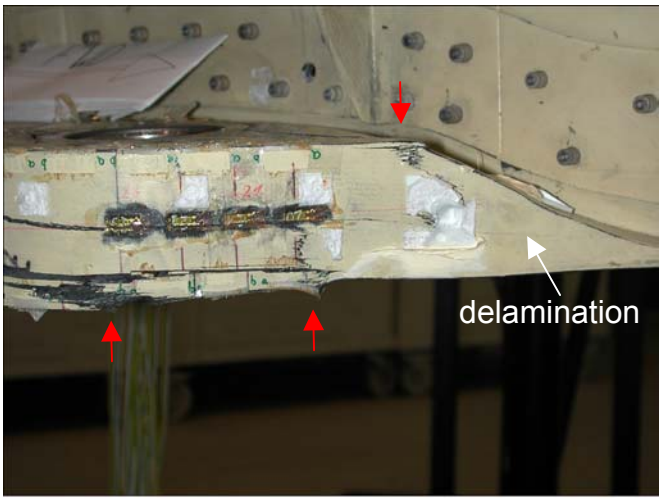

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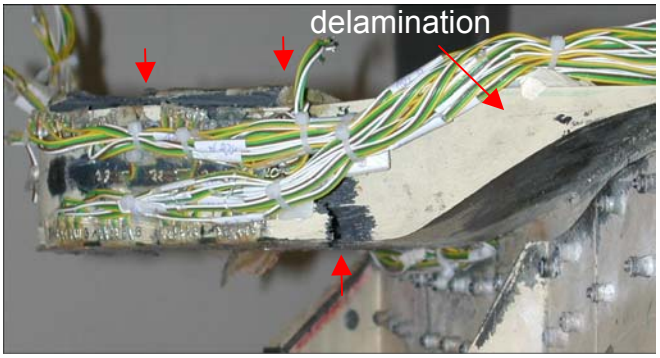

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Figure 4. Views looking upward and aft of the accident right rear lug and the rear lugs from the three detail tests. Unlabeled arrows indicate locations where translaminar fractures intersected the inboard and outboard surfaces of the lugs. Also, delaminations above the translaminar fractures are indicated.