

NATIONAL TRANSPORTATION SAFETY BOARD

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



December 26, 2019

MATERIALS LABORATORY FACTUAL REPORT

Report No. 19-083

A. ACCIDENT INFORMATION

Place : Middletown, New York
Date : May 5, 2018
Vehicle : Aeronca 7AC, N84396
NTSB No. : ERA18FA141
Investigator : Doug Brazy, AS-ERA

B. COMPONENTS EXAMINED

Front and rear seat belt assemblies with attached rear shoulder harness rear attachment assembly.

C. DETAILS OF THE EXAMINATION

The reader is cautioned that this accident involved severe injuries including a fatal injury, and the seat belts from this accident were photographed in the condition as received. Overall views of the submitted front and rear seat belt assemblies with attached shoulder harness rear attachment assembly on the rear seat belt assembly are shown in figures 1 and 2. Labels on the left and right lap belts for the front seat belt assembly and the right lap belt from the rear seat belt assembly (the left lap belt from the rear assembly was not included in the submitted components) read "CONFORMS TO: FAA-TSO-C22f MODEL NO. [model number] DATE OF MFG. [date] RATED STRENGTH OF ASSBY. 1500 LBS. AERO FABRICATORS LYONS, WI., USA". The model number read "90-91R60" on the front right and left lap belts and "R" on the rear right lap belt. The dates read "NOV 01 2016" on the front right lap belt, "AUG 25 ?????" (the year was illegible) on the front left lap belt, and "JAN 03, 2017" on the rear right lap belt. The label on the rear shoulder harness label read "FAA-PMA MODEL NO. H-702-300 DATE OF MFG. MAR 11 2016 STRENGTH OF ASSBY. 1500 LBS. AERO FABRICATORS LYONS, WI., USA".

The front seat belt assembly was received in three pieces as shown in figure 1. The upper aft portion of the shoulder harness with the upper attachment hardware was not received. The webbing at the aft end of the shoulder harness had a straight end face with limited deformation to the fibers, and individual fiber ends had a smooth flat appearance, features consistent with a cut end. Similar features were observed on the separation in the right strap of the shoulder harness and in the right lap belt at the lower attachment location. The right lap belt was separated into two pieces between the white data label and the length adjustment hardware, and the fracture had a more jagged appearance compared to the other cut surfaces. However, the individual fiber ends had

smooth flat appearances consistent with a cut end. The locations of the cut surfaces of the front seat belt assembly are indicated in figure 1.

The length adjuster for the left and right straps on the front shoulder harness were received positioned at approximately $\frac{1}{2}$ the length of the adjustable portion such that the loose end was 6 inches long and 5.5 inches long on the right and left sides, respectively (see figure 3). Buckle attachment fittings on the lower end of the front right and left shoulder harness straps were bent as shown in figures 4 and 5. The upper end of the fitting on the right strap shown in figure 4 was bent inward (toward the harness centerline) 11.3 degrees relative to the lower end, and the upper end of the fitting on the left strap shown in figure 5 was bent inward 13.6 degrees relative to the lower end.

The front left lap belt was separated at two locations at the lower attachment location as shown in figure 1. The separations occurred on either side of the lower attachment location adjacent to the length adjustment hardware. Fibers at both locations were displaced and splayed out consistent with overstress fracture. Optical images showing closer views of typical fiber fracture features are shown in figure 7. Many of the fiber ends had a mushroom appearance consistent with overstress fracture under a high rate of loading. The fabric of the lap belt appeared smooth and silky with no evidence of preexisting wear, stains, cuts, warping, or abrasions.

The rear shoulder harness assembly was received intact with the intact rear attachment assembly separated from the airframe as shown in figure 2. The rear right lap belt was received as shown, and the cut end indicated in figure 2 was received with markings indicating that it had been cut. The lower attachment end of the right lap belt and the entire left lap belt were not included with the submitted components from the rear assembly.

The length adjuster for the left and right straps on the rear shoulder harness were received positioned at the full extent of the adjustment such that the metal tip of the loose end was adjacent to the adjuster (see figure 8). Buckle attachment fittings on the lower end of the rear left and right shoulder harness straps were bent as shown in figures 9 and 10. The upper end of the fitting on the right strap shown in figure 9 was bent inward 14.9 degrees relative to the lower end. The upper end of the fitting on the left strap shown in figure 10 was only slightly bent compared to the others with the upper end bent inward 3.2 degrees relative to the lower end.

A close view of the rear shoulder harness rear attachment assembly is shown in figure 11. For comparison, a diagram of the rear attachment assembly from a similar viewpoint included in installation instructions provided by a representative of the Wag-Aero Group is shown in figure 12.¹ As installed, the upper and lower brackets of the rear attachment assembly are fastened around angular structural tubing near the location where two angled members meet. According to installation instructions and as shown in figure 12, the attachment bolt for the assembly is installed with the head against the

¹ Aeronca/Champion Shoulder Harness Installation Instructions AF-41, Aero Fabricators, Inc., Lyons, Wisconsin (2011).

triangular fitting on the lower side of the assembly and a washer and nut installed against the bracket on the upper side of the assembly. As shown in figure 11, the head of the attachment bolt was on the upper side of the assembly as installed in the accident airplane. No washer was included in the assembly as installed.

As shown in the view of the rear attachment assembly presented in figure 11, the right and left sides of the upper bracket were bent upward relative to the center of the bracket. On the lower side of the assembly, the triangular fitting was rotated such that the edge representing the hypotenuse of the triangle was approximately parallel to the left edges of the attachment brackets.

Next, the rear attachment assembly was disassembled by unscrewing the nut from the bolt. A photograph of the interior surfaces of the upper and lower brackets after disassembly are shown in figure 13. Sliding contact marks were observed on the surfaces corresponding to contact and relative motion between the brackets and the airframe. Unlabeled arrows in figure 13 indicate the relative direction of the sliding contact. The sliding contact marks on the left side of the brackets were approximately parallel to left edge of the bracket, and the marks on the right side generally turned toward the right edge. The overall pattern of the witness marks was consistent with the brackets sliding forward along the left airframe tube while the right tube slipped between the right edges of the brackets.

A small area of paint was removed from each side of the attachment brackets from the rear attachment assembly, and the thickness of each bracket was measured. The measured thicknesses were 0.0898 inch and 0.0878 inch for the upper and lower bracket, respectively. According to the representative from the Wag-Aero Group, the attachment brackets are manufactured from 0.090-inch thick steel sheet.

Matthew R. Fox, Ph.D.
Senior Materials Engineer

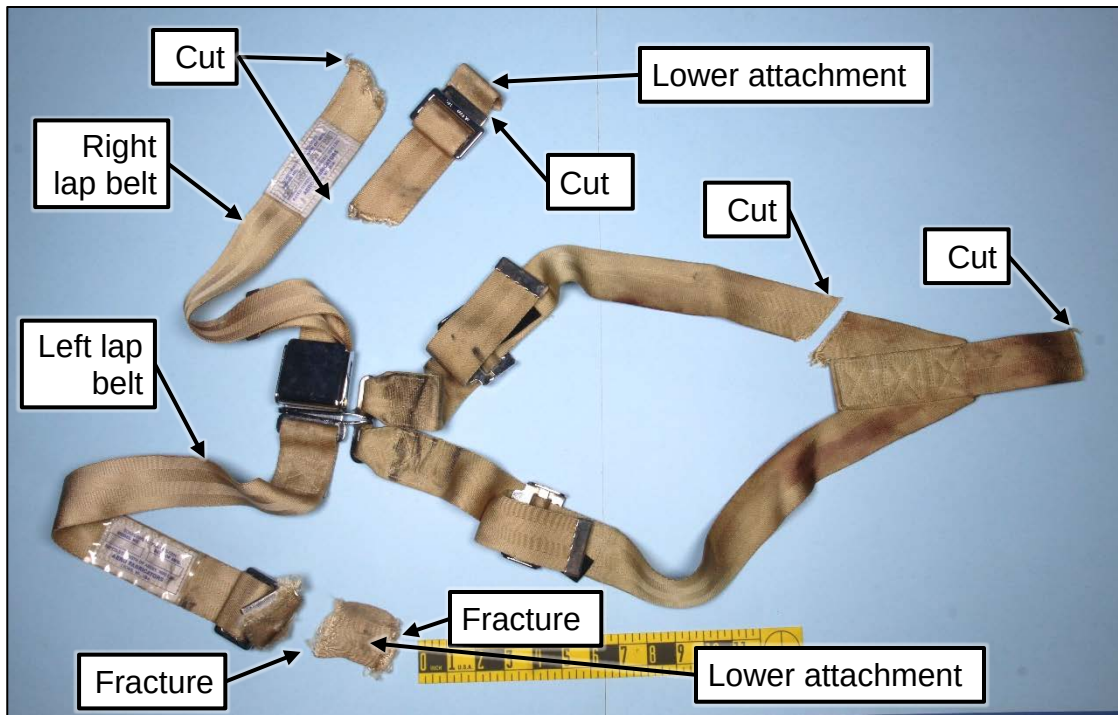


Figure 1. Overall view of the front seat belt assembly.

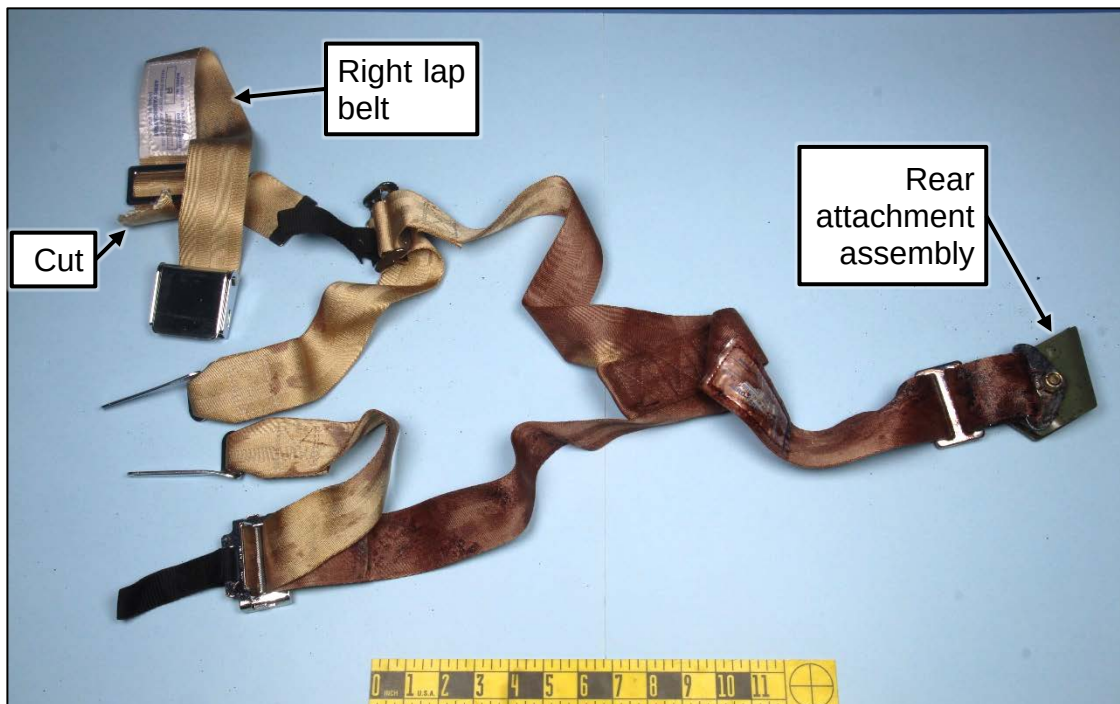


Figure 2. Overall view of the rear seat belt assembly with attached rear shoulder harness rear attachment assembly.



Figure 3. Length adjusters on the front right and left shoulder harness straps.

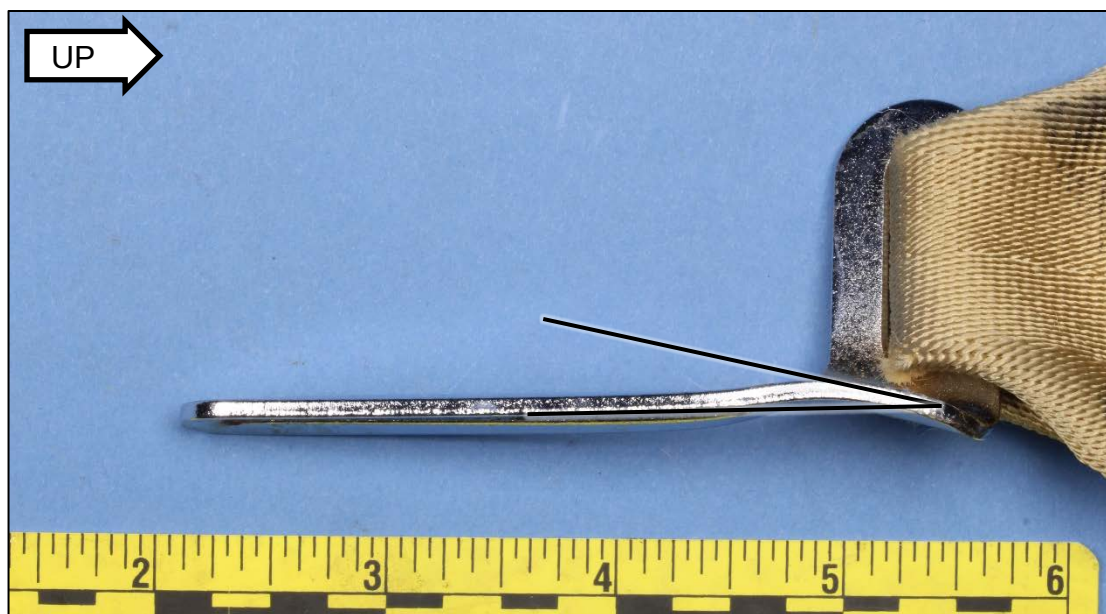


Figure 4. Buckle attachment fitting on the front right shoulder harness strap. The lines indicate the angle of bending.



Figure 5. Buckle attachment fitting on the front left shoulder harness strap. The lines indicate the angle of bending.



Figure 6. Closer view of fractures at the anchor point for the front left lap belt.



Figure 7. Optical images of typical fractured fibers for the front left lap belt fractures shown in figure 6.



Figure 8. Length adjusters on the rear right and left shoulder harness straps.

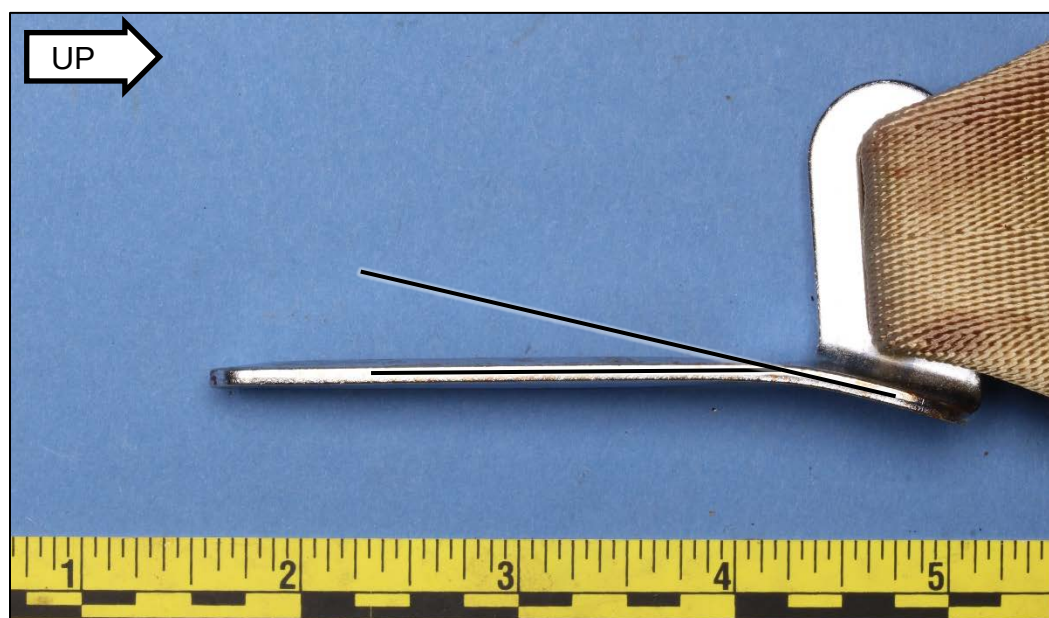


Figure 9. Buckle attachment fitting on the rear right shoulder harness strap. The lines indicate the angle of bending.

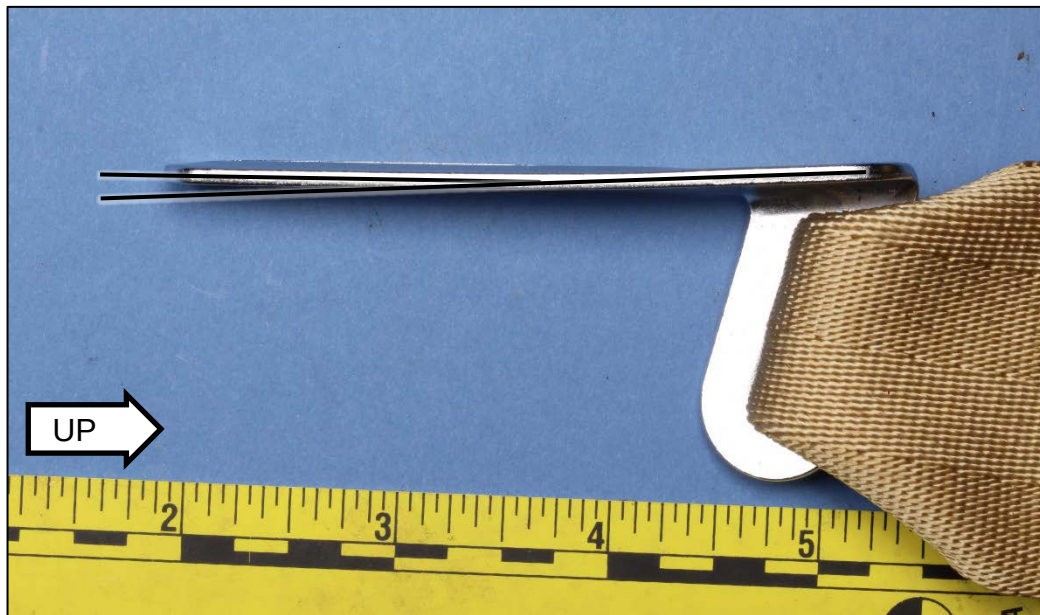


Figure 10. Buckle attachment fitting on the rear left shoulder harness strap. The lines indicate the angle of bending.



Figure 11. Rear shoulder harness rear attachment assembly as viewed looking aft.

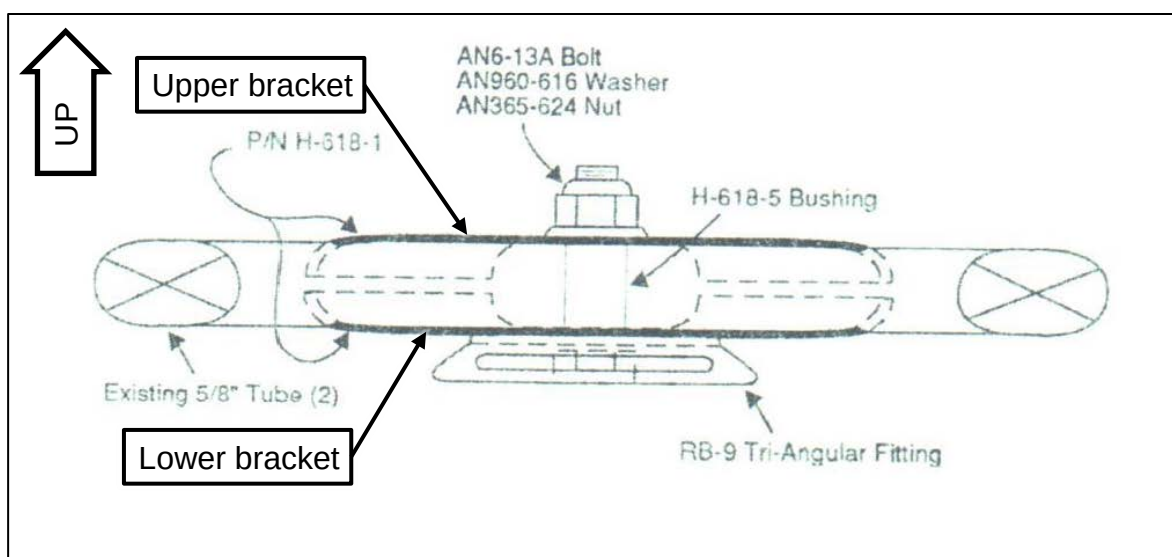


Figure 12. Diagram from the shoulder harness installation instructions showing the rear shoulder harness rear attachment assembly as viewed looking aft. (Instructions provided by Wag-Aero Group.)

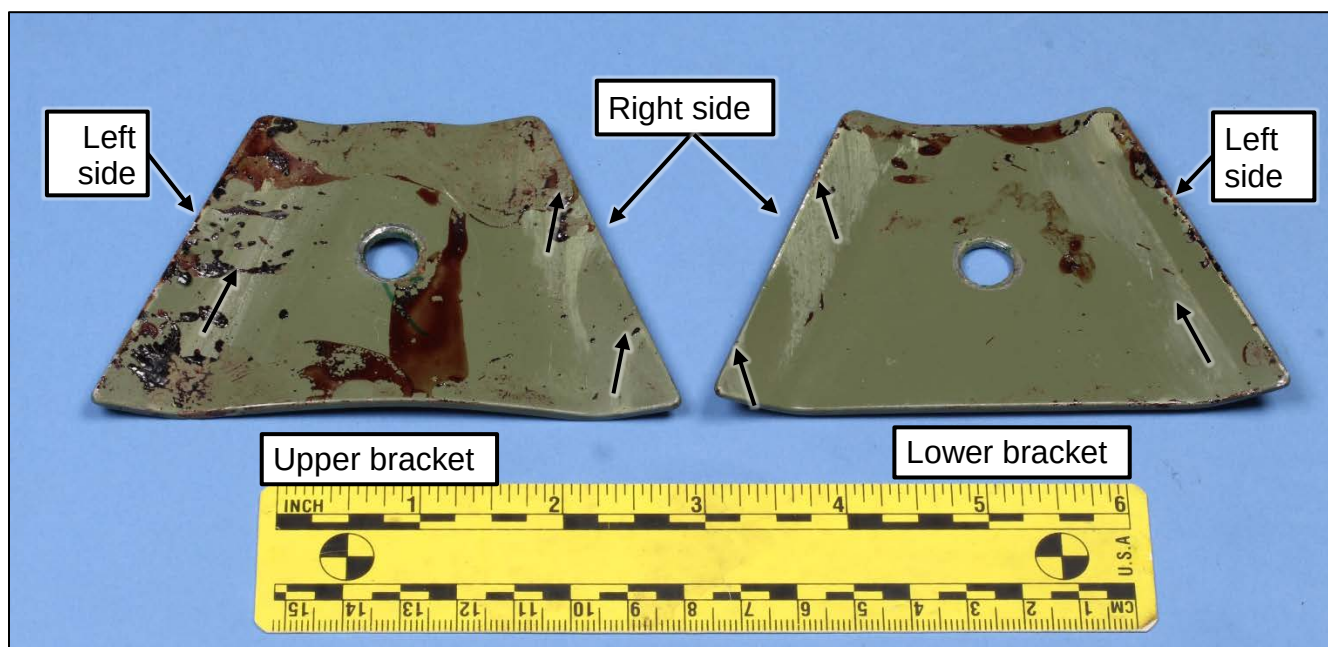


Figure 13. Interior faces of attachment brackets from the rear shoulder harness rear attachment assembly after disassembly. Unlabeled arrows indicate the relative direction of motion for the mating structural frame in areas showing sliding contact marks.