

NATIONAL TRANSPORTATION SAFETY BOARD

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



August 11, 2014

MATERIALS LABORATORY FACTUAL REPORT

Report No. 14-051

A. ACCIDENT INFORMATION

Place : Parma, New York
Date : July 5, 2014
Vehicle : Cessna 140, N76850, serial number 11284
NTSB No. : ERA14FA327
Investigator : Todd Gunther, ERA

B. COMPONENTS EXAMINED

Center Safety Belt Bracket

C. DETAILS OF THE EXAMINATION

The as-received center safety belt bracket is displayed in figure 1. The bracket was used to attach the center portions of the left and right lap belts to the fuselage. It was reported to be an original part with Cessna part number 0425132. The Illustrated Parts Catalog depicts the bracket attached the floor of the cabin area between the seats in the orientation indicated.

As shown in greater detail by figure 2, the left side tang of the bracket was fractured adjacent to the forward foot for the left seat belt attachment. The fracture was oriented at about 45 degrees at the juncture between the tang and the foot. Magnified optical examinations revealed fracture features and deformation patterns indicative of a shearing overstress separation. No indications of preexisting cracking or corrosion were noted. As shown in the upper view of figure 1, the left side tang showed deformation patterns consistent with both pre and post fracture deflections.

The examined bracket was determined by chemical analysis and metallographic cross section, to have been made from an Alclad¹ aluminum alloy, either 2014 or 2024². Hardness and conductivity measurements of the core material were consistent with either a T3 or T4³ temper condition for either alloy.

Engineering drawing, 0425132, Bracket-Seat Belt, became inactive for use in 1966. The latest drawing specified the bracket material as SAE 4130 alloy steel, normalized after forming. The drawing also depicted a shape with two different widths as shown in figure 3.

¹ Thin layers of pure aluminum metallurgically bonded to the surface of sheet or plate for corrosion protection of the core aluminum alloy.

² Heat treatable aluminum alloys whose major alloying element is copper.

³ Solution heat treated, and naturally aged to a substantially stable condition.

The drawing showed a forward 0.88 wide section with a 0.75 inch wide aft section. In comparison, the received bracket measured 0.75 inch wide along its entire length. The widths of the tangs on the fractured bracket also measured smaller than the drawing dimensions, 0.215 inch versus 0.25 inch on the drawing. Other dimensions including hole sizes, thickness, bend angles appeared to be consistent between the received bracket and the drawing.

Based on the 45 degree fracture across the tang, the received bracket has approximately 7% less cross sectional area than the latest version of the bracket.

A review of the Drawing Change Notices (DCN) found a material change from "24ST ALC"⁴ to normalized 4130 alloy steel. DCN 6886A, dated 10-21-46, cites the material change and states "Strengthen Part" as the reason. DCN 9155, dated 11-27-46, shows the two width shape of the steel bracket and further lists the applicability as model 140 serial number 13582 on (with 3 exceptions) and model 120 serial number 13563 on. No drawings were found showing the shape and dimensions of the previous version of the bracket.

A review of the FAA aircraft registry database found approximately 2,310 Cessna model 140s and 862 model 120s still registered in the United States. Of these about 1,594 (69%) model 140s and 701 (81%) 120s were manufactured before the effectivity of the material change from above.

Based on strength data from the 1995 version of the Aerospace Structural Metals Handbook⁵, normalized (1600 F) 4130 alloy steel has a typical yield strength of 68,000 psi⁶. From the same reference, Alclad 2024 T3 has a typical yield strength of 40,000 psi⁷. This represents a nearly 40% reduction in yield strength for the aluminum bracket compared to the steel bracket.

Joe Epperson
Senior Metallurgist

⁴ Outdated designation for Alclad 2024 T3 aluminum alloy.

⁵ CINDAS/USAF CRDA Handbook Operation, Purdue University West Lafayette IN

⁶ Table 3.0212

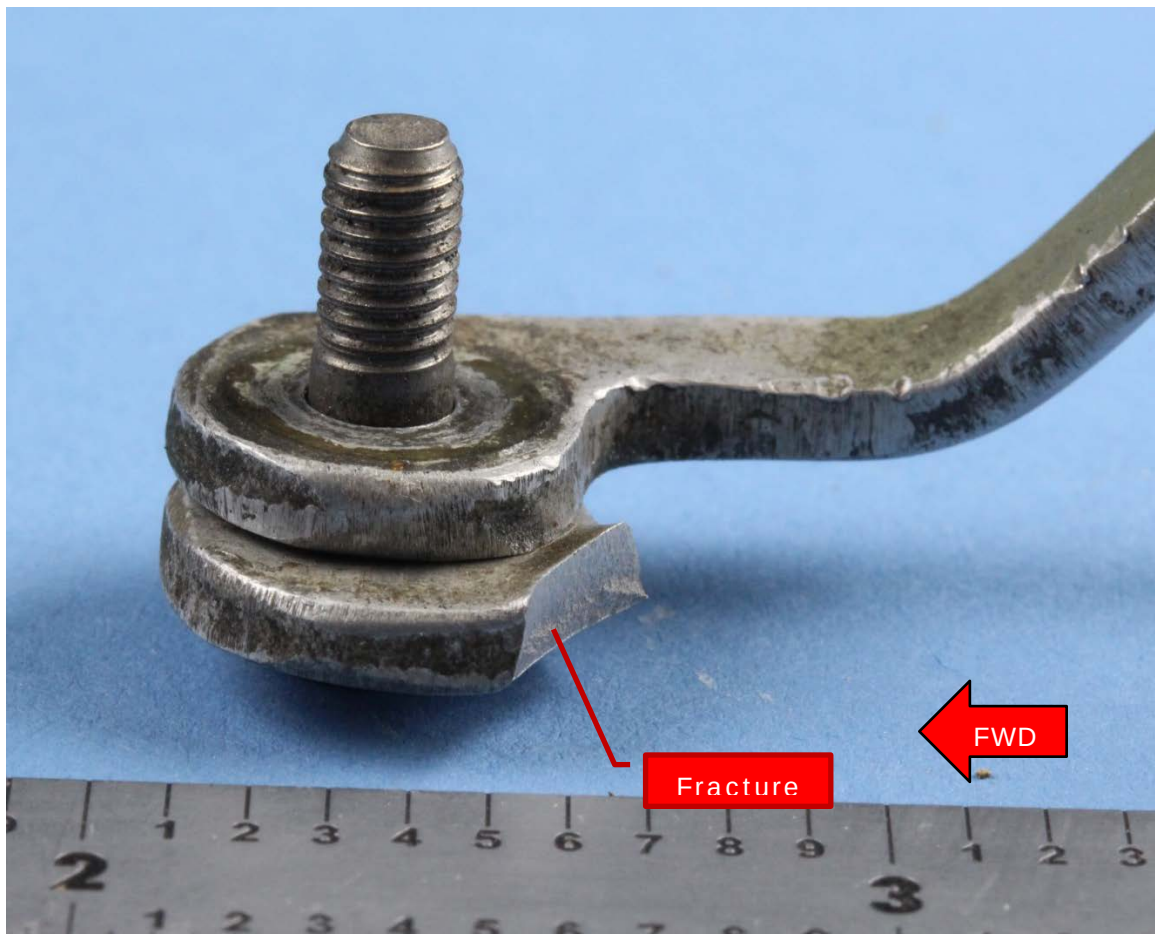
⁷ Table 3.012.



Figure 1. Two views of the fractured seat belt bracket, left side at top, top view below. The extent and shape of both the pre and post fracture deformation is visible in the side view at top.



Figure 2. Two views of the fractured foot shown positioned relative to the intact right foot as installed. Exemplar bolt used.



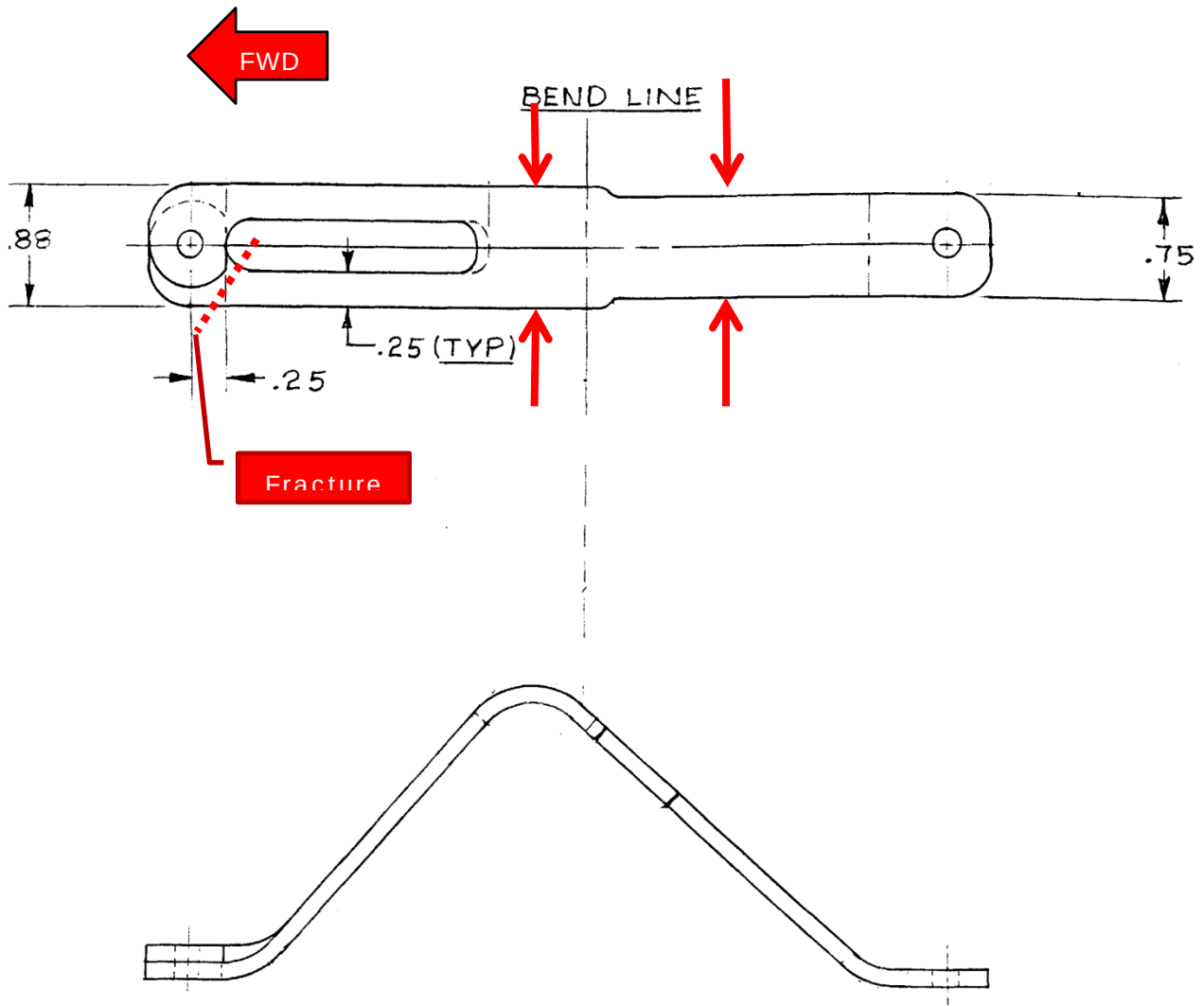


Figure 3. Illustration of the bracket shape depicted in the latest Cessna drawing for the seat belt bracket. Note the two different widths as indicated by the opposed red arrows.