

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA23FA247

MATERIALS LABORATORY

Factual Report 23-073

September 1, 2023

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A. ACCIDENT INFORMATION

Location: Lake Worth, Florida
Date: May 26, 2023
Vehicle: Cessna 172P, N3KV
Investigator: Heidi Kemner (AS-ERA)

B. COMPONENTS EXAMINED

Aileron cable

C. EXAMINATION PARTICIPANTS

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

D. DETAILS OF THE EXAMINATION

The subject aircraft crashed shortly after takeoff, with both passengers aboard fatally injured. During the post-crash examination, a separation was noted in the aileron cable in the vicinity of the left upper door post right direct aileron cable pulley. The full cable was submitted to the NTSB Materials Laboratory for examination.

The separated aileron cable pieces were submitted in two bags, one labeled "attached to R wing" and the other labeled "connected inside fuselage". The R wing cable piece had separated approximately 24 inches from the fitting end. The cable attached to the fuselage end was secured in a coil. The cable is shown in Figure 1, with a close-up of the separation visible in the top image. The cable strands remained bundled, and the separated ends of the cable tapered to points, with only a few wires splayed outwards. The cable in the vicinity of the separation was coated in reddish-brown colored deposits consistent with corrosion.

Digital microscope images show the reddish-brown deposits of the separated end of the R wing cable piece in Figure 2. Very thick deposits made the strands look like solid pieces and appeared to hold the bundled wires together. Approximately 2 inches from the end of the separation was sectioned from the R wing cable piece. The sectioned piece was iteratively cleaned by soaking in Evapo-Rust® (CRC Industries, Horsham PA) heavy rust remover in an ultrasonic bath. Figure 3 shows digital microscope images of the sectioned piece after cleaning. A few wires had uneven, localized thinning either at the separated ends or along the length of the wire. Pockmarks consistent with corrosive attack were observed on the surfaces of numerous wires. Some of the wire ends had necked down, with cup-cone fractures visible, while other wires had no thinning and angled fractures at the ends.

The cleaned sectioned piece from the R wing cable end was examined using a scanning electron microscope (SEM). The outer diameter (OD) surfaces of the wires had a layered woody appearance, with some areas shedding material layers, as indicated by the yellow brackets in Figures 4 and 5. The uneven, localized thinning observed in some wire cross-sections (yellow dotted circles) resulted from substantial shedding of material. Pockmarks were observed on the surfaces of most wires. The woody appearance, shedding material, and pockmarks were all consistent with corrosive attack.

The angled fracture surfaces visible on some wires in Figures 4 and 5 had the same layered woody appearance as the wire OD surfaces. The similarities indicate those wires likely fractured in tension due to embrittlement and weakening from corrosive attack. A few necked down wires are shown in Figures 6 and 7. The cup-cone fractures on the necked down wires had dimpled features consistent with ductile tensile overstress on the majority of the fracture surfaces. Pockets of layered woody features consistent with corrosive attack were visible between the dimpled features. Figure 8 compares a fracture surface fully covered in layered woody features with a cup-cone fracture surface that has only pockets of layered woody features (yellow arrows) interspersed in majority dimpled features (blue arrows).

Submitted by:

Adrienne V. Lamm
Materials Engineer

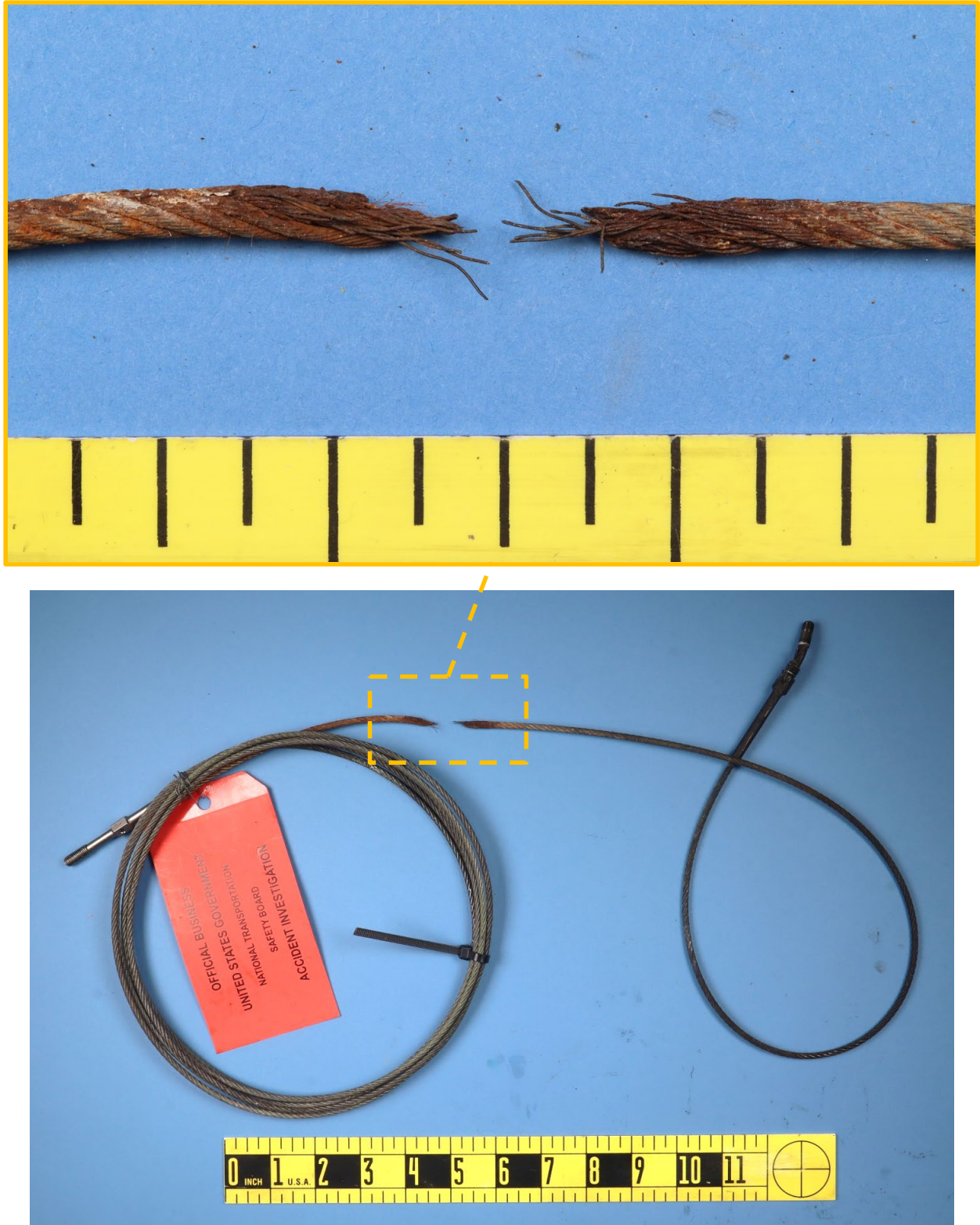


Figure 1. (Bottom) Macro photo showing the submitted cable pieces. (Top) Close-up photo showing the separated ends of the cable pieces.

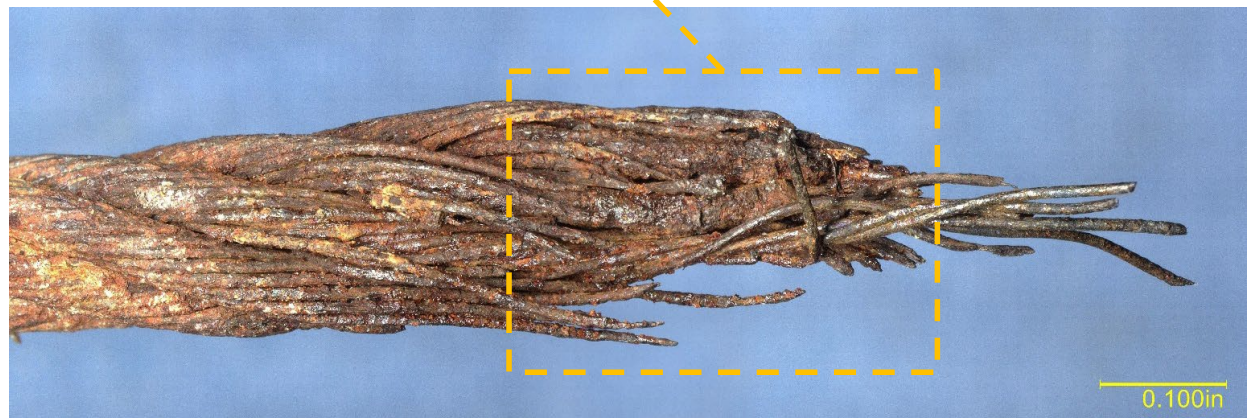


Figure 2. Digital microscope images of the separated end of the R wing cable piece in the as-submitted condition.

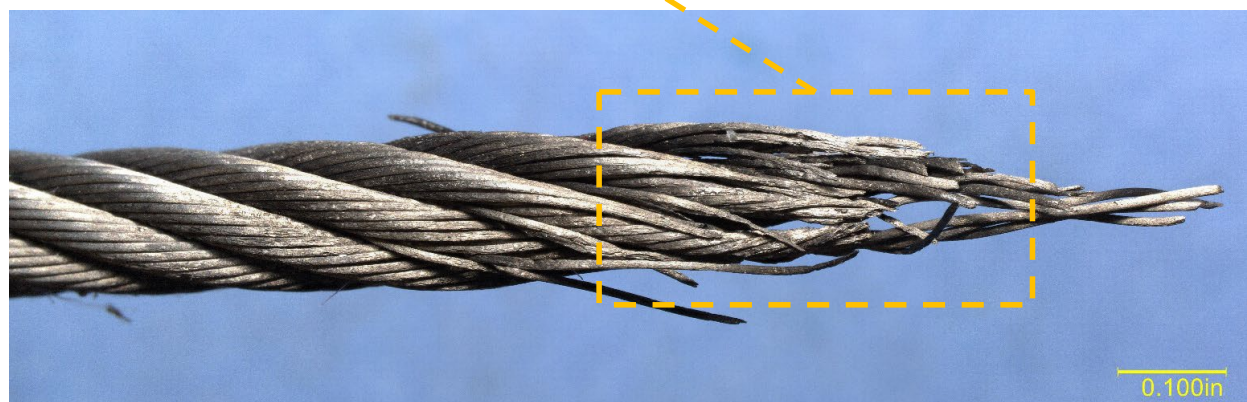


Figure 3. Digital microscope images of the separated end of the R wing cable piece after cleaning.

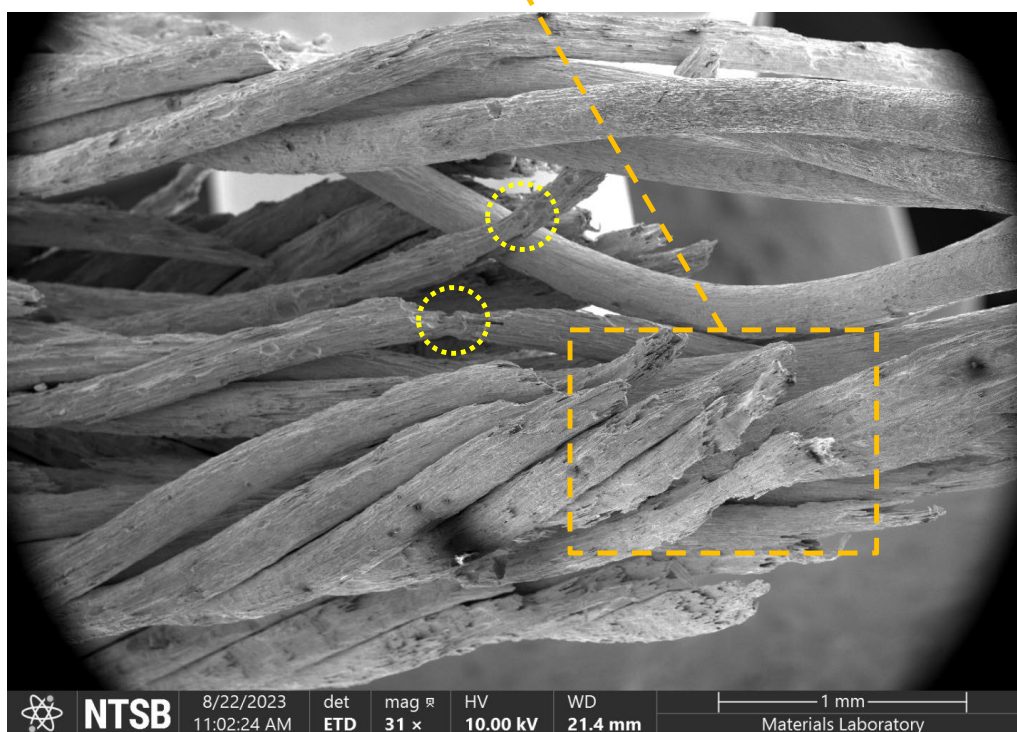
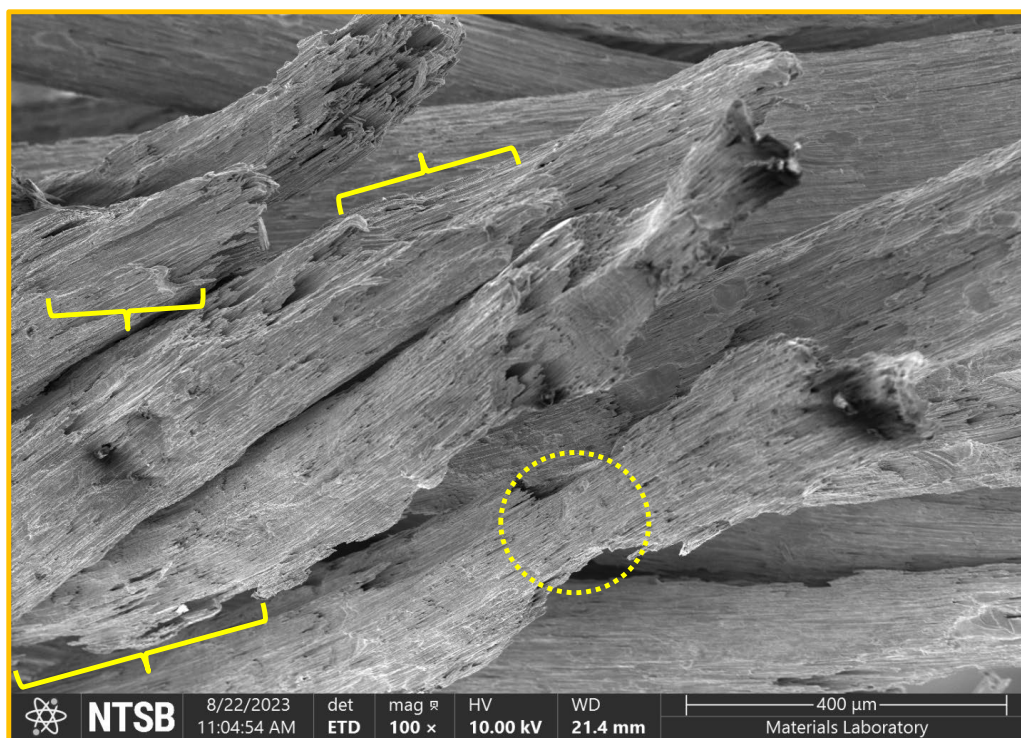


Figure 4. SEM images of the separated end of the R wing cable piece after cleaning. The yellow brackets indicate areas where material is shedding in layers from wires. Uneven, localized thinning in wire cross-sections resulting from material shedding is indicated by yellow dotted circles.

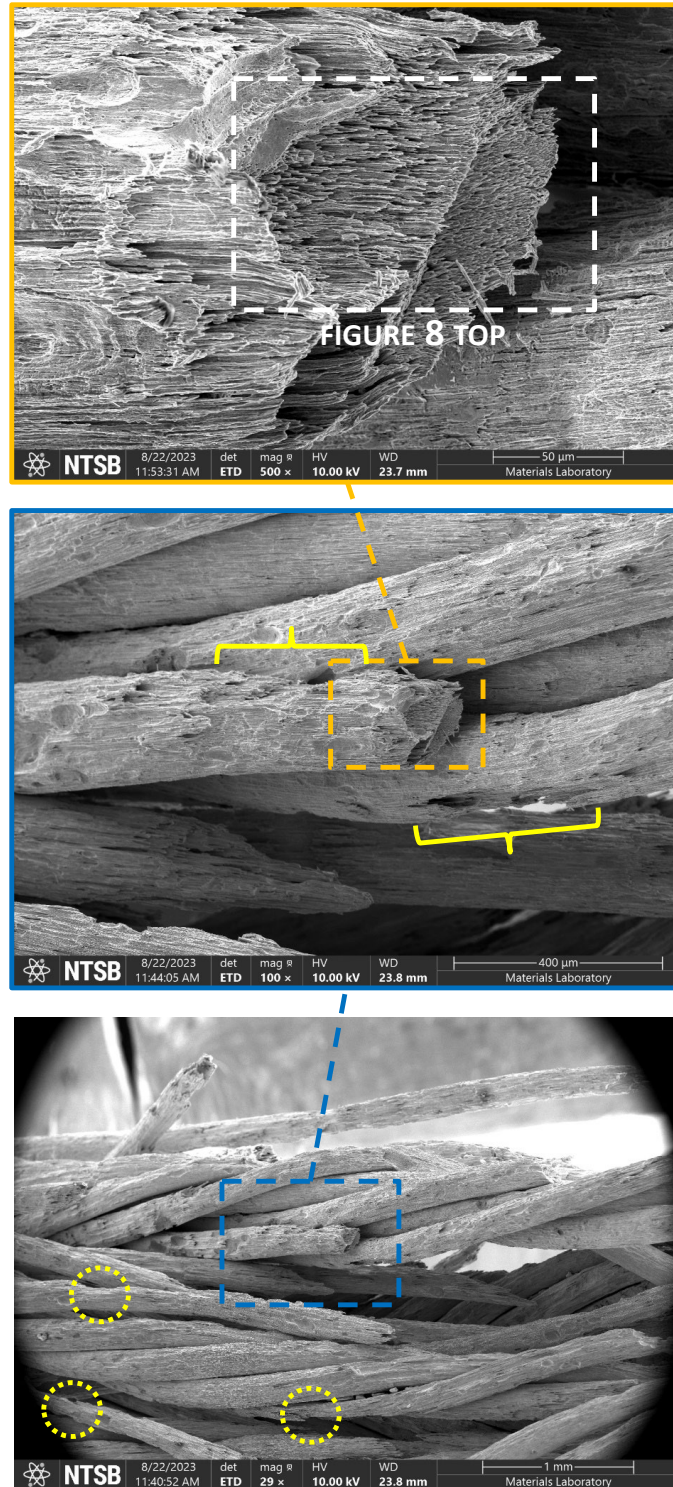


Figure 5. SEM images of the separated end of the R wing cable piece after cleaning. The yellow brackets indicate areas where material is shedding in layers from wires. Uneven, localized thinning in wire cross-sections resulting from material shedding is indicated by yellow dotted circles.

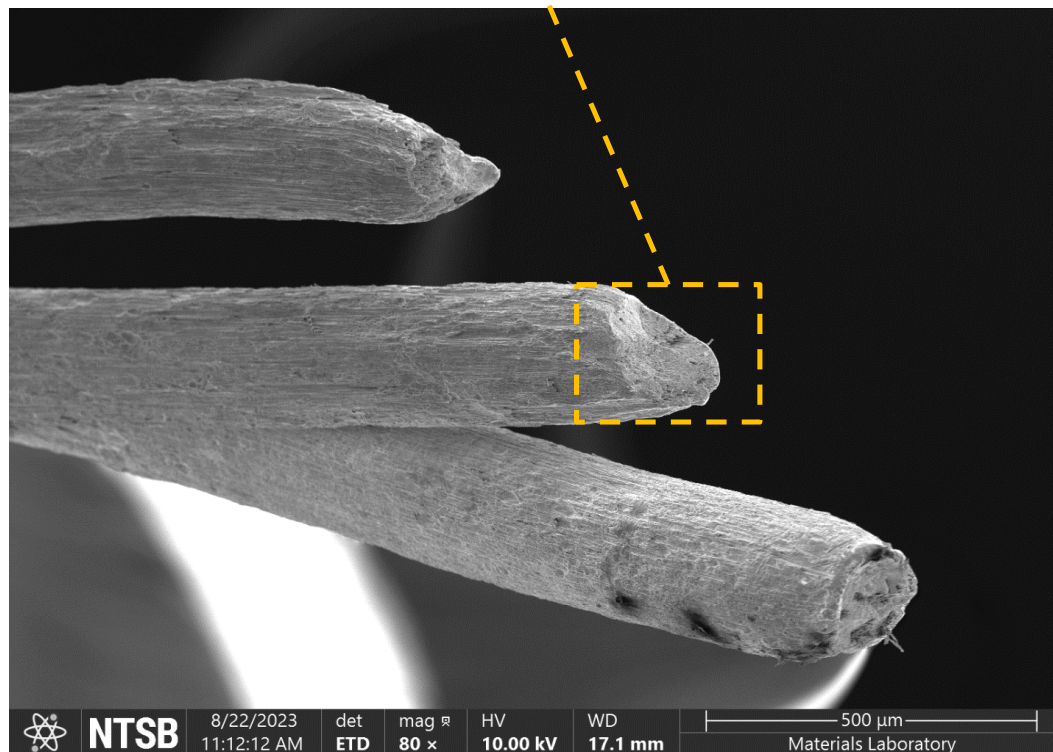
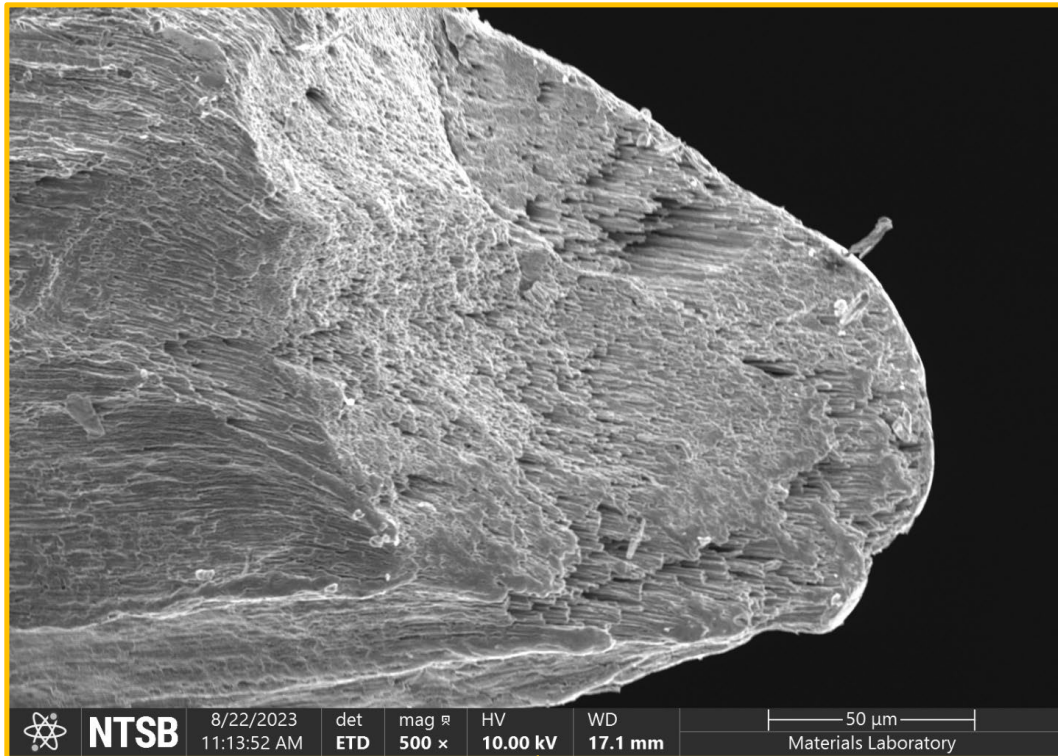


Figure 6. SEM images of wires with necking and cup-cone fractures observed in the separated end of the R wing cable piece after cleaning.

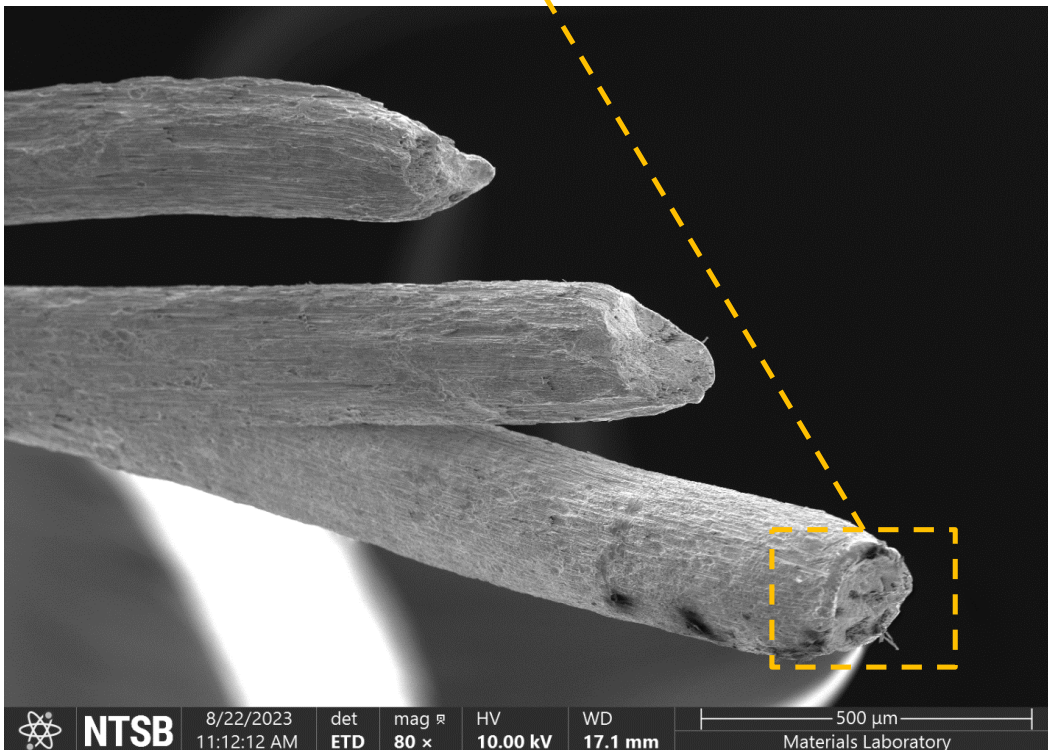
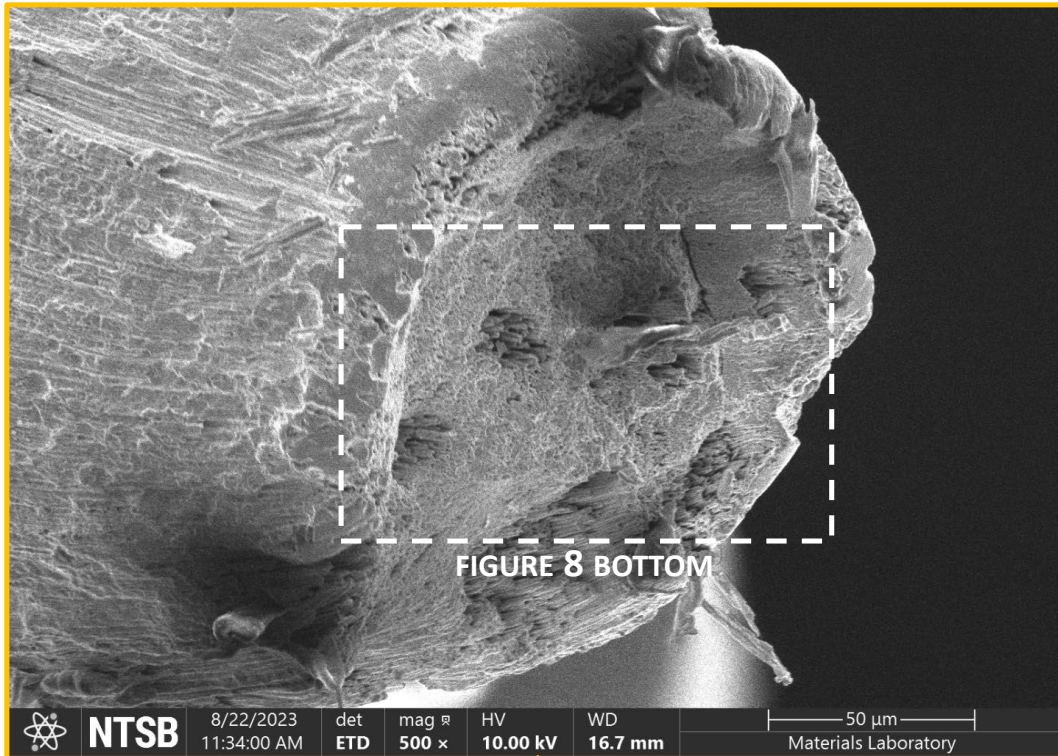


Figure 7. SEM images of wires with necking and cup-cone fractures observed in the separated end of the R wing cable piece after cleaning.

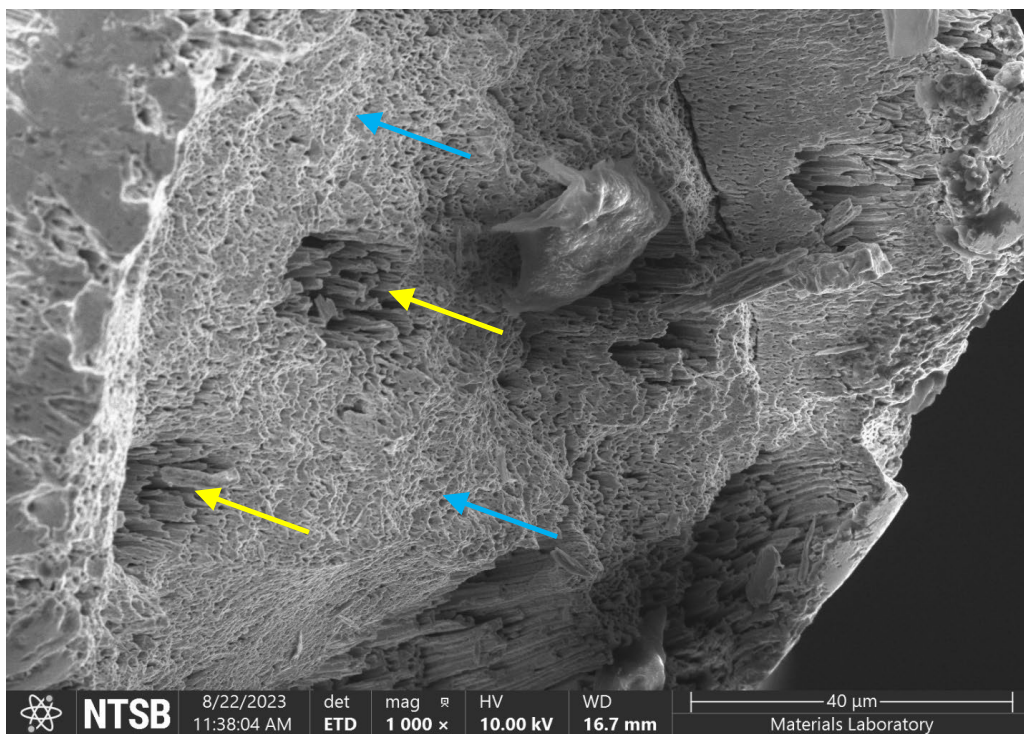
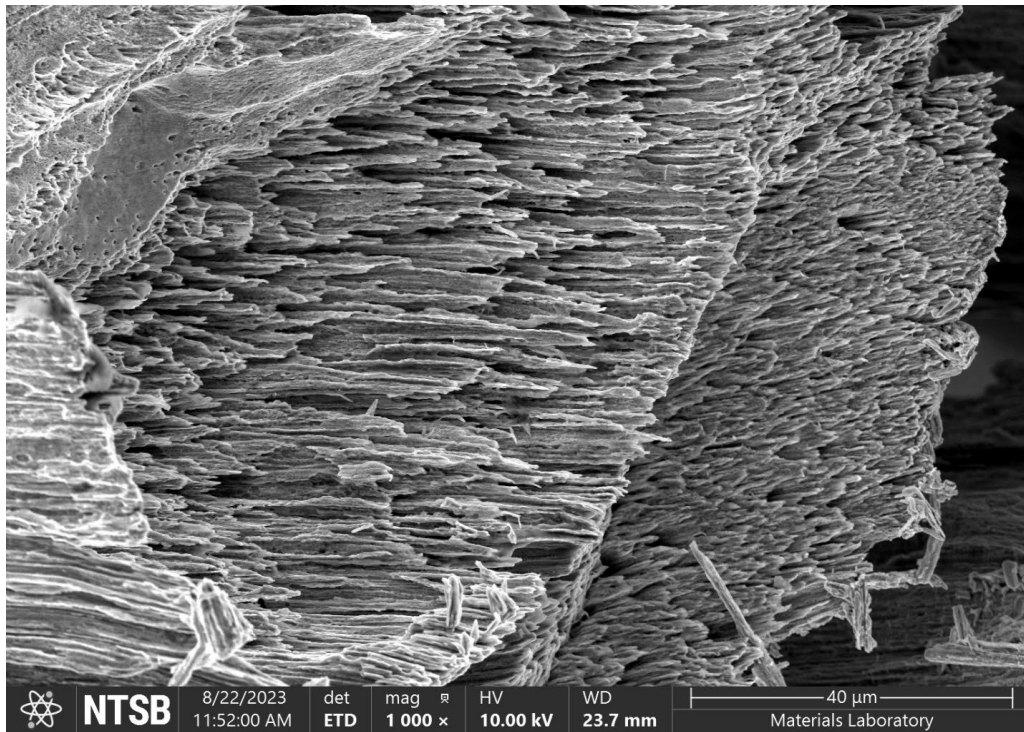


Figure 8. SEM images comparing a wire that had an angled fracture surface (top) and a wire that had a cup-cone fracture surface (bottom) in the separated end of the R wing cable piece after cleaning. The pockets of layered woody features (yellow arrows) from corrosive attack were observed interspersed with dimpled features (blue arrows) from ductile tensile overstress on the cup-cone fracture surface.