

# National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



WPR21LA337

## **MATERIALS LABORATORY**

Factual Report 22-096

December 7, 2022

(This page intentionally left blank)

## **A. ACCIDENT INFORMATION**

Location: Enterprise, Oregon  
Date: September 2, 2021  
Vehicle: Cessna 172E, N3965S  
Investigator: Fabian Salazar (AS-WPR)

## **B. COMPONENTS EXAMINED**

Upper torque link pieces

## **C. EXAMINATION PARTICIPANTS**

Specialist                      Adrienne Lamm  
                                        National Transportation Safety Board  
                                        Washington, D.C.

## **D. DETAILS OF THE EXAMINATION**

The upper torque link for the nose wheel landing gear was found fractured during post flight inspection after the aircraft veered left and nosed over during landing. Both halves of the torque link were disassembled from the aircraft and submitted to the NTSB Materials Laboratory for examination.

The submitted torque link assembly is shown in Figure 1. The fracture in the upper torque link is indicated by the red arrow. A photo of exemplar nose landing gear with a matching red arrow indicating the approximate location of the fracture is also shown in Figure 1.

Figures 2 and 3 show the fracture in the upper torque link as viewed from the forward and aft sides, respectively. The resulting fracture surfaces of the upper torque link are shown in Figure 4. The fracture surface shown on the left in Figure 4 was sectioned from the longer upper torque link piece, then cleaned with mild detergent and rinsed in a methanol ultrasonic bath.

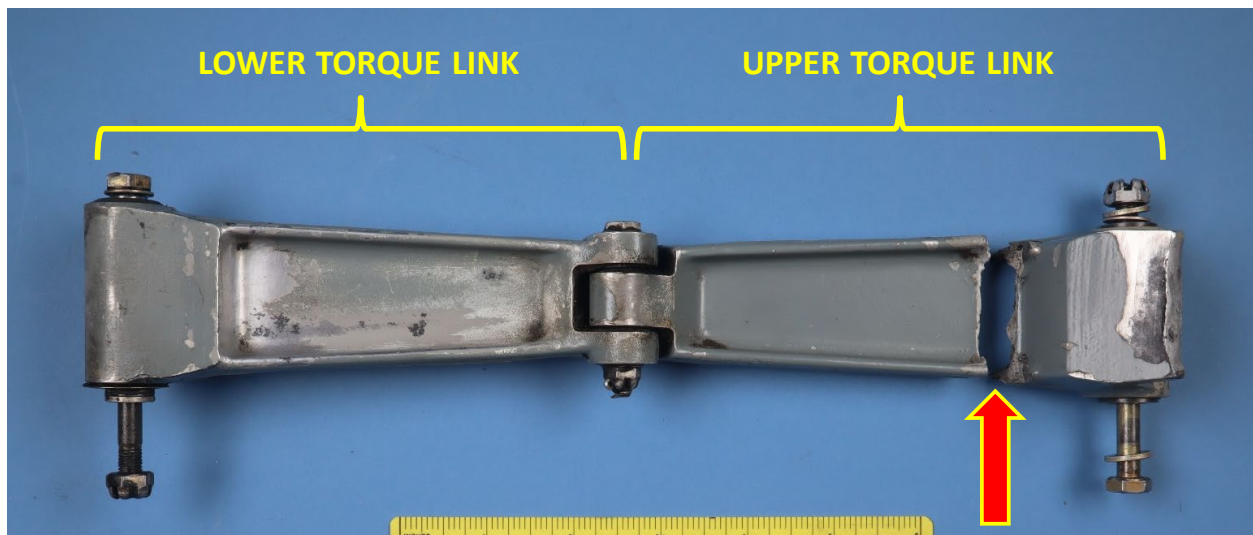
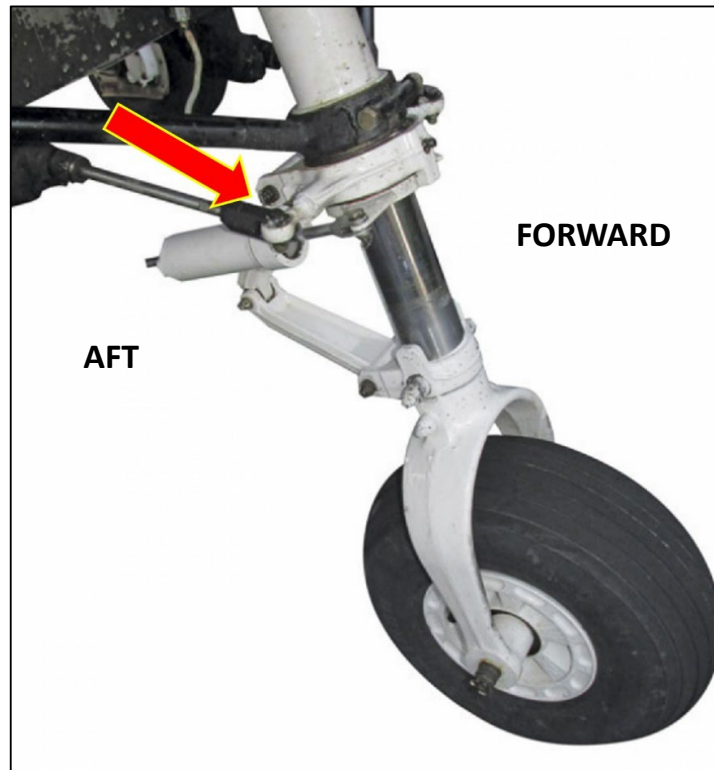
Flat areas were observed at the forward ribs on the fracture surface of the upper torque link. Digital microscope images of the forward ribs fracture surfaces are shown in Figures 5 and 6. Yellow brackets indicate the flat areas viewed in profile, while yellow dotted lines outline the flat areas on top-down views of the fracture surfaces. The flat areas emanated from the forward edge of the ribs and extended almost until the transition from the ribs to the web of the upper torque link.

The cleaned fracture surface was examined using a Thermo Scientific Apreo 2 field emission scanning electron microscope (SEM). Within the flat areas on the fracture surface transgranular features consistent with fatigue cracking were observed

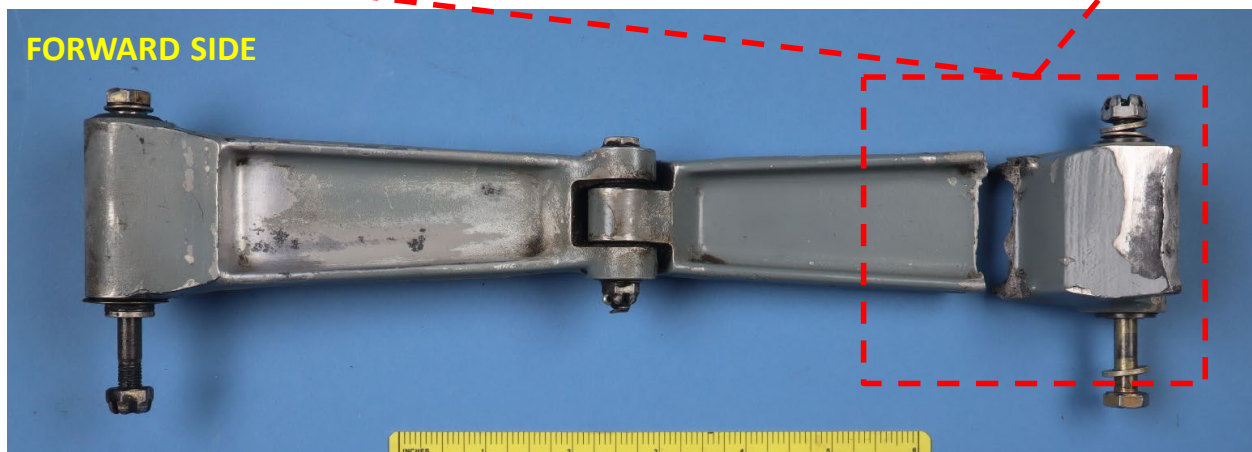
(top image, Figure 7). Outside the flat areas the fracture surface features were consistent with dimpled rupture from overstress (bottom image, Figure 7).

Submitted by:

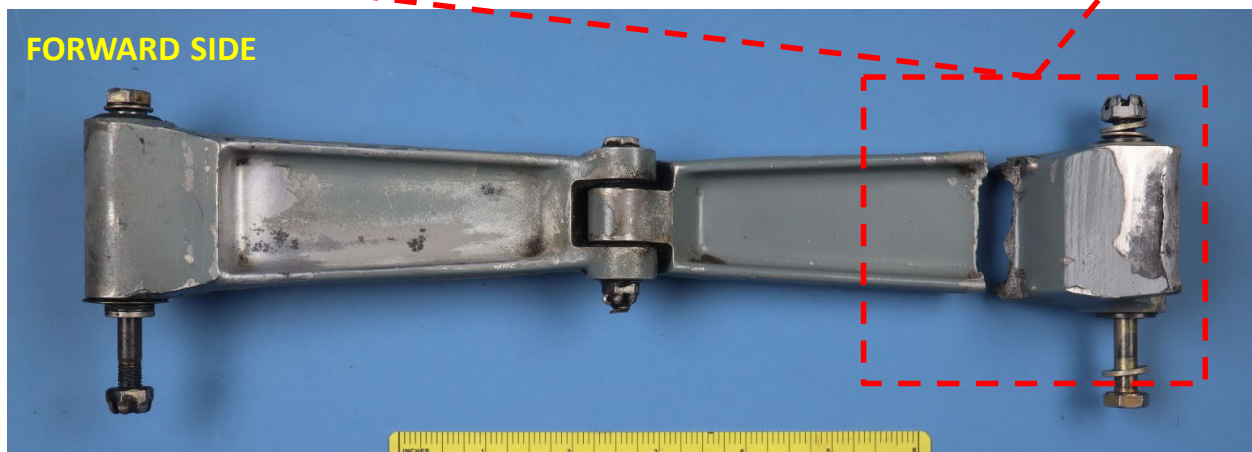
Adrienne V. Lamm  
Materials Engineer



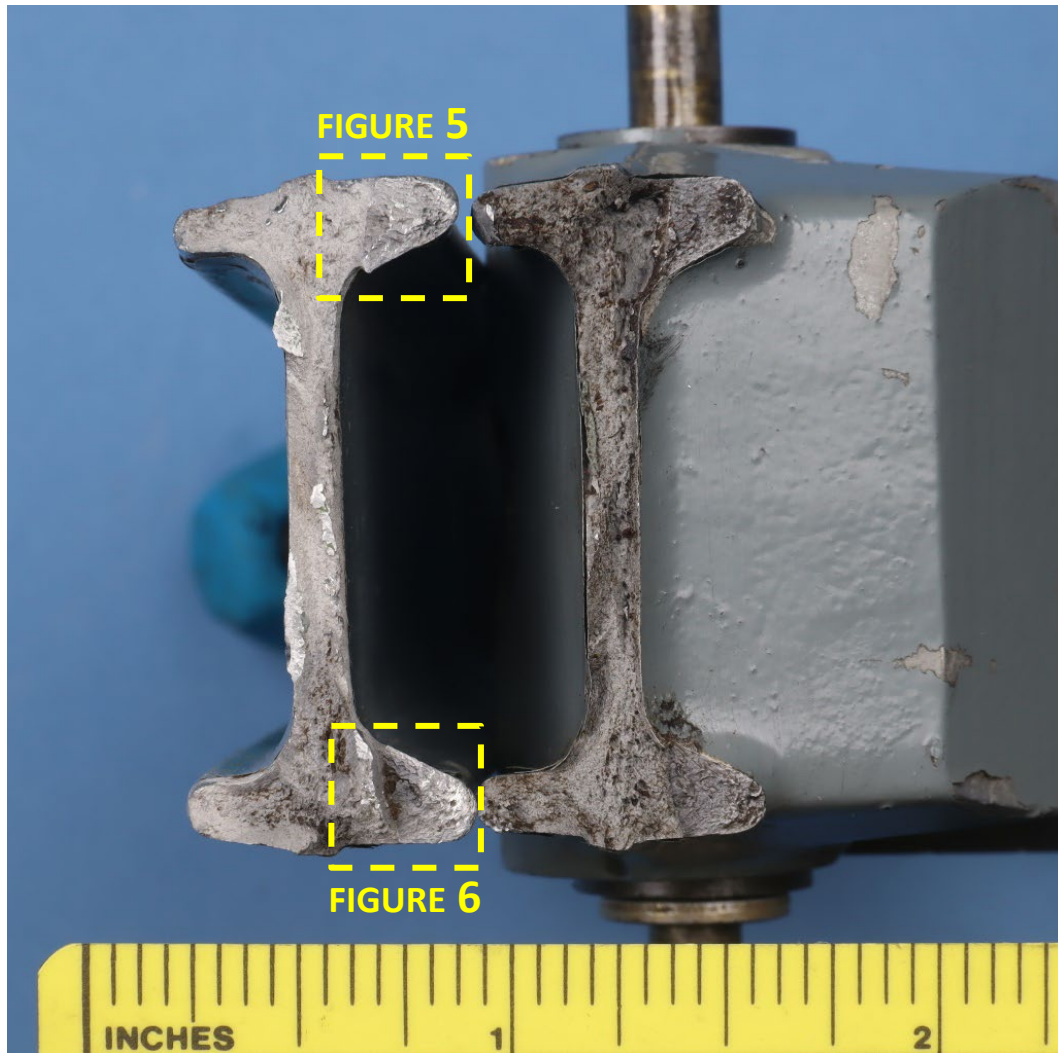
**Figure 1.** (Bottom) Overall photo of the submitted nose landing gear torque link assembly. (Top) Image showing an exemplar nose landing gear assembly. The red arrows point to the fracture in the upper torque link.



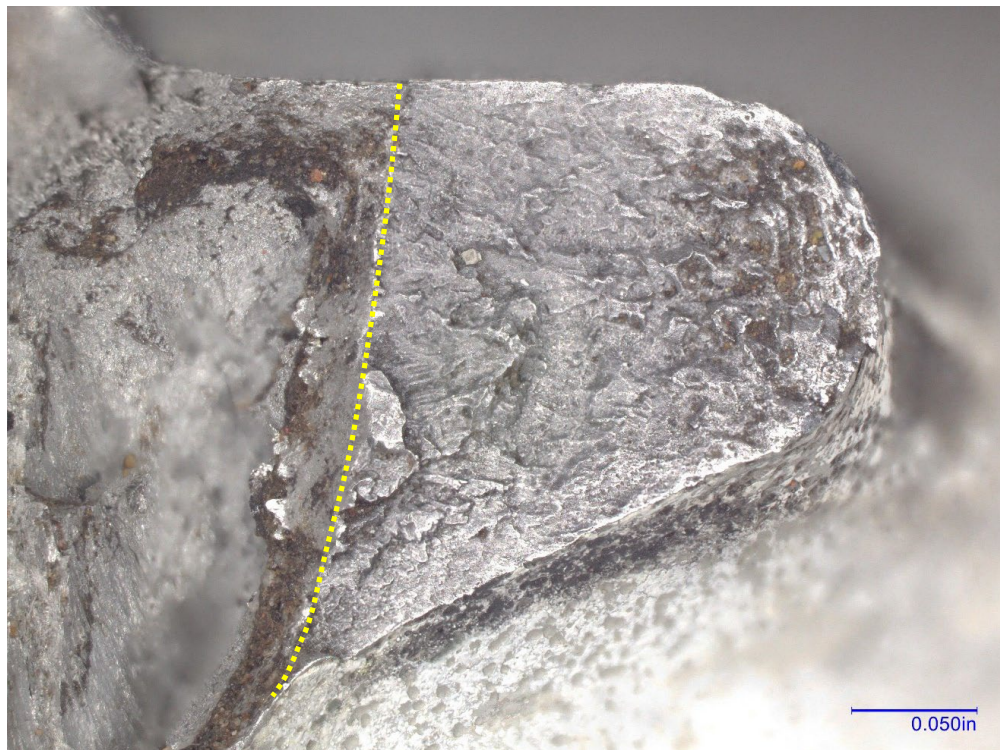
**Figure 2.** Overall and close-up photos of the forward side of the fractured upper torque link.



**Figure 3.** Overall and close-up photos of the aft side of the fractured upper torque link.



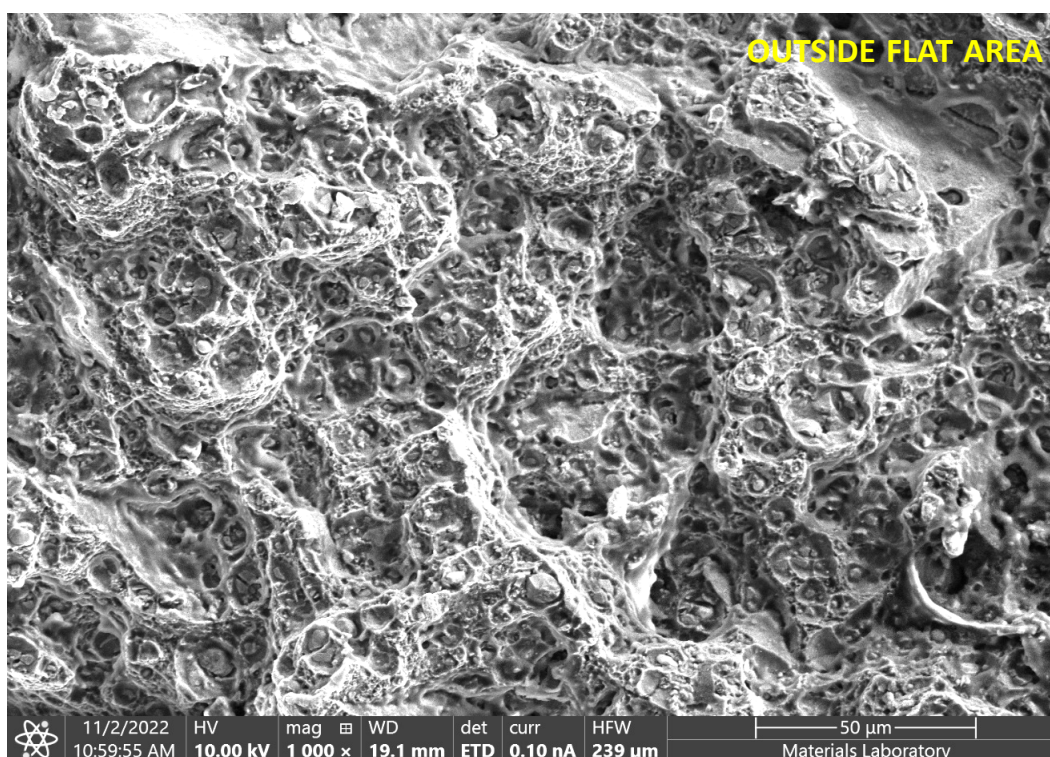
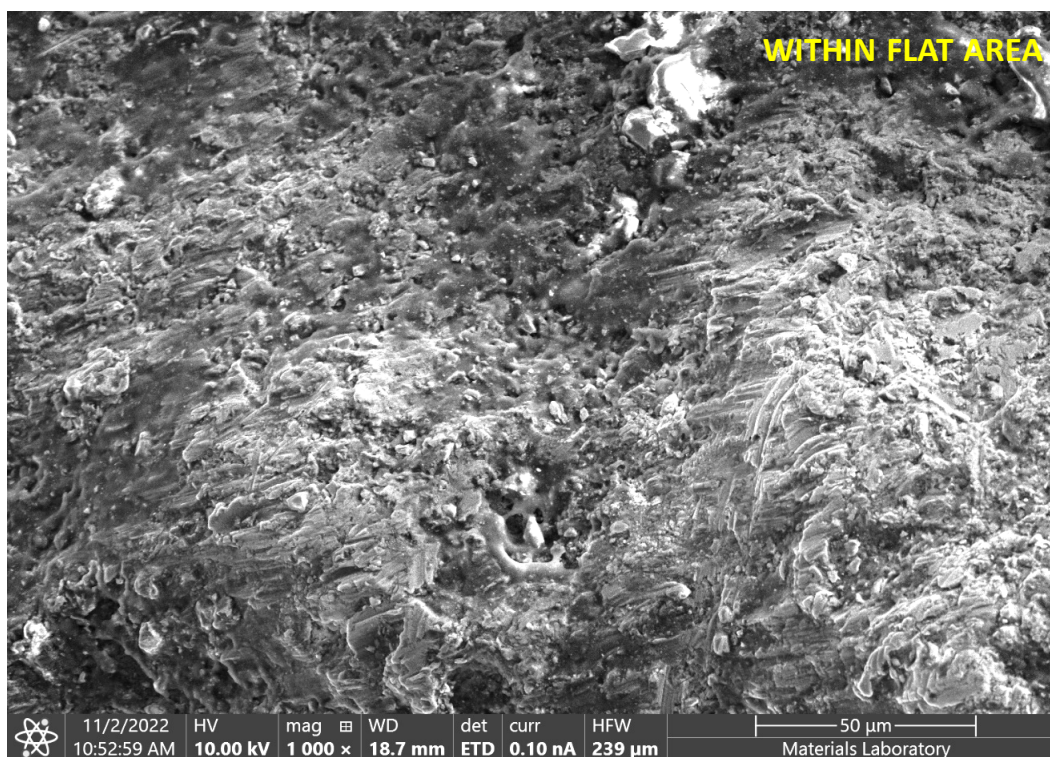
**Figure 4.** Close-up photo of the fracture surfaces of the upper torque link. The fracture surface on the left is shown after cleaning. The indicated areas are shown in more detail in Figures 5 and 6.



**Figure 5.** Digital microscope images showing the flat area (yellow bracket) on the fracture surface of the top rib indicated in Figure 4. The yellow dotted line delineates the edge of the flat area.



**Figure 6.** Digital microscope images showing the flat area (yellow bracket) on the fracture surface of the bottom rib indicated in Figure 4. The yellow dotted line delineates the edge of the flat area.



**Figure 7.** The top image is a secondary electron SEM image showing fracture surface features within the flat area on the bottom rib shown in Figure 6. The bottom image is a secondary electron image showing fracture surface features within the web of the fractured upper link piece, away from the flat areas on both ribs.