

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594



June 14, 2013

MATERIALS LABORATORY FACTUAL REPORT

Report No. 13-053

A. ACCIDENT

Place : Scio, Oregon
Date : November 26, 2012
Vehicle : McDaniel RV-6, N424D
NTSB No. : WPR13FA056
Investigator : Van McKenny

B. COMPONENTS EXAMINED

Wing structure.

C. DETAILS OF THE EXAMINATION

Figure 1 shows a photograph of the as-received wing structure. The right wing separated approximately 1 foot from the centerline of the center section. The left wing remained attached to the center section. The wing structure shown in figure 1 was disassembled in the field (on-site) from the fuselage to facilitate shipping, handling, and examination. The wing contains a forward and aft spar. The forward spar at the fracture location contained a total of 4 reinforcement pieces for the web; 9 reinforcement strips for the upper spar cap; and 9 reinforcement strips for the lower spar cap, as shown in figure 2. Examination of the forward spar revealed the fracture faces of the lower spar cap at the inboard side contained less mechanical damage¹ compared to those on the upper spar cap pieces.

The aft spar contained an attachment plate with two holes (about $\frac{3}{4}$ -inch diameter, each) as shown in figure 3. When intact, the attachment plate extends between the aft spar for the center section and the aft spar for the right wing. The attachment plate is to be attached by rivets to the upper and lower brackets of the aft spar for the right wing. The inboard end of the plate is to be attached by two bolts and corresponding nuts to the aft spar of the center section. Examination of the attachment plate revealed the attachment rivets between the center section and right wing fractured at the shank portions in the areas indicated by unmarked arrows in figure 3. The fracture faces of the rivets exhibited metal flow consistent with ductile separation in shear mode. The outboard end of the attachment plate was deformed up and aft relative to the aft spar of the center section. The upper and lower brackets remained attached to the aft spar of the right wing.

¹ Mechanical damage that resulted from relative movement between mating fractures.

Visual and portable binocular microscope examination of the fracture faces on the forward and aft spar sections of the wing structure and those on the center section showed gray-granular rough features on a slant plane consistent with overstress separation with no evidence of fatigue cracking.

The forward spar cap pieces and web portions are to be made from aluminum alloy grade 2024 in the –T3 condition. A metallurgical section was made on the first strip portion of the lower spar cap on the right wing and another section was made on the first forward web portion of the same wing in the area near the fracture locations. The metallurgical sections were polished and etched with Keller's reagent. Examination of the etched sections revealed the external surfaces of the web displayed a light layer consistent with clad material. The strip portion of the lower cap piece showed no evidence of clad material (light layer) on the external surfaces. According to Specification MIL-H-6088, Heat Treatment of Aluminum Alloys, the typical minimum hardness for aluminum alloy 2024 in the –T3 condition is to be 57 HRB for sheet thickness 0.062 inch and under; and 50 HRB for sheet thickness 0.063 inch and over. The thickness of each web piece on the forward spar measured between 0.0385 inch and 0.0391 inch. The upper spar cap was constructed with nine 0.125 inch x 1.50 inch reinforcement strips. Similarly, the lower spar cap was constructed with nine 0.125 inch x 1.50 inch reinforcement strips. The thickness of each reinforcement strip measured between 0.1254 inch and 0.1273 inch. The width of the reinforcement strips measured approximately 1.50 inches. Microhardness testing of the sections produced hardness values in the range between 70 HRB (125 DPH) and 76 HRB (138 DPH), consistent with hardness values for aluminum alloy 2024 in the –T3 condition.²

Frank Zakar
Senior Metallurgist

² Hardness conversion per ASM Handbook, Desk Edition, Second Edition

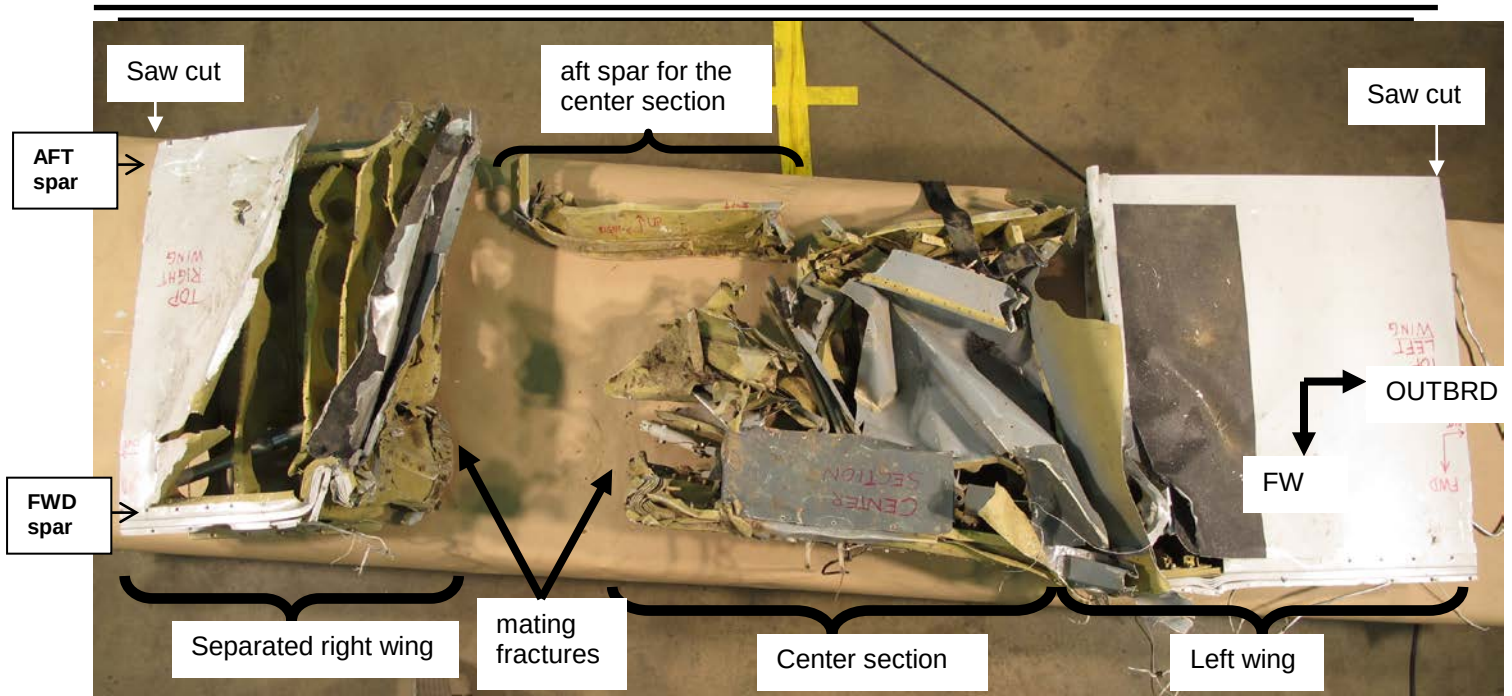


Figure 1. Photograph of the as-received wing structure pieces showing the top surfaces. The right wing separated from the center section. The left wing remained attached to the center section.

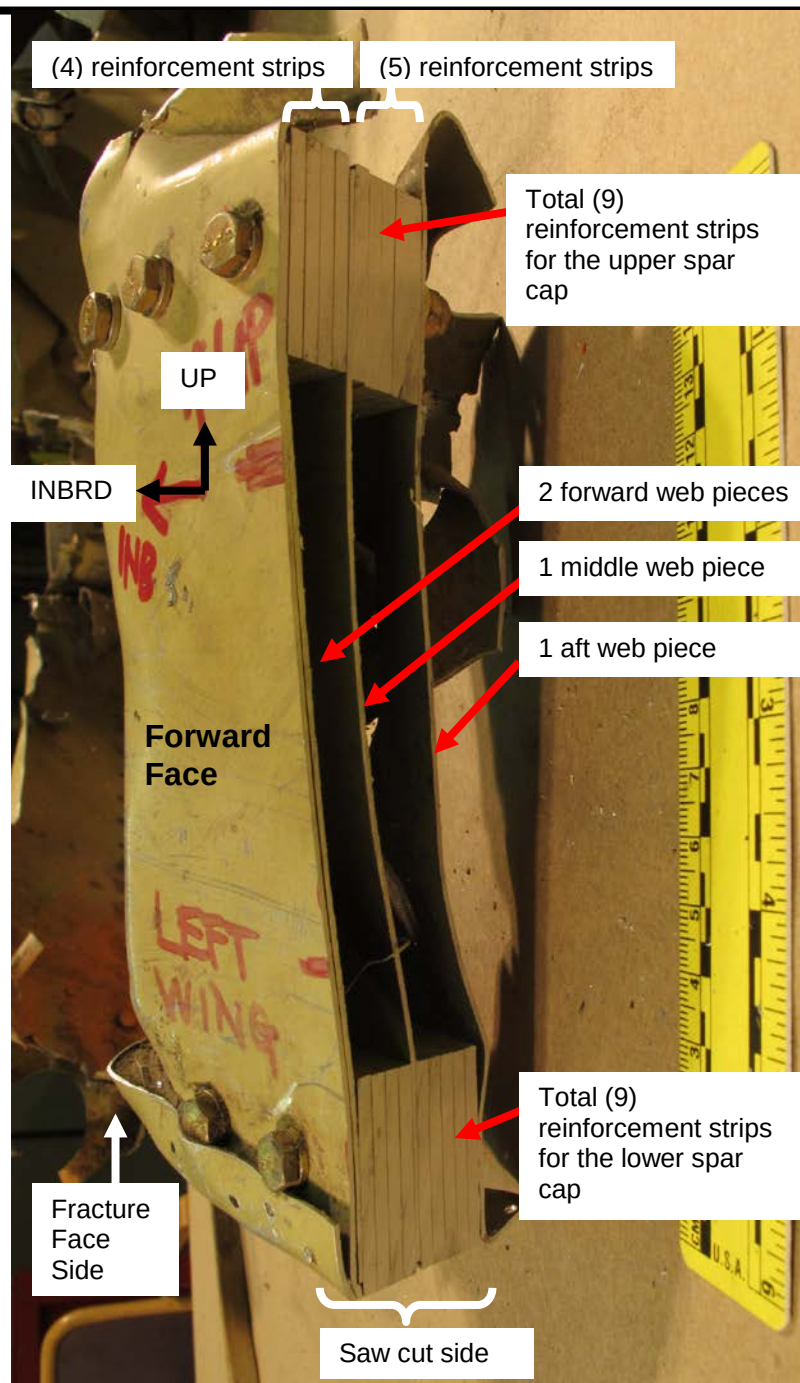


Figure 2. Oblique view of a portion of the forward spar for the left wing. The saw cut was made to show the cross section of the forward spar and to facilitate examination of the fracture faces.

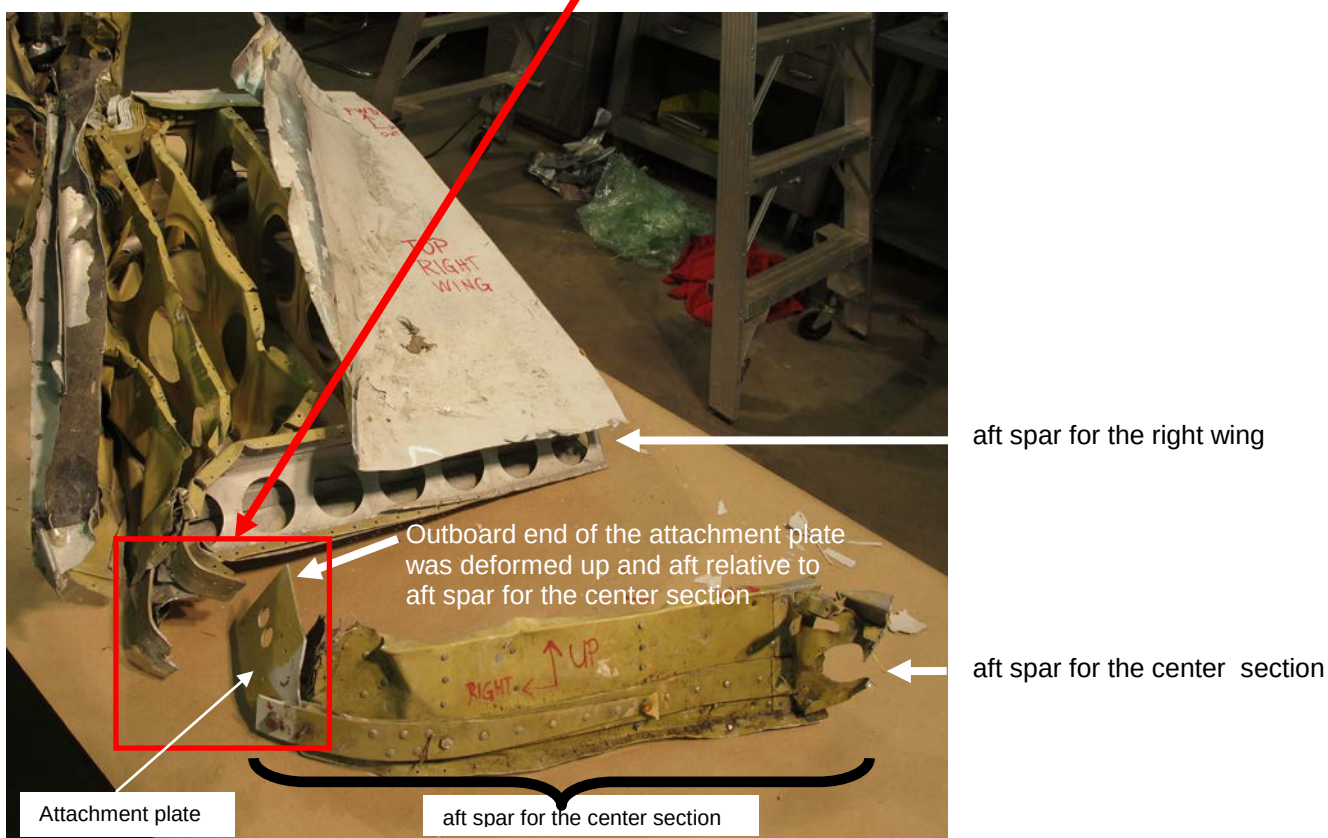
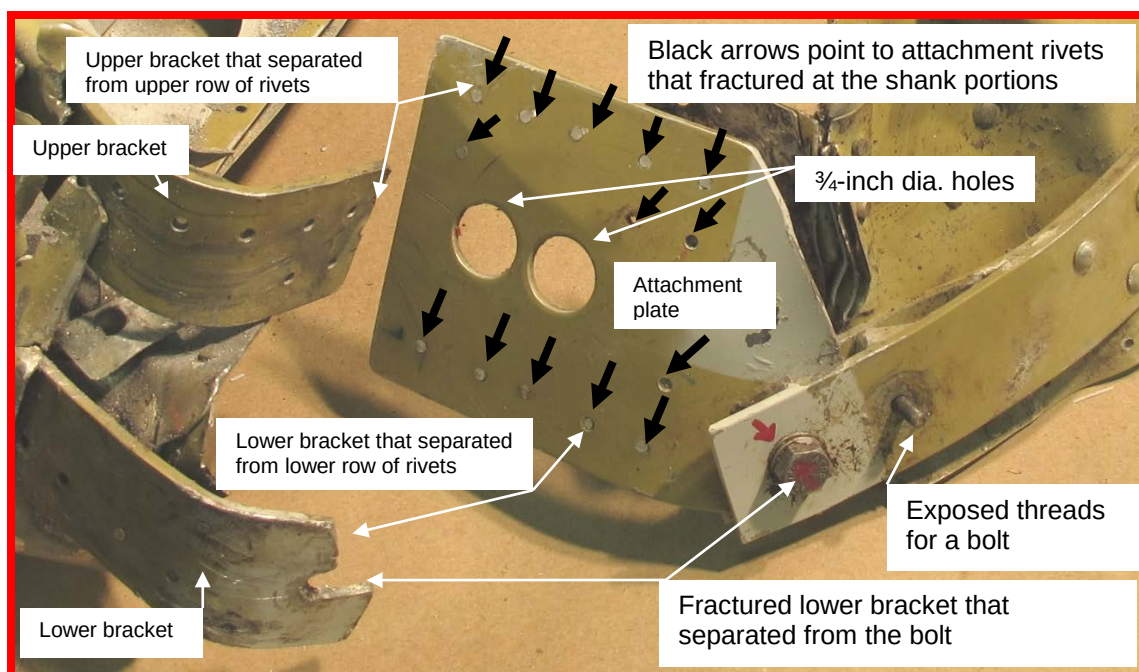


Figure 3. Overall view of the forward face of the aft spar for the center section relative the aft spar for the right wing (bottom of page) and higher magnification photograph of the attachment plate (top of page).