

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR23LA350

MATERIALS LABORATORY

Factual Report 24-035

6/10/2024

(This page intentionally left blank)

A. ACCIDENT INFORMATION

Location: Challis, ID
Date: 9/20/2023
Vehicle: Cessna U206C, N2923G
Investigator: Fabian Salazar, AS-WPR

B. COMPONENTS EXAMINED

Left main landing gear leg, fractured into two pieces.

C. EXAMINATION PARTICIPANTS

Materials Engineer Brian Fuchs
Research and Engineering – Materials Laboratory Division
Washington, DC

D. DETAILS OF THE EXAMINATION

On September 20th, 2023, a Cessna U206C experienced failure of the left main landing gear during a takeoff roll. The leg was recovered and submitted to the Materials Laboratory for examination.

Figure 1 shows the landing gear leg as received. The leg had fractured into two parts. The inboard piece was approximately 20.5 inch in length, and the outboard piece was approximately 22.75 inch in length.

The fracture surfaces are pictured side-by-side in **Figure 2**. The surfaces were mostly planar and perpendicular to the length of the leg. The appearance of the surfaces was rough and dull, consistent with ductile overload failure. Areas of corrosion product were present in this region of the surface

The outboard fracture surface was subjected to cleaning with acetone and closer examination. The surface exhibited chevron marks radiating from an area on the lower surface, shown in **Figure 3**. Three adjacent thumbnail-shaped features were present on the lower surface. The largest of these features measured 0.18 inch across, with a depth of 0.054 inch. This feature exhibited a series of parallel ratchet marks, consistent with multiple small cracks joining into a larger singular crack.

The piece was re-cleaned using acetone in an ultrasound bath. It was then examined in a field-emission scanning electron microscope (SEM). The surface in the thumbnail features (**Figure 4**) exhibited a mix of crack progression striations and intergranular decohesion features. Outside of these regions, the surface showed primarily ductile dimpling interspersed with intergranular facets (**Figure 5**), consistent with overstress.

Examination of the roots of the thumbnail features revealed radial marks emanating from dimple features on the bottom surface, as shown in **Figure 6**. Backscattered electron (BE) imaging of these dimples revealed a nonconductive phase in the dimple. Energy Dispersive Spectroscopy (EDS) of the phase revealed the presence of iron and high amounts of oxygen, consistent with iron oxide. Acetate tape was employed to remove obscuring corrosion product and depth of one such pit was measured to be approximately 0.001 inch.

The piece was again subjected to acetone cleaning in an ultrasound bath to strip paint and primer away from the bottom edge of the leg. The surface had a dimpled appearance, consistent with shot peening. Corrosion product was observed in the dimples. The piece was subjected to further cleaning in acetone and a soft scrubbing pad was used to remove primer that continued to adhere. This progression is shown in **Figure 7**. Corrosion product was observed on the surface after the primer was removed.

The chemical composition of the leg was inspected using X-ray Fluorescence (XRF) and was found to be consistent with an alloy steel. Hardness measurements were taken per ASTM E18. The average hardness was found to be 50 HRC, consistent with alloy steel in a quenched and tempered condition.

Submitted by:

Brian Fuchs
Materials Engineer



Figure 1. Left landing gear leg as-received.

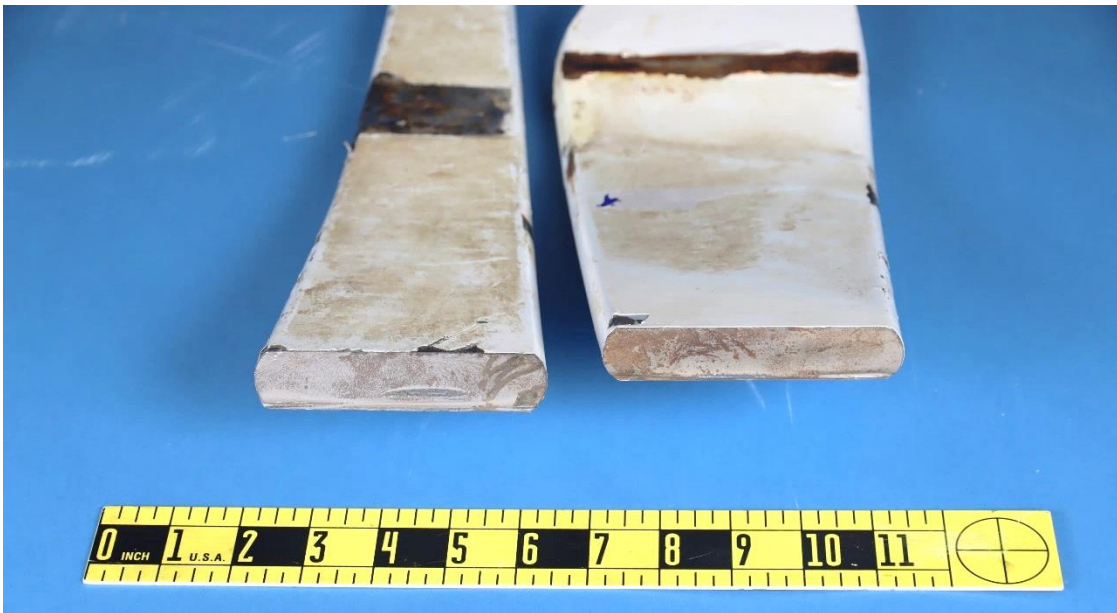


Figure 2. Fracture surfaces side-by-side.

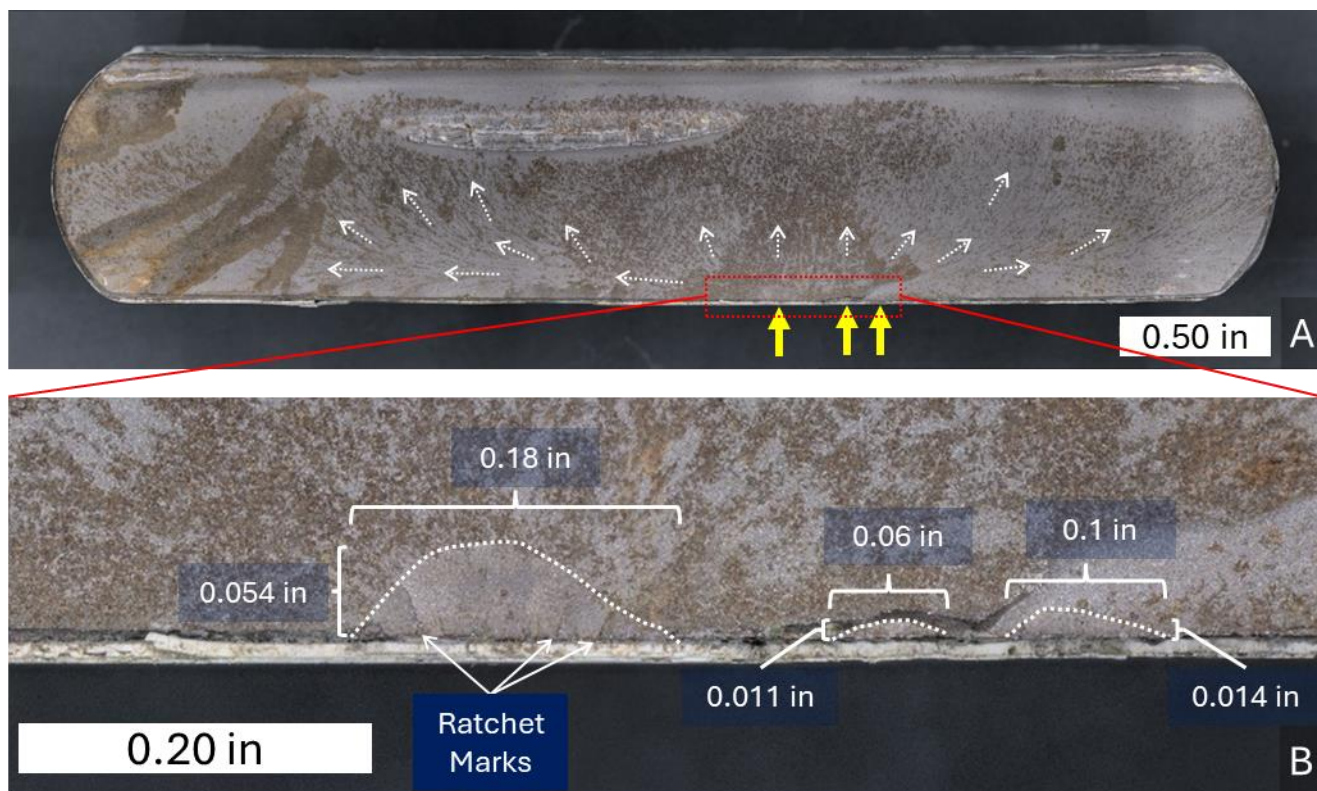


Figure 3. A) Outboard fracture surface. Yellow arrows mark the location of three thumbnail crack features at the lower edge, and white dashed arrows indicate the direction of crack propagation. B) Closer view and measurements of the thumbnail crack features.

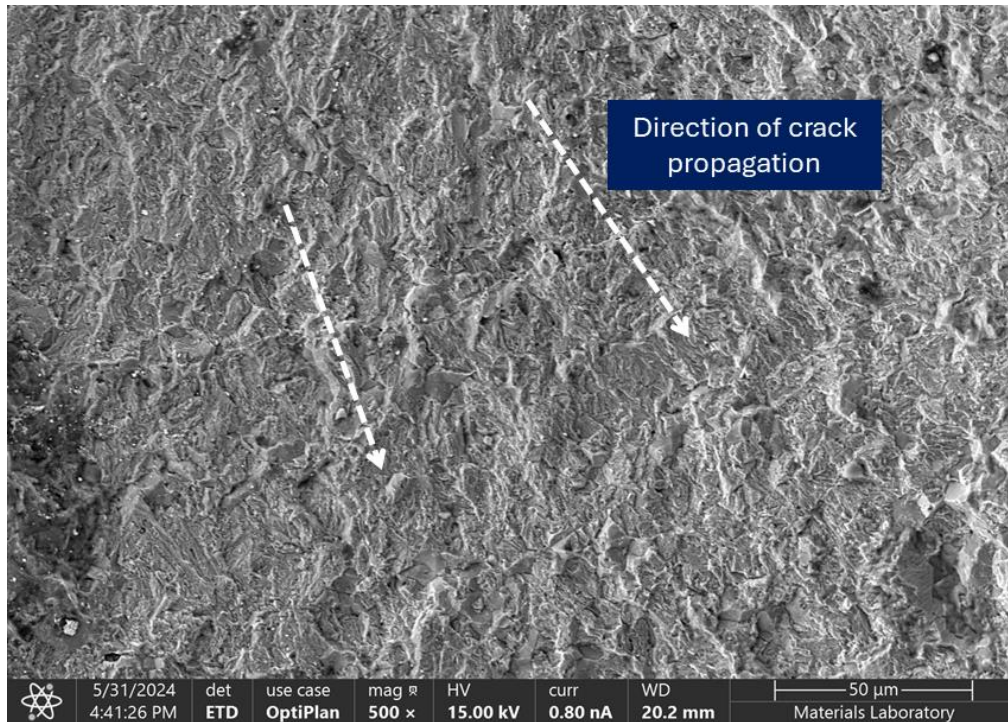


Figure 4. Secondary Electron (SE) image of the thumbnail surface showing striations interspersed with intergranular facets.

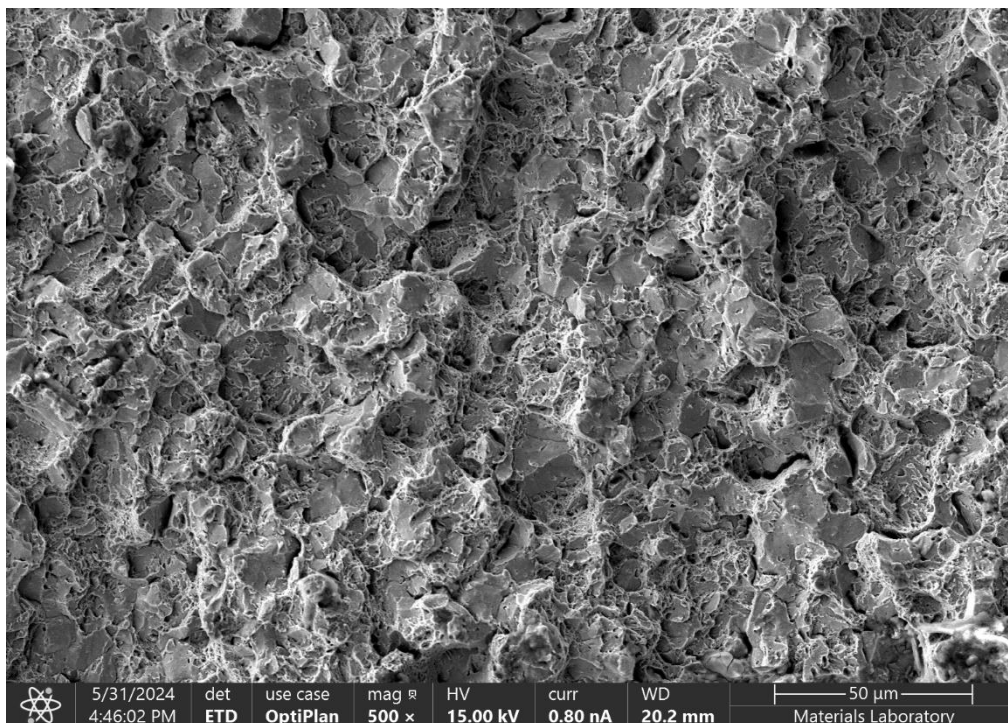


Figure 5. SE image of fracture surface outside the thumbnail region showing a mix of ductile dimpling and intergranular decohesion features.

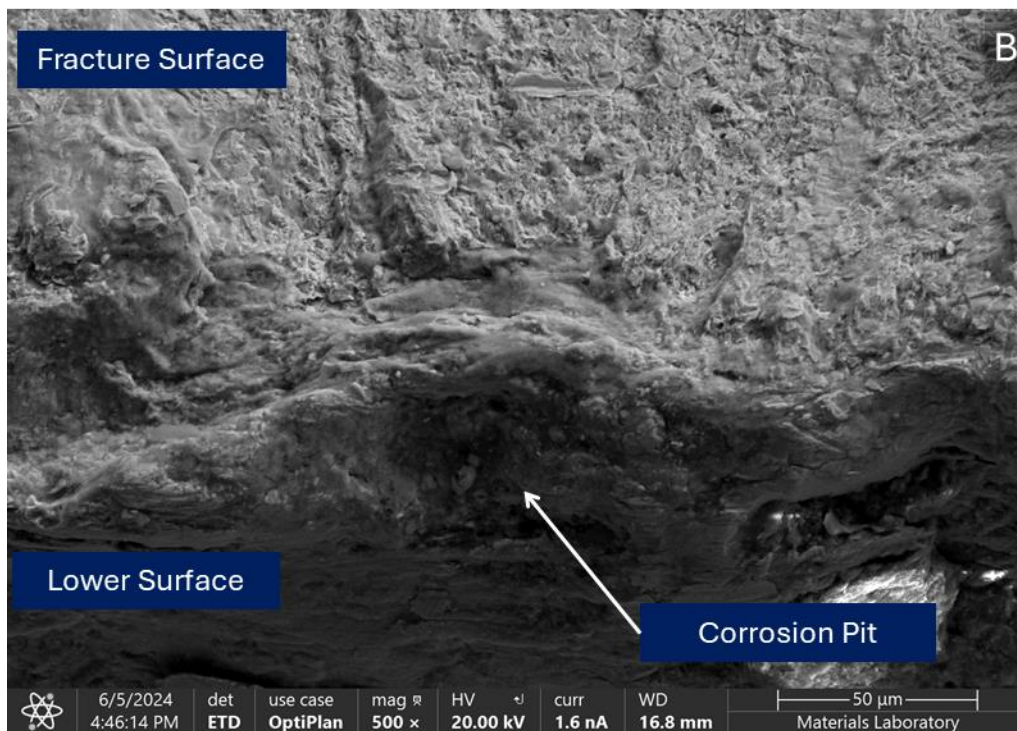
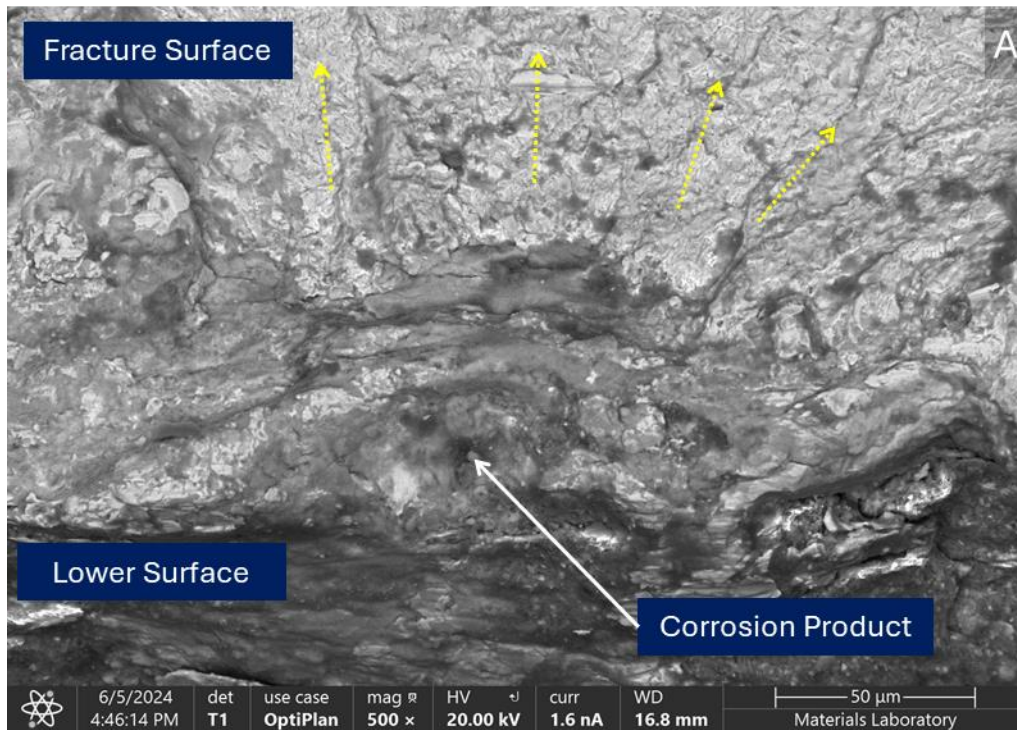


Figure 6. A) BE image of a corrosion pit at the base of a thumbnail feature. Yellow arrows indicate crack progression direction. B) SE image of same area showing corrosion pit.

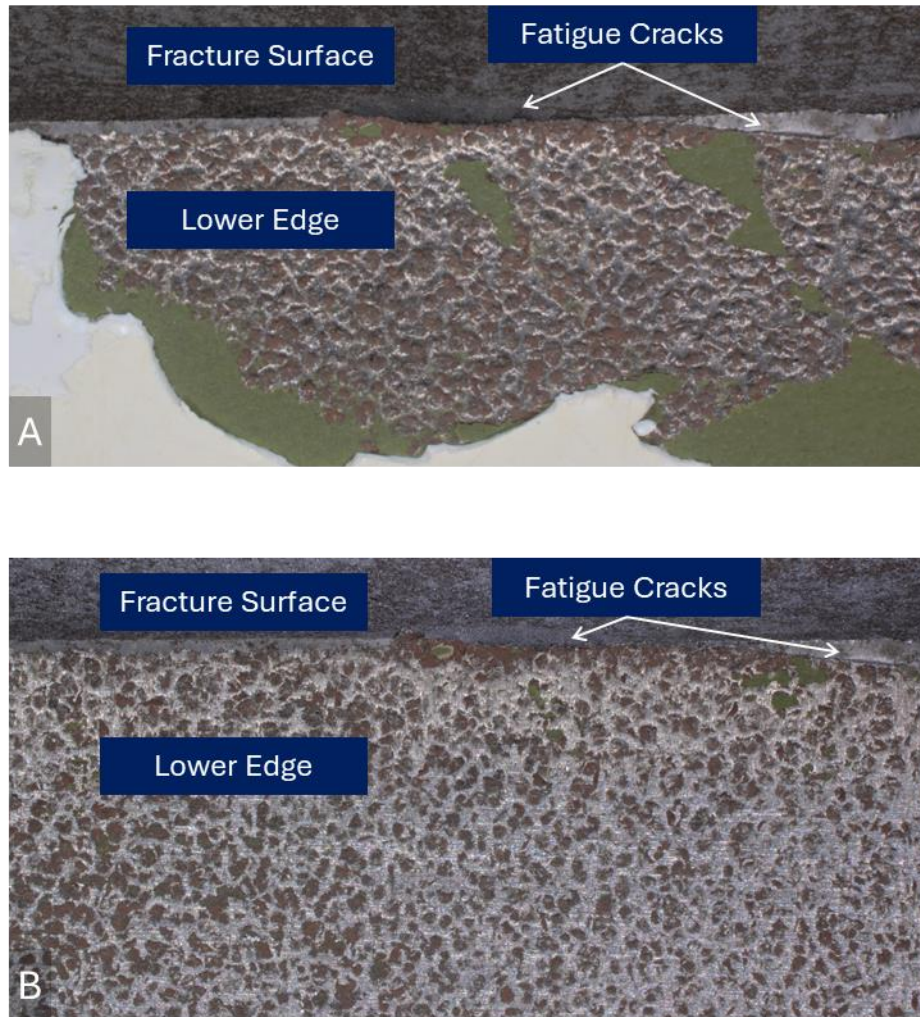


Figure 7. Bottom surface near the thumb nail cracks A) after initial cleaning with acetone in ultrasound bath and B) after repeated cleanings in an acetone ultrasound bath and application of a soft scrubber. Brown corrosion product was found in dimples where paint was removed.