

NATIONAL TRANSPORTATION SAFETY BOARD

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



October 21, 2021

MATERIALS LABORATORY FACTUAL REPORT

Report No. 21-080

1. ACCIDENT INFORMATION

Place : Port Alsworth, Alaska
Date : August 21, 2021
Vehicle : Stinson 108-3, N6476M
NTSB No. : ANC21LA086
Investigator : David Banning, AS-ANC

2. COMPONENTS EXAMINED

Remnants of a brake backing plate

3. DETAILS OF THE EXAMINATION

On September 12, 2021, about 0900 Alaska daylight time, a Stinson 108-3 airplane was substantially damaged when it was involved in an accident near Port Alsworth, AK. The pilot was not injured. The pilot reported that the brakes were not operating properly after landing. The airplane subsequently veered to the left, impacted a ground object, and then nosed over, sustaining substantial damage to the fuselage and left wing. An initial postaccident examination by the pilot revealed the right brake torque plate had fractured. The torque plate was sent to the NTSB Materials Laboratory for additional examination.

The two pieces of the brake torque plate are shown as received in Figure 1, viewed from opposite sides. The remnants consisted of the main body of the part, along with a flange segment that had fractured. Both pieces exhibited areas of post fracture batter and scrape marks. In addition, the fractures about the lower bolt hole in Figure 1b showed material that was bent and deformed out of plane from the rest of the flange fractures. These out-of-plane features were typical of subsequent fractures.

As it exhibited multiple fractures and was still generally planar in shape, the flange fragment was examined more extensively. As shown in Figure 2, the flange had fractured at five locations, each around an attachment bolt or fastener hole, consistent with the locations of least cross-sectional area, or higher stress concentration. Each end of the flange fragment exhibited two fractured filaments about a hole, with another fracture at the center bolt hole on one of the filaments, while the one opposite was intact.

The fractures on the right side of the flange fragment in Figure 2 are shown in Figure 3 from a planar view, showing the surfaces. Each surface exhibited a generally dull fibrous luster, with a rough surface texture. In addition, the area of the flange fragment adjacent to the bolt hole exhibited a depression, consistent with wear from the adjacent bolt head or nut, similar to a countersunk machining process.

The fracture in Figure 3 exhibited localized thinning along the centerline (creating a bowtie shape) with some downward deformation (as oriented in Figure 3) adjacent to the fracture. The left filament exhibited localized thinning or necking in both directions, as demonstrated in Figures 3 and 4.

These fracture surfaces were examined using a scanning electron microscope (SEM). Figure 5 shows a typical area of the fracture surface, examined as received without cleaning. As illustrated in Figure 6, the fracture surface exhibited dimpled rupture, consistent with overstress fracture in tension. No other fracture features consistent with other failure modes were observed on these fracture surfaces.

Figure 7 shows the fracture surfaces of the opposite side of the flange fragment (left side in Figure 2). These fractures exhibited similar features to those of the right side of Figure 2, except for the left filament which had been bent upward, as positioned in Figure 7. Both fracture surfaces exhibited a dull, fibrous luster, with a rough surface texture. The right filament in Figure 7 exhibited a general cup shape, with outward deformation (towards the right in Figure 7) and wear on the inside bolt surface. Examination of the fracture surfaces using a SEM found dimpled rupture features analogous to those illustrated in Figures 5 and 6. These features were consistent with overstress fracture, interacting with the fastener that pushed outward and upward when the flange failed.

Figures 8 and 9 illustrate the planar and side views of the fractured filament at the central bolt hole in the flange fragment. The fracture surfaces faced and mated to each other, with one side exhibiting a cup shape, and the opposite having a cone shape. Particularly shown in Figure 9, the fractured filament exhibited localized thinning in the form of necking at the fracture location. These features were consistent with classical features of tensile overstress.

The opposite filament is illustrated in Figure 10. This area exhibited localized necking, consistent with unstable plastic deformation prior to fracture in tension. This area, however, did not exhibit any fractures or cracks, consistent with the applied stresses decreasing prior to fracture.

The combined features of these plate remnants were consistent with having fractured from overstress in tension with some subsequent bending. None of the fracture surfaces exhibited features consistent with pre-existing damage, such as cracks or corrosion.

The chemical composition of the plate was examined using energy dispersive x-ray spectroscopy (EDS) and x-ray fluorescence (XRF). The plate was consistent with a cadmium-coated plain carbon steel. The hardness was inspected per ASTM E18. The hardness, after removing the cadmium coating, averaged 38 HRBW. This hardness was lower than typical reported values for carbon steel (usually greater than 55 HRB), however, the values were influenced by the residual presence of the soft cadmium coating.

Erik M Mueller
Materials Research Engineer



Figure 1 – View of the pieces of the torque plate from (a) the outboard and (b) inboard sides.



Figure 2 – View of the fractured flange remnant, showing the five fractured surfaces.



Figure 3 – View of the fracture surfaces around the bolt hole on the right side of Figure 2.



Figure 4 – Oblique view of the left fractured filament in Figure 3 near the bolt hole, showing localized thinning.

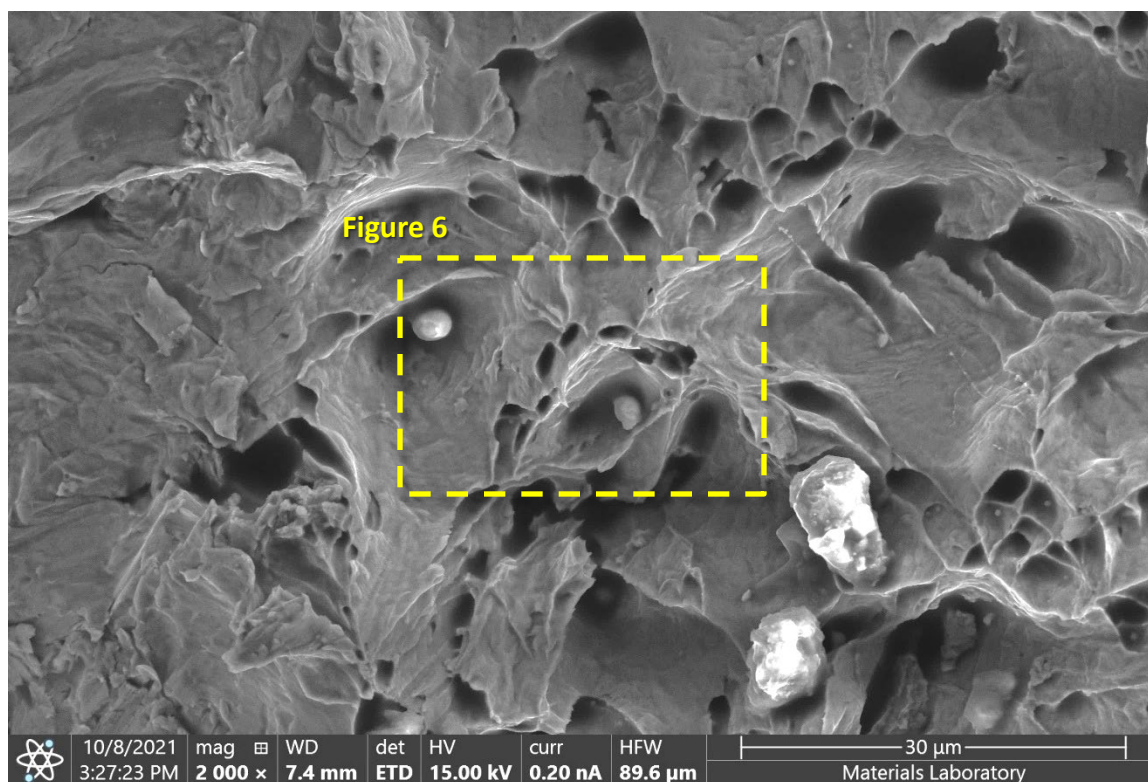


Figure 5 – Secondary electron (SE) micrograph of a typical area of the fracture surface in Figure 3 and Figure 4.

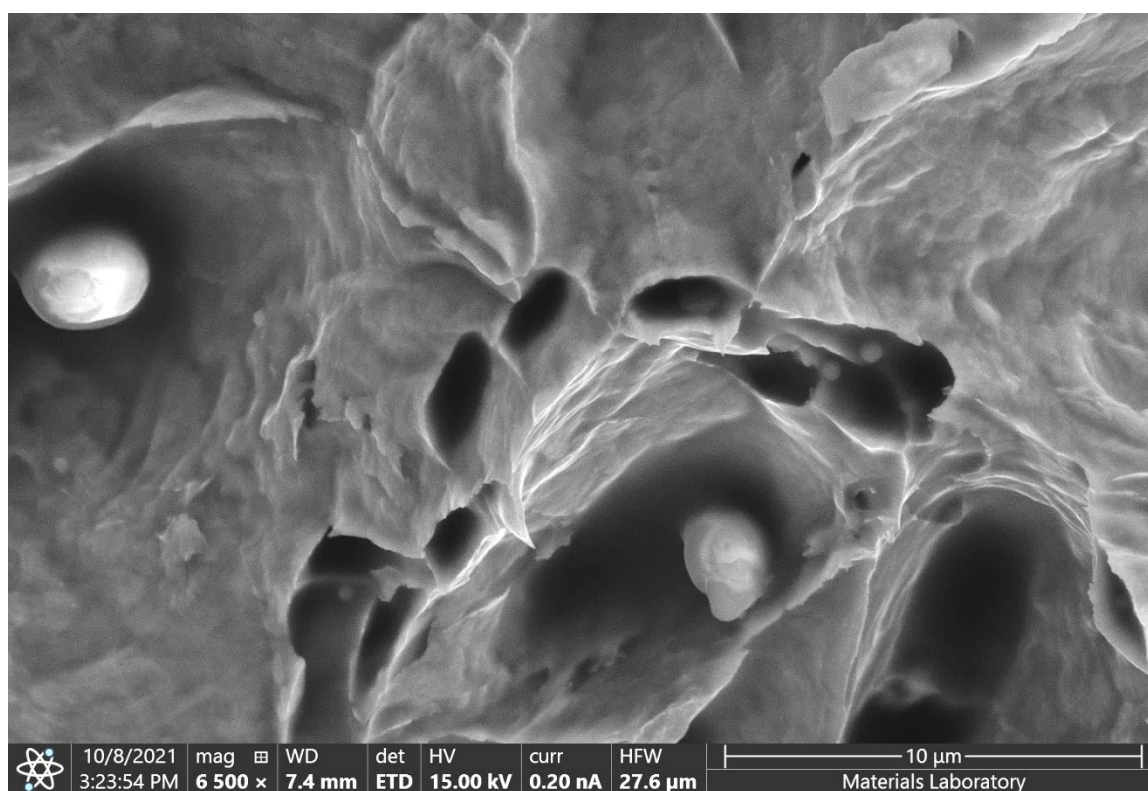


Figure 6 – SE micrograph of a dimpled rupture in the boxed area in Figure 5.



Figure 7 – View of the fracture surfaces around the bolt hole on the left side in Figure 2.



Figure 8 – View of the lower fracture around the bolt hole in the middle of Figure 2.

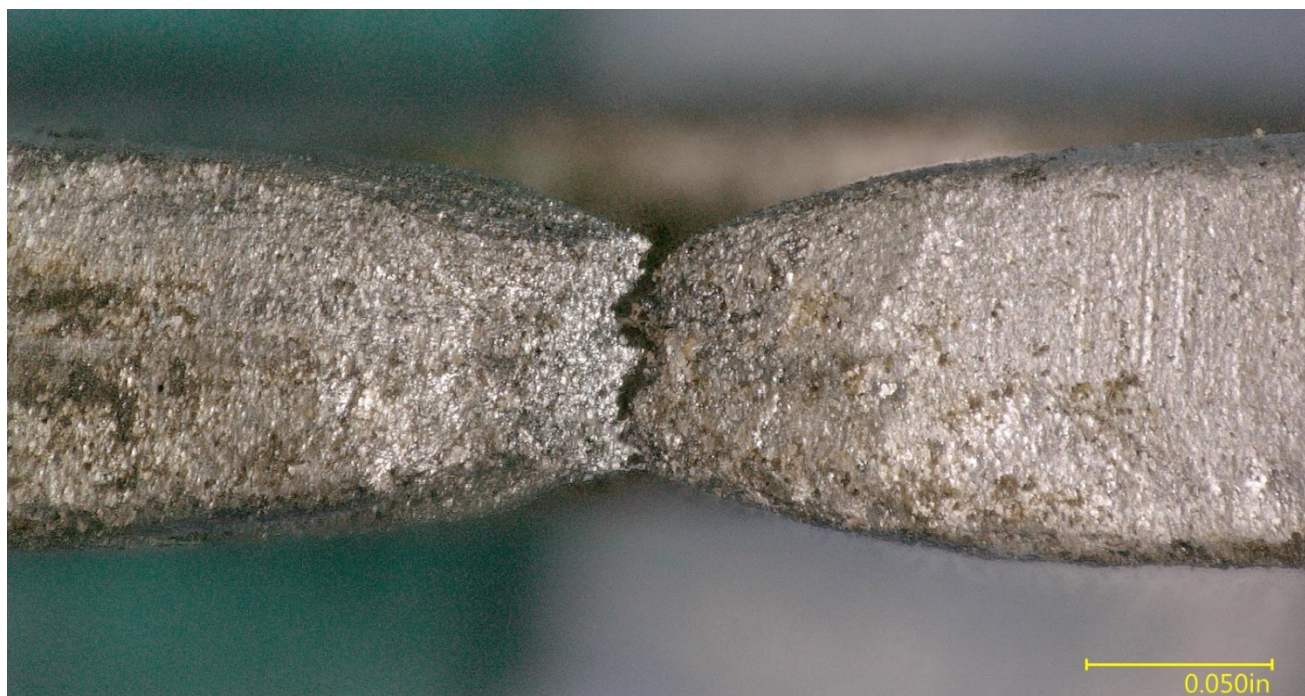


Figure 9 – Side view of the fracture in Figure 8, showing necking at the fracture.



Figure 10 – The intact filament opposite the fractured one in Figure 8 and Figure 9, showing necking.