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

July 26, 2013

MATERIALS LABORATORY FACTUAL REPORT Report No. 13-044

A. ACCIDENT INFORMATION

Place : Surprise, Arizona
Date : December 10, 2011
Vehicle : Vans RV-7A, N724WD
NTSB No. : WPR12FA059
Investigator : Michael Huhn, AS-WPR

B. COMPONENTS EXAMINED

Left and Right Wing Rear Spar Fuselage Attachment Points

C. DETAILS OF THE EXAMINATION

An overall view of the as-received wing components is displayed in figure 1. The components consisted of the inboard ends of the rear spars (W-707 assembly) from both the left and right wings and the respective mating areas of the fuselage structure (F-705 bulkhead). The right wing pieces were separated and the bolt had been removed, as shown in the upper view of figure 2. The left wing components were received still assembled, as shown in the lower view of figure 2. The wing rear spar to fuselage connections were made up of a fork (W-707G) and doubler (W-707D) on the rear spar bolted between a center section bar (F-705B) and a bar doubler (F-605C). A Van's Aircraft representative indicated that the wing pieces were 2024-T3 aluminum sheet and the fuselage pieces were 2024-T4 aluminum.

As shown in the upper view of figure 2 and in figure 3, the right wing rear spar components were fractured. Inspections showed horizontal fractures between the bolt hole and the inboard component edges and vertical fractures between the bolt hole and the lower edges of the doubler and fork. Microscopic examinations of the fracture surfaces uncovered features consistent with overstress shearing at the horizontal fractures and tensile overstress at the vertical fractures. With the vertical fractures placed together, as in figure 4, significant deformation and inboard elongation of the bolt hole was apparent prior to separation of the fork and doubler. No indications of preexisting cracking or corrosion were noted at the separation locations.

Measurements indicated that the holes were about 0.33 inch in diameter or approximately 5/16 inch (0.3125 inch) as specified in the assembly instructions. Based on measurements of the most outboard portion of the remaining hole, the center of the initial hole was estimated to be located approximately 0.61 inch from the original edge of the spar pieces (edge margin). The assembly instructions specify a minimum of 5/8 inch (0.625

inch) edge margin. The mating holes in the fuselage pieces also measured 5/16 inch but did not display noticeable elongation or deformation. X-ray fluorescence analysis of the fork and doubler found the material to be consistent with 2024 aluminum alloy. Averaged hardness and electrical conductivity measurements, shown in table below, were more consistent with a T4 temper condition than the specified T3.

	Right Wing		**2024 T3**	**2024 T4**
	Fork	Doubler	Typical per	Typical per
Material	2024	2024	MIL-H-6088G[1]	MIL-H-6088G
Hardness HRB	67.7 avg	61.2 avg	69 min	63 min
Conductivity % IACS[2]	33.9-34.0	34.9-35.5	27.5-32.5	27.5-34.0
			64 Ksi tensile[3]	62 Ksi tensile[4]

The left wing rear spar connection to the fuselage was intact as shown in the lower view of figure 2. Removing the bolt and separating the joint revealed some mechanical damage to the faying surfaces of the wing pieces as shown in figure 5. The damage was consistent with relative movement between the faying surfaces of the wing and fuselage while the joint was clamped.

The bolt holes in the wing pieces were also elongated and the inboard edges were bulged and deformed slightly as indicated by yellow brackets in figure 5. As shown in figure 6 the bulging measured about 0.02 inch above the normally straight edge of the wing piece. The bolt hole measured approximately 0.33 inch (~5/15 inch) in diameter and was elongated about 0.03 inch in the inboard direction. The bolt holes in the mating fuselage components were round and undeformed.

The left wing rear spar pieces had measured electrical conductivities between 33.3 and 33.7 % IACS and chemistries consistent with 2024 aluminum alloy.

The wing bolts are displayed in figure 7. Neither bolt was significantly damaged but showed marks in the grip regions consistent with contact by the respective wing pieces.

Joe Epperson
Senior Metallurgist

[1] Military Specification; Heat Treatment of Aluminum Alloys, 1 April 1991
[2] Percent International Annealed Copper Standard
[3] Federal Specification QQ-A-250/4E Aluminum Alloy 2024,Plante and Sheet, January 18, 1971
[4] Federal Specification QQ-A-250/4E Aluminum Alloy 2024,Plante and Sheet, January 18, 1971

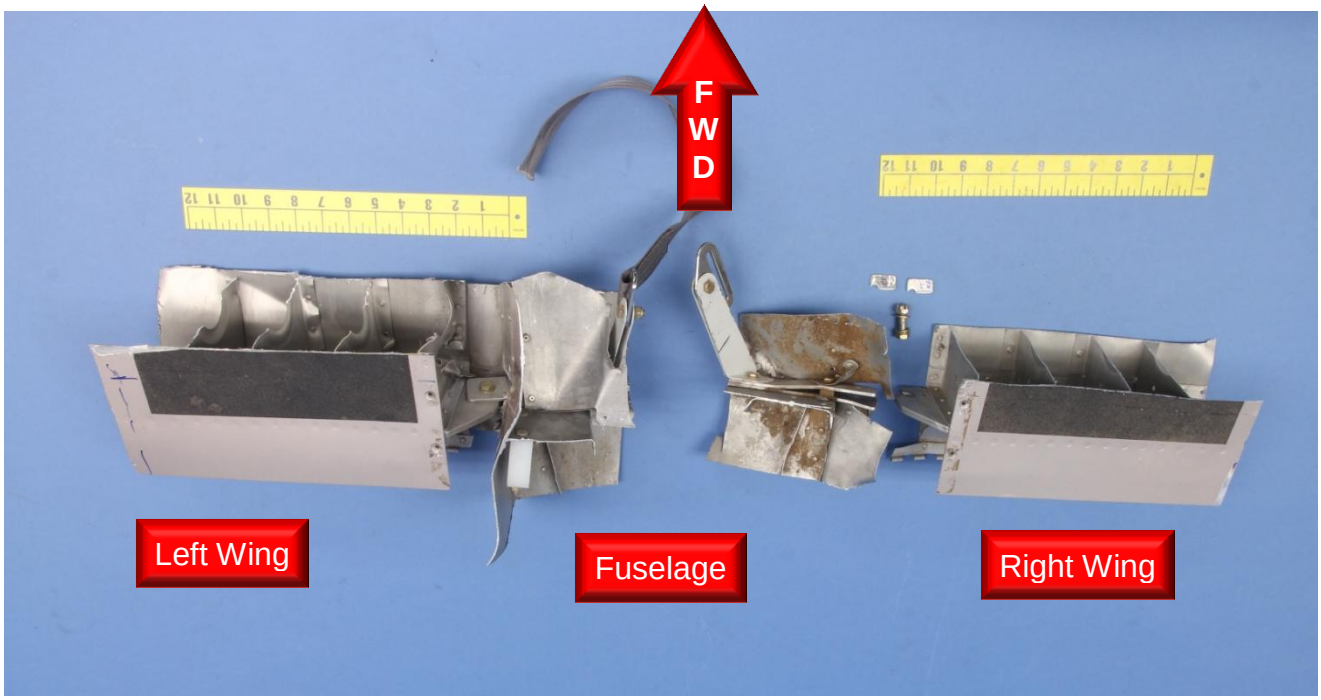

Figure 1. An overall top view of the as-received wing and fuselage components.

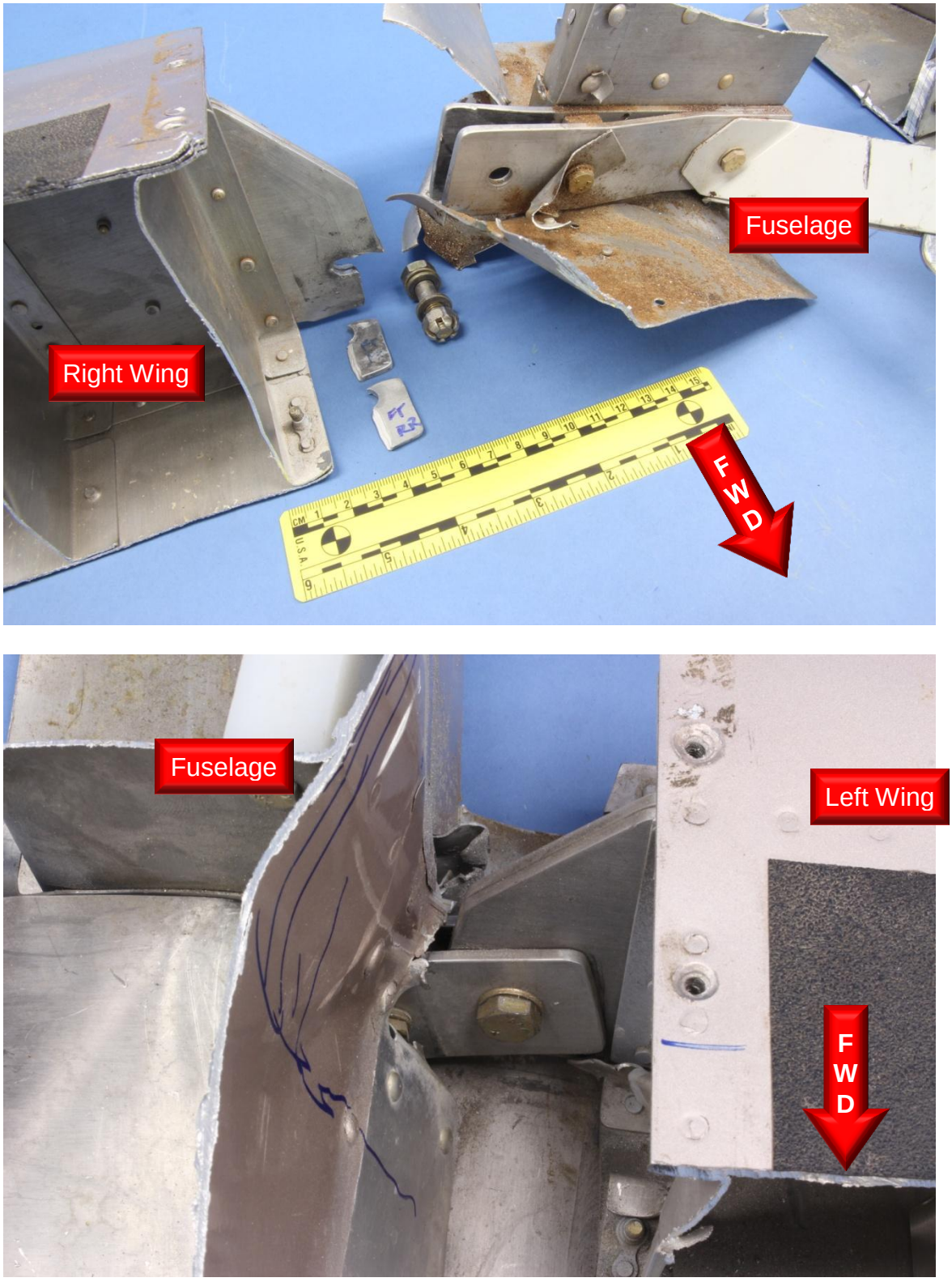

Figure 2. Closer views of the rear spar to fuselage connection as they were received. Right wing at top. Left wing below.

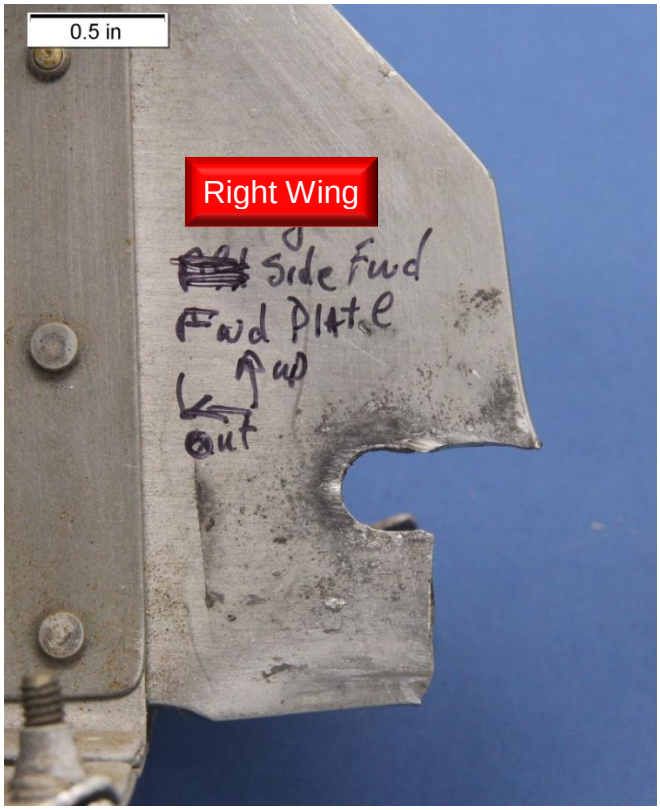

Figure 3. Views of the forward and aft sides of the right wing and fuselage pieces showing the fracturing and hole deformation of the wing side components.

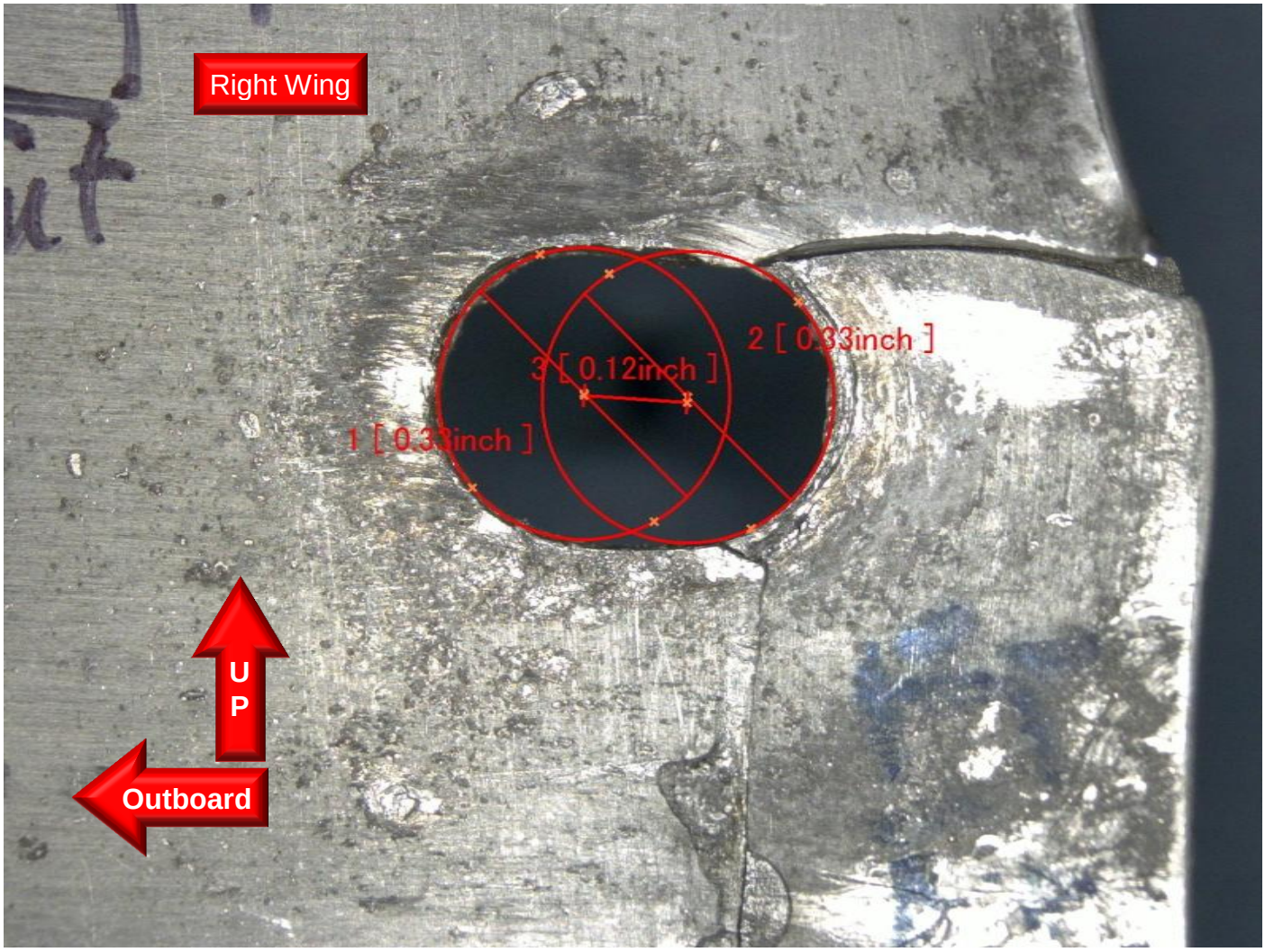

Figure 4. Closer view of the right wing fork attachment hole with the separated piece in its original position showing the inboard elongation of the hole.

Figure 5. Views of the forward and aft sides of the left wing and fuselage pieces showing the hole deformation and damage of the wing side components.

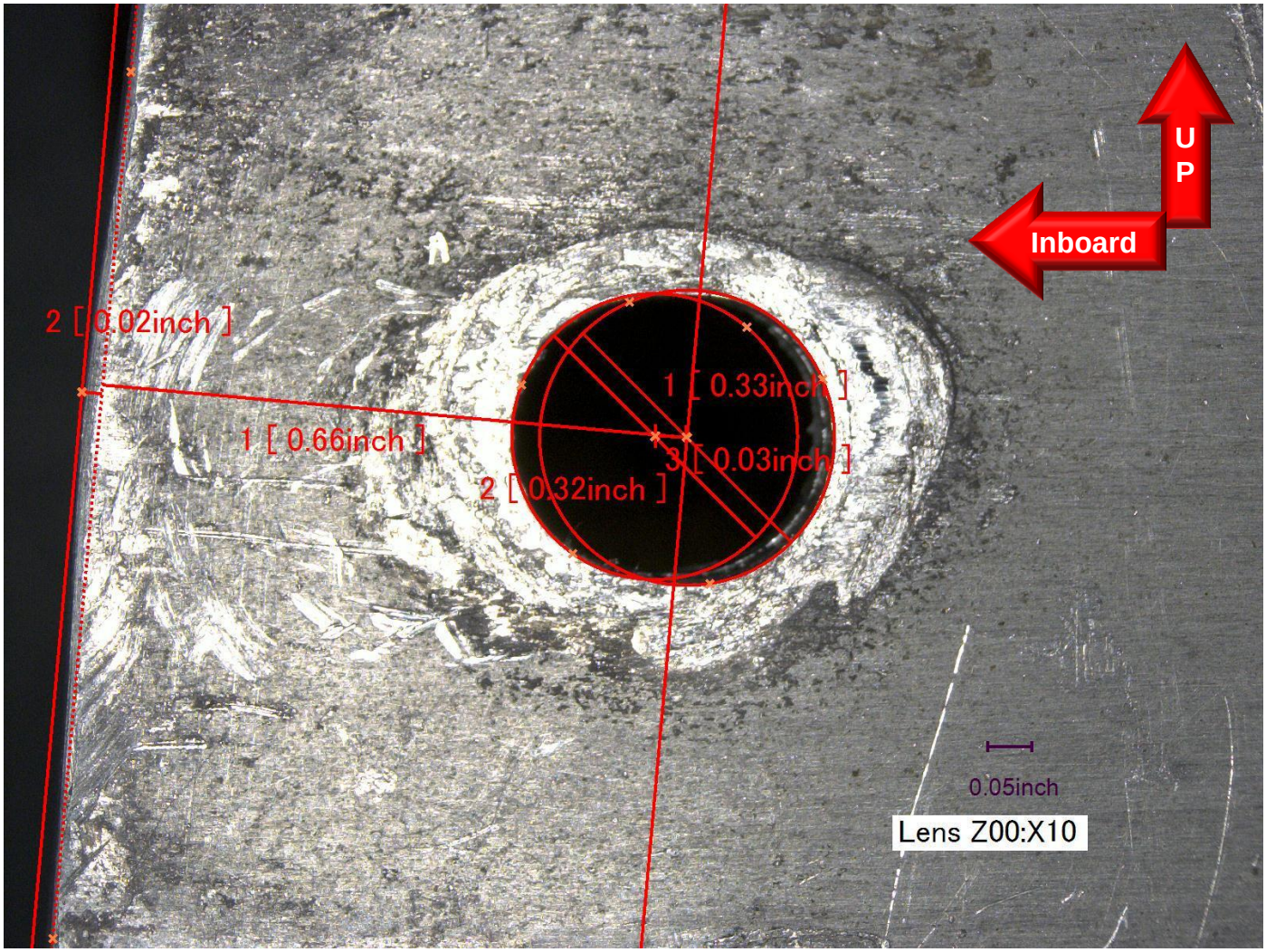

Figure 6. Closer view of the intact left wing fork attachment hole showing the inboard elongation of the hole and surrounding damage. Also the bulge is measured at the left.

Figure 7. The intact left and right wing rear spar attaching bolts showing grip contact with the respective wing and fuselage components.