

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR22FA304

MATERIALS LABORATORY

Factual Report 22-103

December 22, 2022

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A. ACCIDENT INFORMATION

Location: Yellow Pine, ID
Date: August 15, 2022
Time: 06:30 mountain daylight time
12:30 coordinated universal time
Vehicle: Aviat A-1A, N26HV
Investigator: Eric Gutierrez, AS-WPR

B. COMPONENTS EXAMINED

Portion of wire rope and pieces of an aileron turnbuckle barrel

C. EXAMINATION PARTICIPANTS

Specialist Erik Mueller, Ph.D., P.E.
Office of Research and Engineering, NTSB
Washington, DC

D. DETAILS OF THE EXAMINATION

On August 15, 2022, an Aviat A-1A was substantially damaged when it was involved in an accident near Yellow Pine, ID. The pilot and passenger were fatally injured. A witness stated that he heard the airplane takeoff, followed by a sound similar to a "door slamming shut." While overflying the north end of the airport, he observed the accident airplane in the creek near the departure end of runway 35. Examination of the accident site revealed that the airplane impacted terrain, having come to rest upright in a creek. No visible ground scars or damaged vegetation were observed near the wreckage. All major structural components of the airplane were located at the accident location. The wreckage was recovered to a secure location for further examination.

Figure 1 shows the cable assembly as received. This remnant included a fractured turnbuckle subcomponent, shown on the right in the figure. The turnbuckle was removed from the rest of the cable and cleaned in an ultrasonic bath of acetone. The fracture was located between 0.077 and 0.79 inches from the tapered (shorter) end and 1.49 to 1.50 inches from the face of the longer end. Other measurements are annotated in Figure 3. The markings on the body of the turnbuckle stated, "P2005 MS21251 B35".

Figures 2 and 3 show the fracture turnbuckle remnants, with the mating fracture surfaces positioned to face each other. While the nominal outer diameter of much of the turnbuckle was 0.280 inches, near the fracture surface, the diameter varied between 0.264 and 0.289 inches. Likewise, the inner diameter varied between 0.155

and 0.205 inches. These measurement variabilities were consistent with localized deformation near the fracture surface.

Figure 2 shows some downward deformation from the left or larger remnant. The fracture surfaces exhibited a general cup and cone shape, exemplified in Figures 3 and 4. The fracture surfaces were angled at a 45° inward towards the bore.

Figure 5 shows the fracture surface of the smaller remnant (on the right in Figures 2 through 4). This surface exhibited a rough texture and a general dull luster. The inward orientation of the fracture is illustrated in Figure 6. There was a small ridge in the upper portion of the fracture surface, illustrated in Figure 7.

The turnbuckle fracture surface was examined using a field emission scanning electron microscope (SEM). Figures 8 and 9 show an overall view of the fracture surface with the ridge. This fracture exhibited V-shaped chevron marks, annotated in Figure 9. A closer examination of the fracture surface revealed dimpled rupture features, as exemplified in Figure 10. These features were consistent with overstress fracture. The fracture morphology was indicative of overstress fracture of thin-walled structures in tension, torsion, and bending.

The chemical composition of the turnbuckle was examined using energy-dispersive x-ray spectroscopy (EDS) and x-ray fluorescence (XRF). The composition was consistent with a leaded brass. The hardness of the turnbuckle was examined per ASTM E18.¹ The hardness averaged 81 HRBW.²

Submitted by:

Erik M. Mueller
Materials Research Engineer

¹ ASTM E18 - *Standard Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials*. ASTM International, West Conshohocken, PA.

² HRBW - Hardness, Rockwell B scale. An indentation method of determining the hardness of softer metals using a 1/16-inch diameter tungsten ball indenter and 100 kg major load.

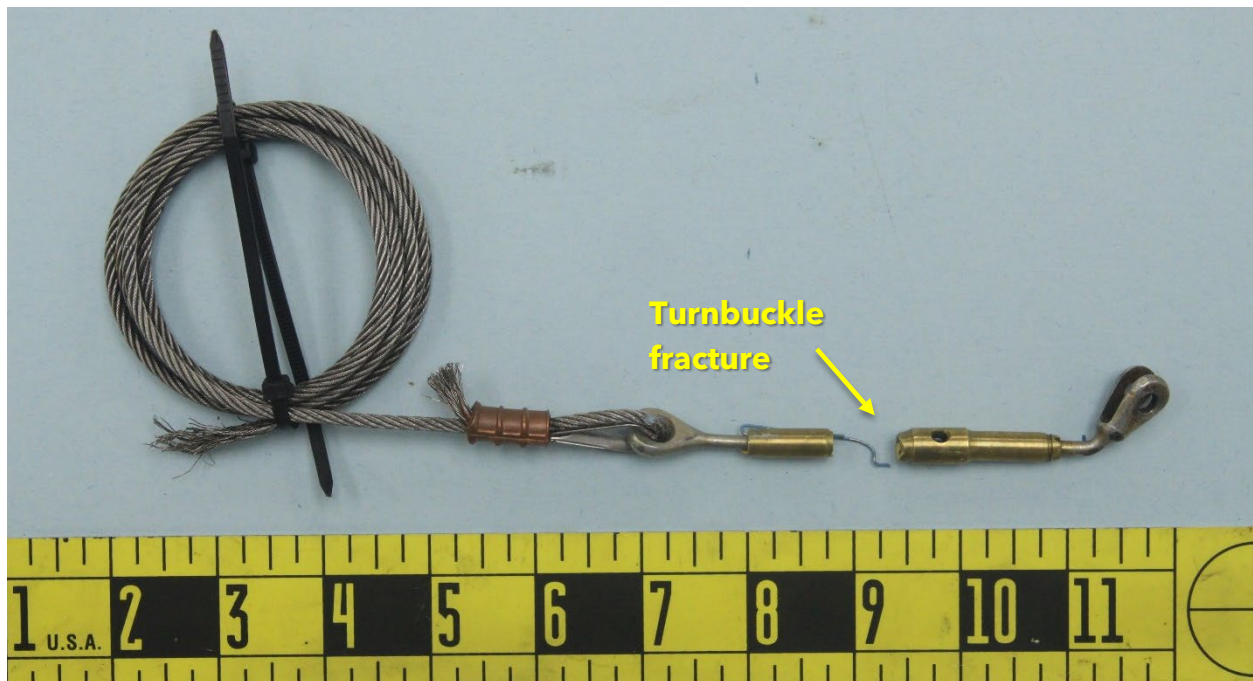


Figure 1. View cable assembly with the fractured turnbuckle, as received.

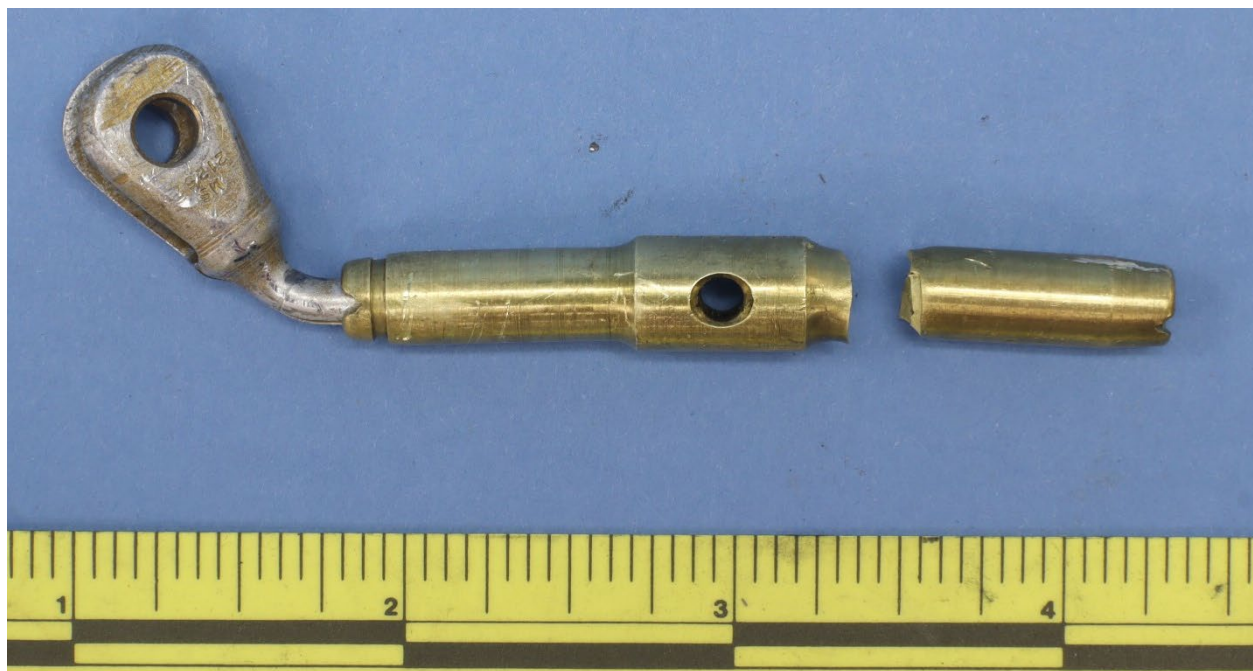


Figure 2. View of the fractured pieces of the turnbuckle, after removal from the cable and cleaning.

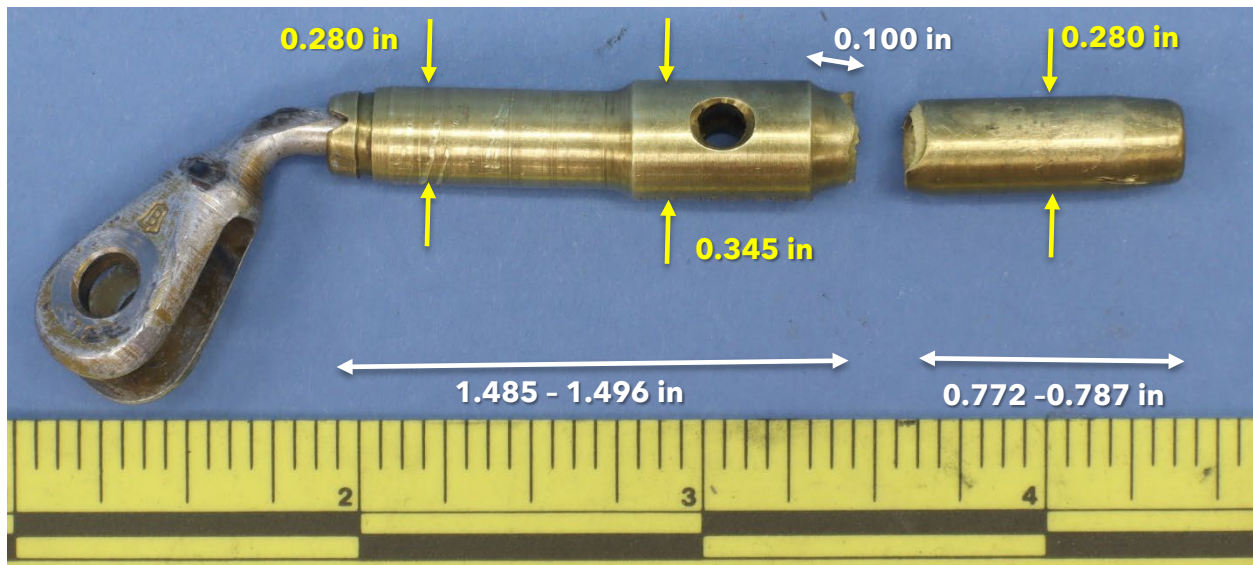


Figure 3. View of the turnbuckle, 180° from the side view in **Figure 2**.

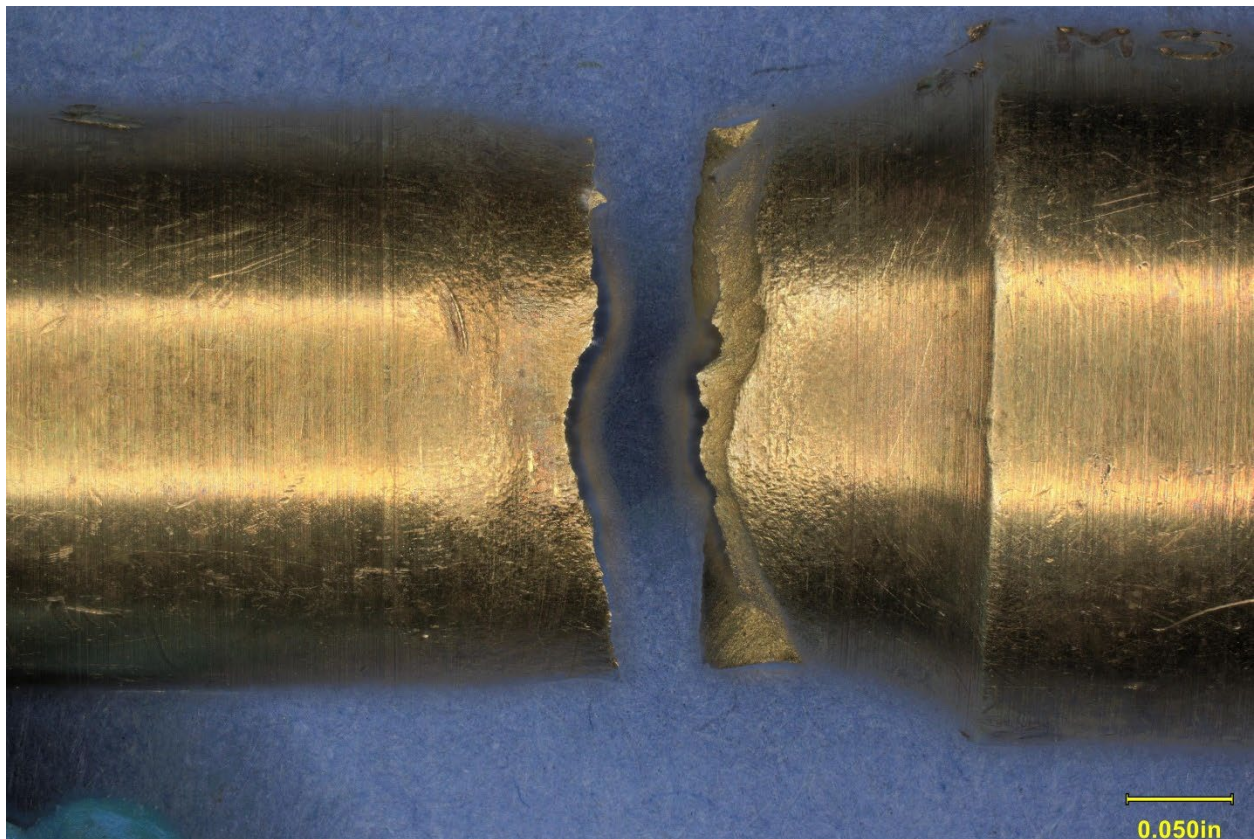


Figure 4. Closer view of the mating fracture surfaces of the turnbuckle remnants.



Figure 5. View of the fracture surface of the smaller turnbuckle remnant on the right in **Figure 4**.

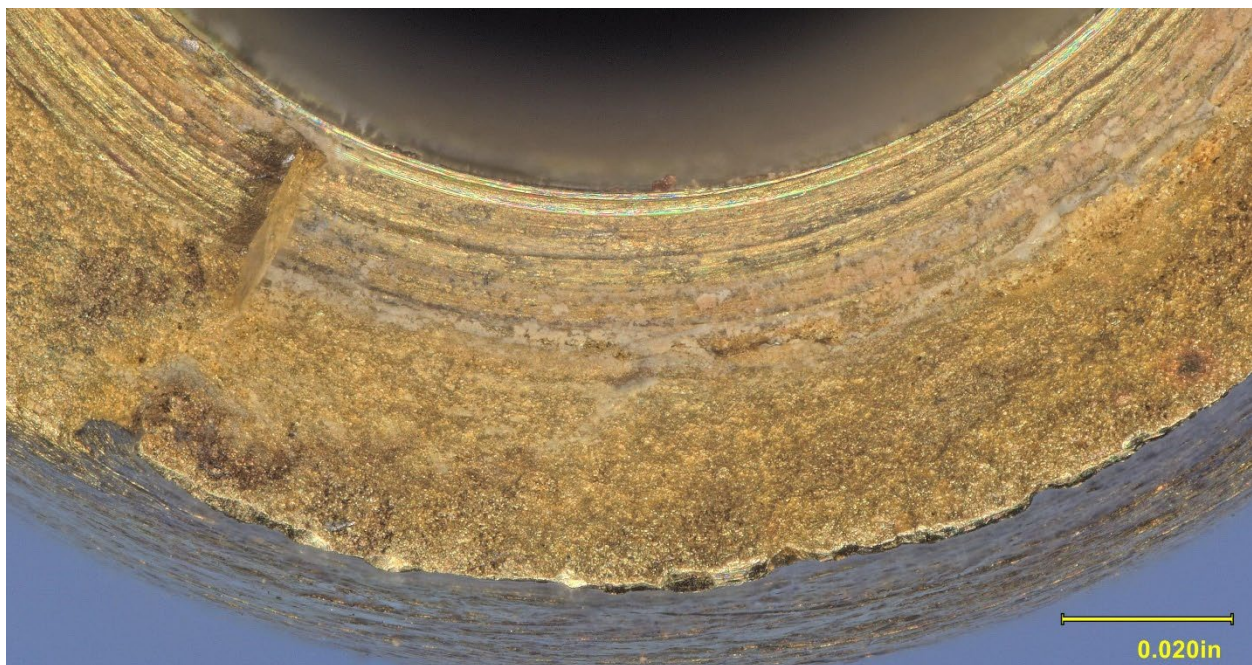


Figure 6. Closer view of the angled fracture surface portion from **Figure 5**.

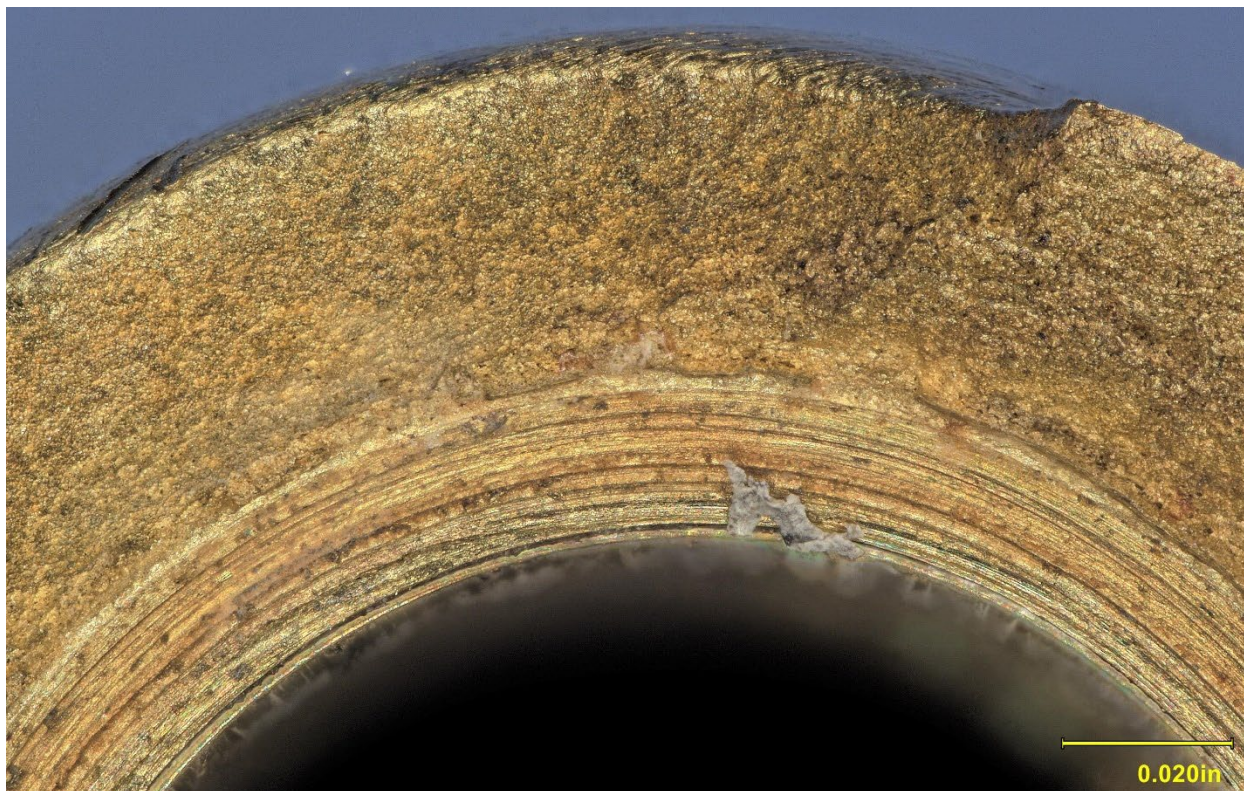


Figure 7. View of the ridge from the upper portion of the fracture surface in Figure 5.

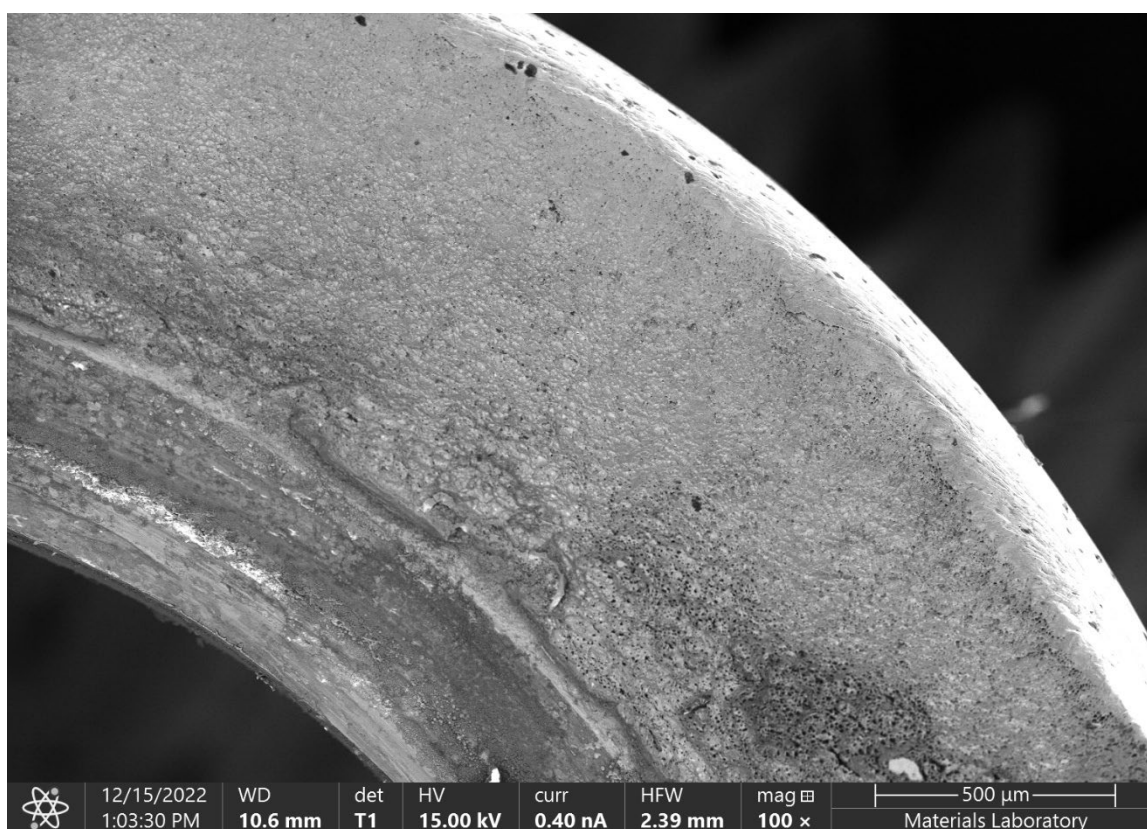


Figure 8. Backscattered electron (BE) micrograph of the fracture surface in Figure 7.

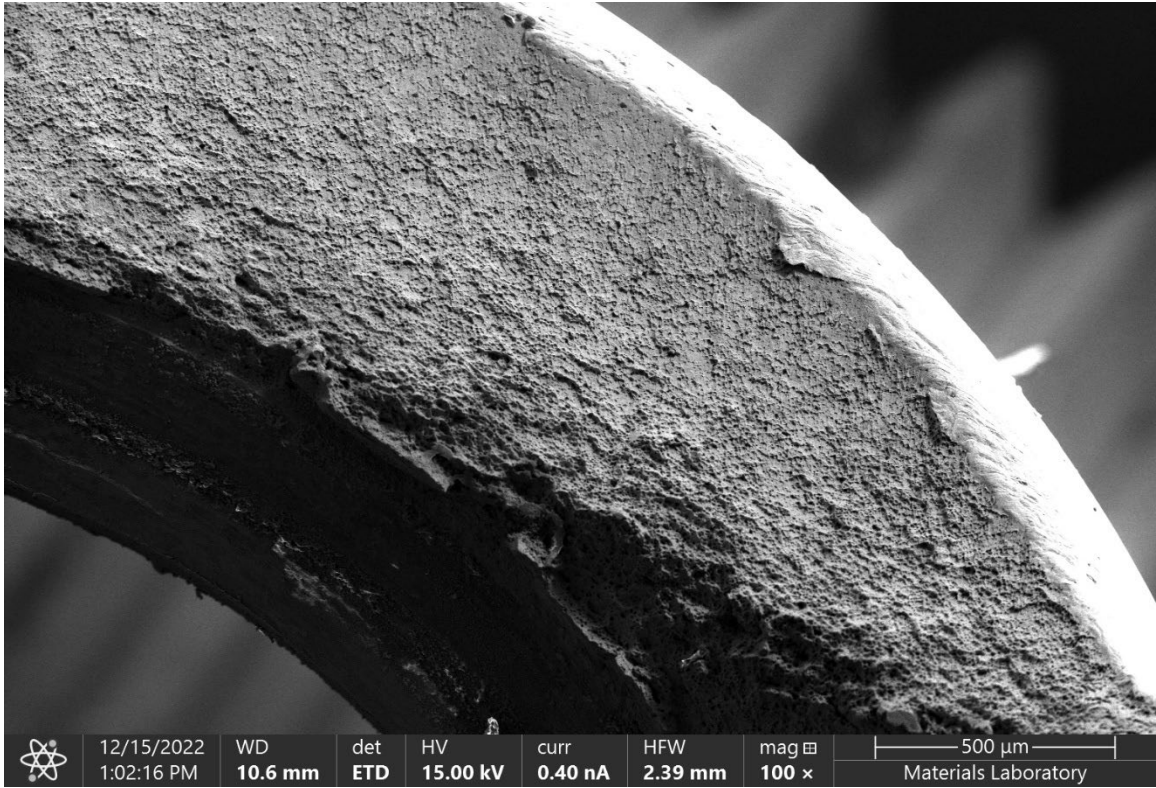


Figure 9. Secondary electron (SE) micrograph of the fracture surface in Figure 8, with the chevron marks annotated.

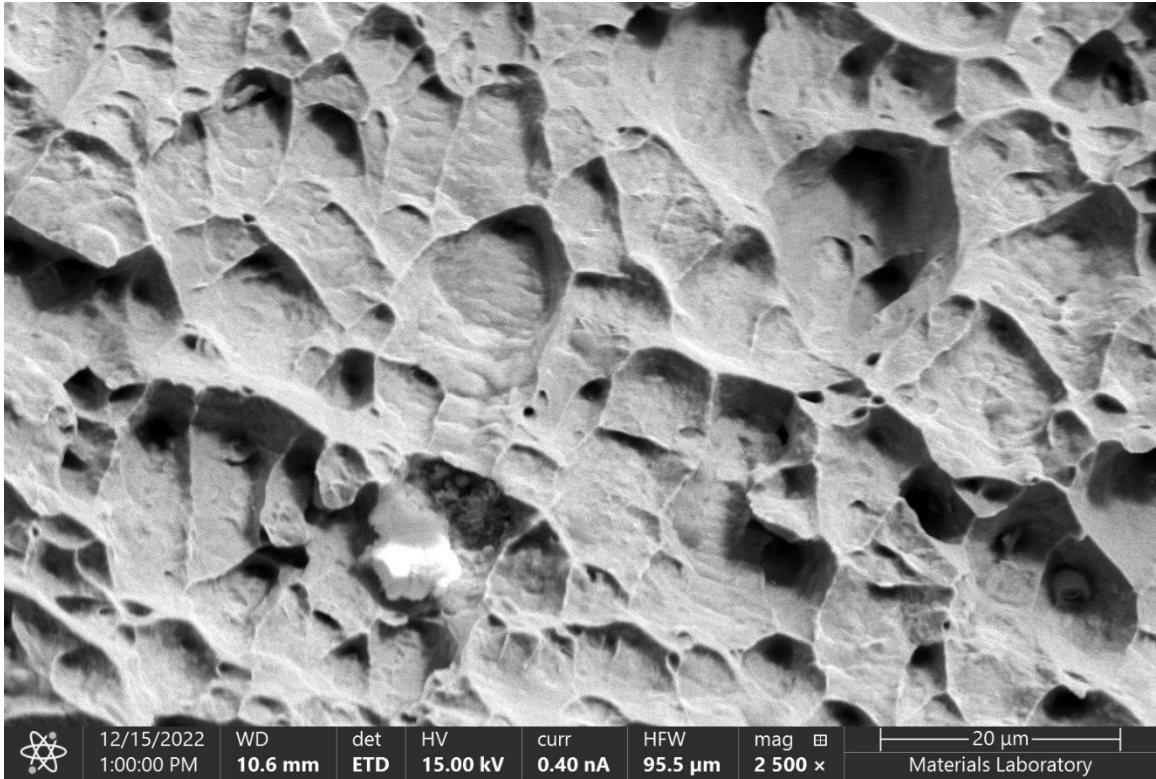


Figure 10. SE micrograph of a typical area of the fracture surface, showing dimpled rupture.