

# NATIONAL TRANSPORTATION SAFETY BOARD

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



December 23, 2015

## MATERIALS LABORATORY FACTUAL REPORT

Report No. 15-126

### A. ACCIDENT INFORMATION

Place : Kasilof, Alaska  
Date : August 22, 2015  
Vehicle : Cessna 180 (N3043E)  
NTSB No. : ANC15FA066  
Investigator : Shaun Williams

### B. COMPONENTS EXAMINED

Two pieces of top elevator wire rope.

### C. DETAILS OF THE EXAMINATION

The submitted wire rope pieces are shown in Figures 1 and 2 with forward and aft orientations of the rope labelled. As-received, the surfaces of the wire rope wires exhibited corrosion product on all surfaces—including fracture surfaces.

Using a 5X to 50X stereo-zoom microscope and a 5X to 200X digital microscope, the fractured ends of the wire rope pieces were examined. Representative images of the fractured end labelled "wire rope fracture A" in Figure 2 are shown in Figures 3-5. Corrosion product obscures the surfaces and the fractured ends of the wires.

The fractured ends of the wire rope pieces were cut from the larger wire rope pieces and were cleaned to remove corrosion product<sup>1</sup>. After cleaning, the fractured wires were examined using a 5X to 50X stereo-zoom microscope and a 5X to 200X digital microscope. Representative digital microscope images are shown in Figures 6 and 7. In all instances, the wire fracture surfaces exhibited necking and shear lips consistent with overstress fracture.

The fractured end labelled "wire rope fracture A" (Figure 2) was also examined by scanning electron microscope (SEM). Representative SEM images are shown in Figures 8-10. In addition to necking and shear lip features, the SEM images revealed gouging and skiving scars on the wire surfaces. In some instances, gouging scars are present at the wire fracture surface (see Figures 8b, 9a, and 10). Some of the fractured wires exhibited tight-radius bends at the fractured end as depicted in Figures 8b and 9a. Skiving scars were observed on the surfaces of some wires as indicated in Figure 9b.

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<sup>1</sup> Immersed in room temperature Evapo-Rust® for 60 minutes and exposed to 1 minute of ultrasonic cleaning.

Dimensional measurements were performed on a cleaned portion of the wire rope sample using a digital micrometer. The wire rope average diameter is approximately 0.137 inch. The average wire diameter is approximately 0.0077 inch. The rope is comprised of 7 strands and each strand contains 19 wires (1 x 19 configuration). The bundles and rope are right-hand twisted. Hence the wire rope dimensions are consistent with 1/8 inch diameter 7 x 19 right-hand lay wire rope.

Using a Thermo Scientific Niton XL3t-980 x-ray fluorescence (XRF) alloy analyzer, the wire rope contained significant concentrations of iron and minor concentrations of zinc, consistent with the zinc-coated steel wire.

Michael Budinski  
Chief, Materials Laboratory Division

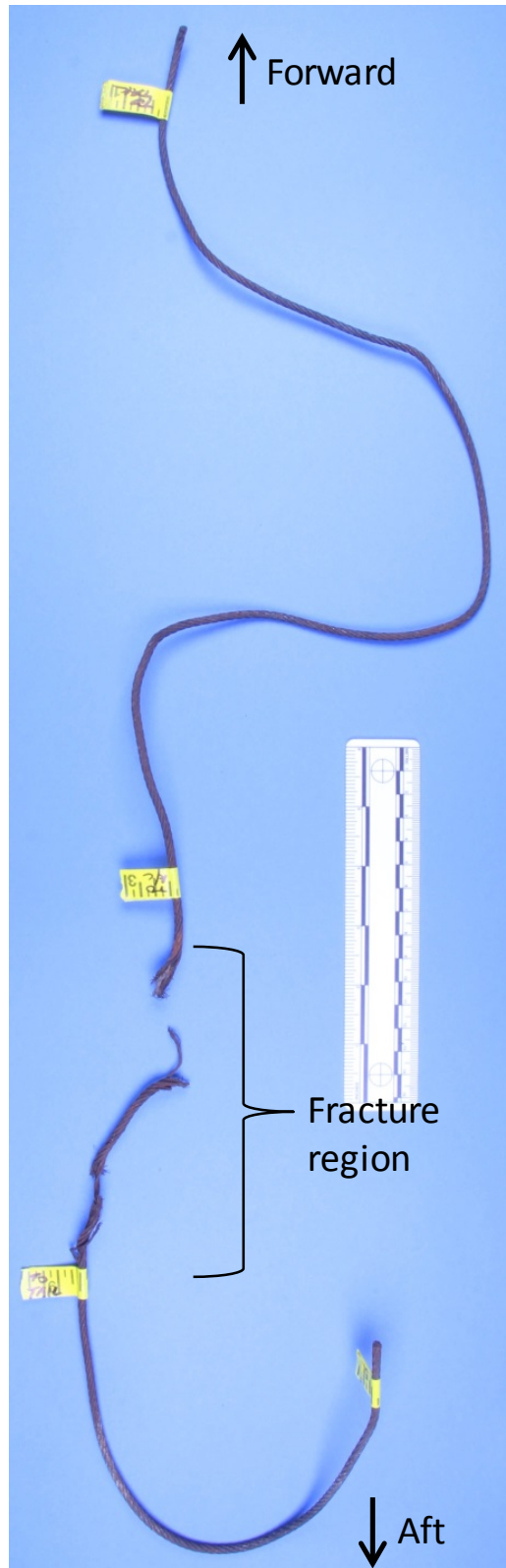


Figure 1 As-received wire rope pieces, arranged according to the forward and aft directions of the airplane.



Figure 2 Closer view of the fractured ends on the wire rope pieces.



Figure 3 Digital microscope images of the end labeled “wire rope fracture A” in Figure 2 (before cleaning). A higher magnification image is shown in view b.

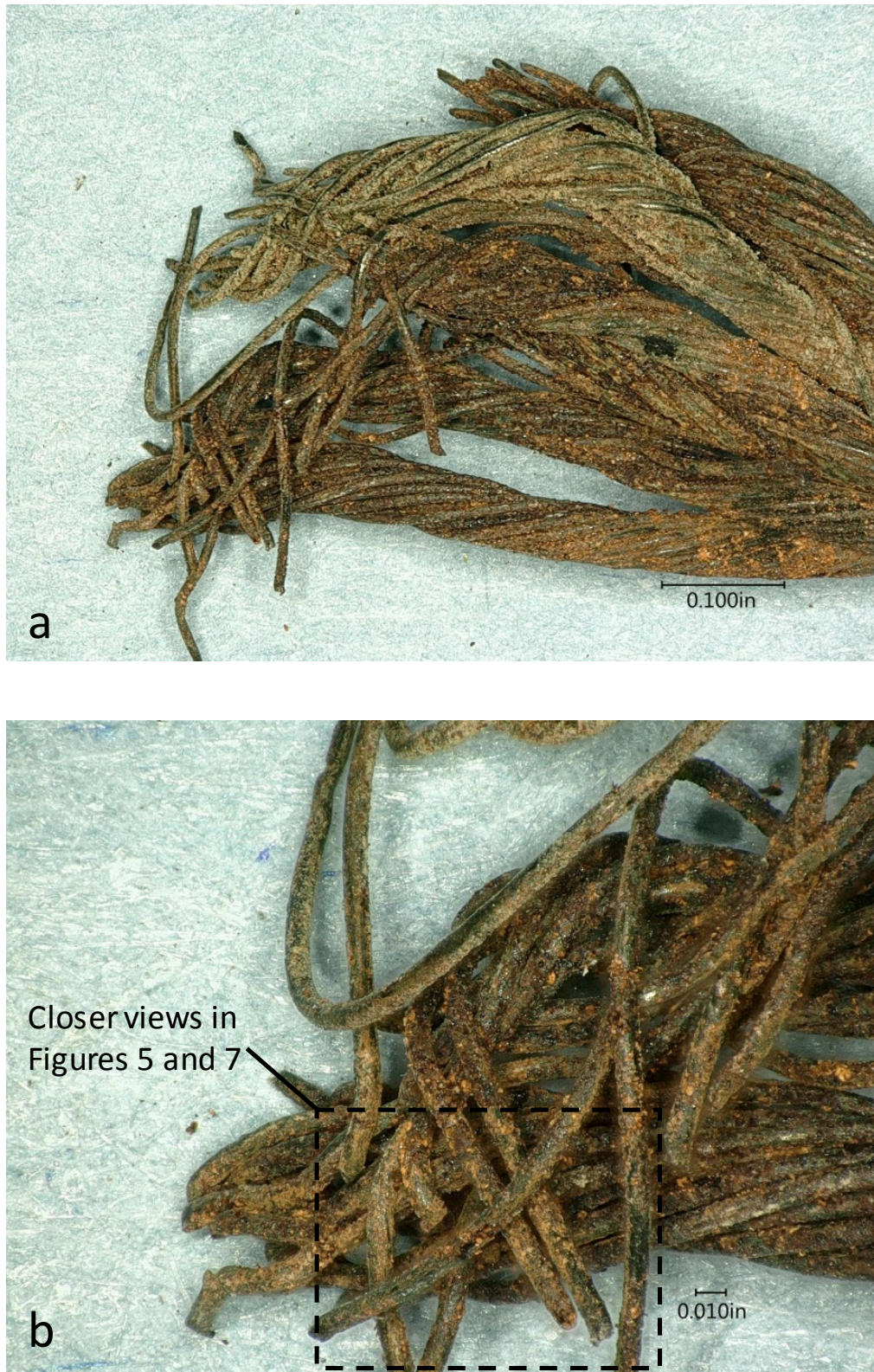


Figure 4 Digital microscope images of the end labeled “wire rope fracture A” in Figure 2 , the reverse side of Figure 3 (before cleaning). A higher magnification image is shown in view b.

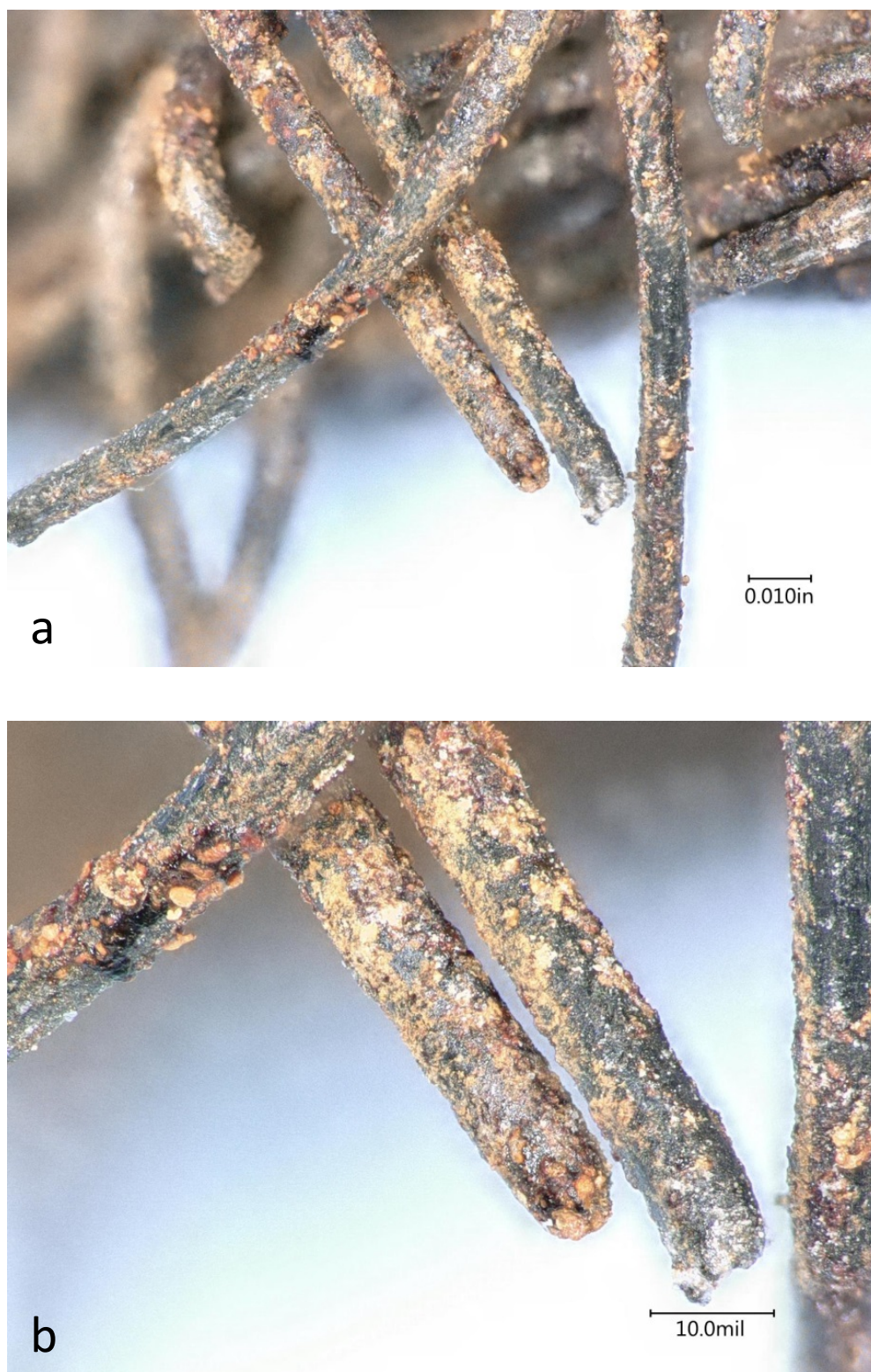


Figure 5 Digital microscope images of individual wires identified in Figure 4b (before cleaning).

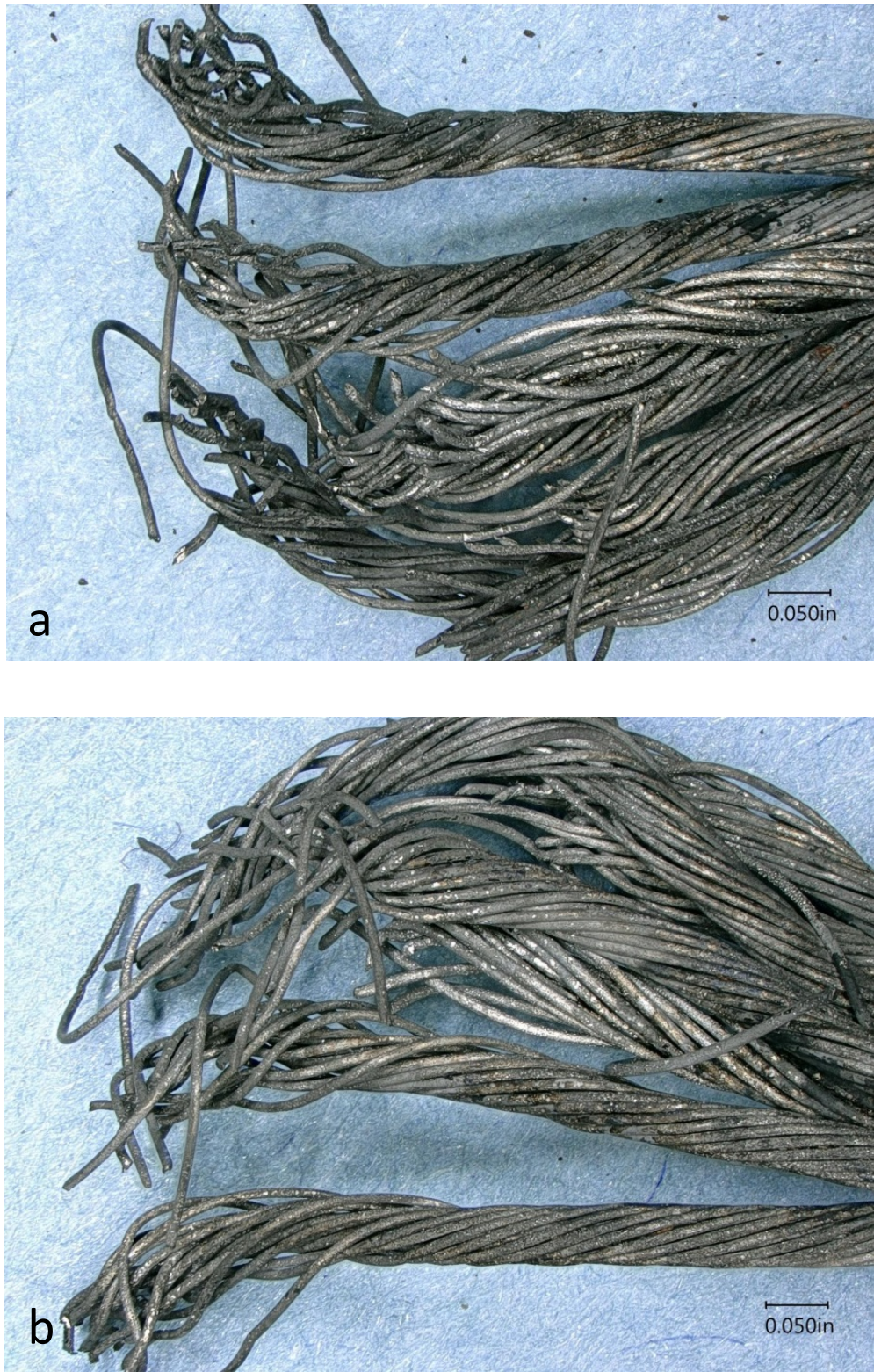


Figure 6 Digital microscope images of the end labeled “wire rope fracture A” in Figure 2 (after cleaning to remove corrosion product). View a is the obverse side shown in Figure 3a. View b is the reverse side shown in Figure 4a.

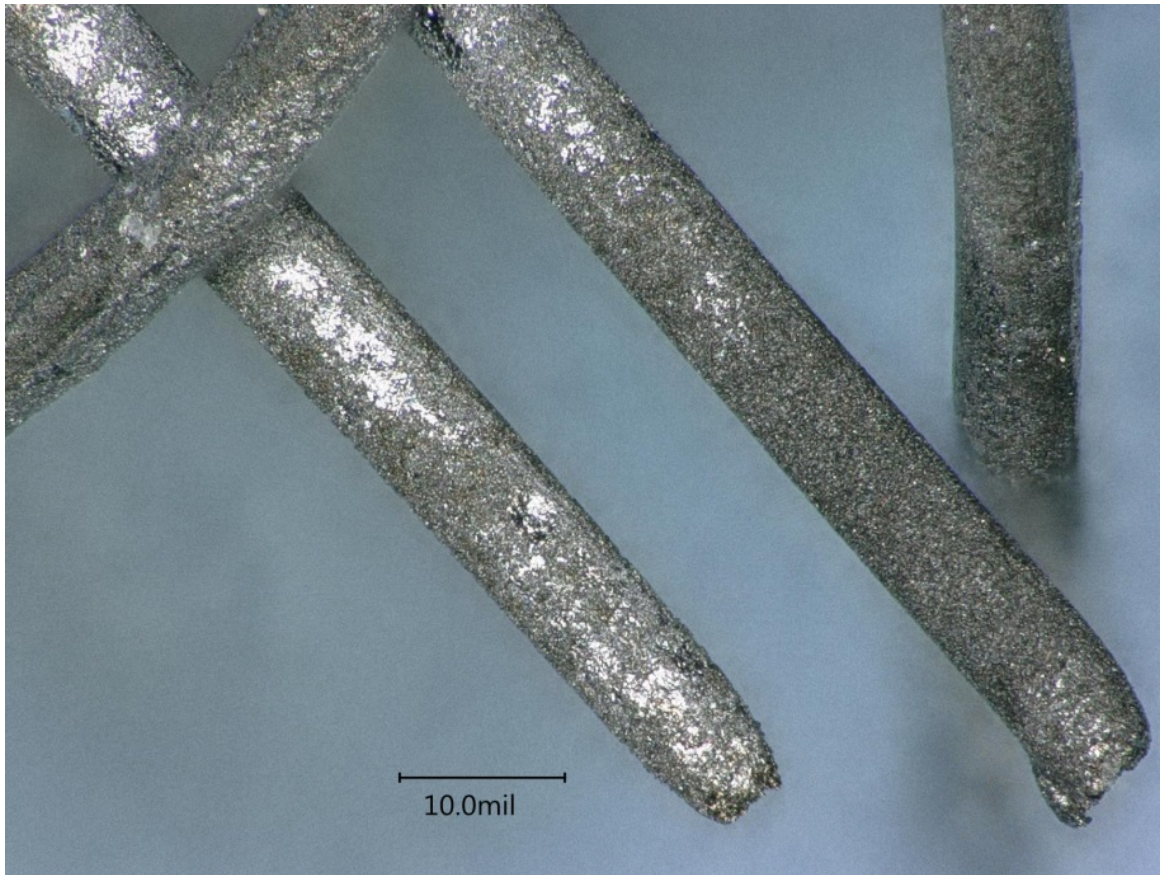


Figure 7 Digital microscope images of individual wires identified in Figure 4b (after cleaning to remove corrosion product).

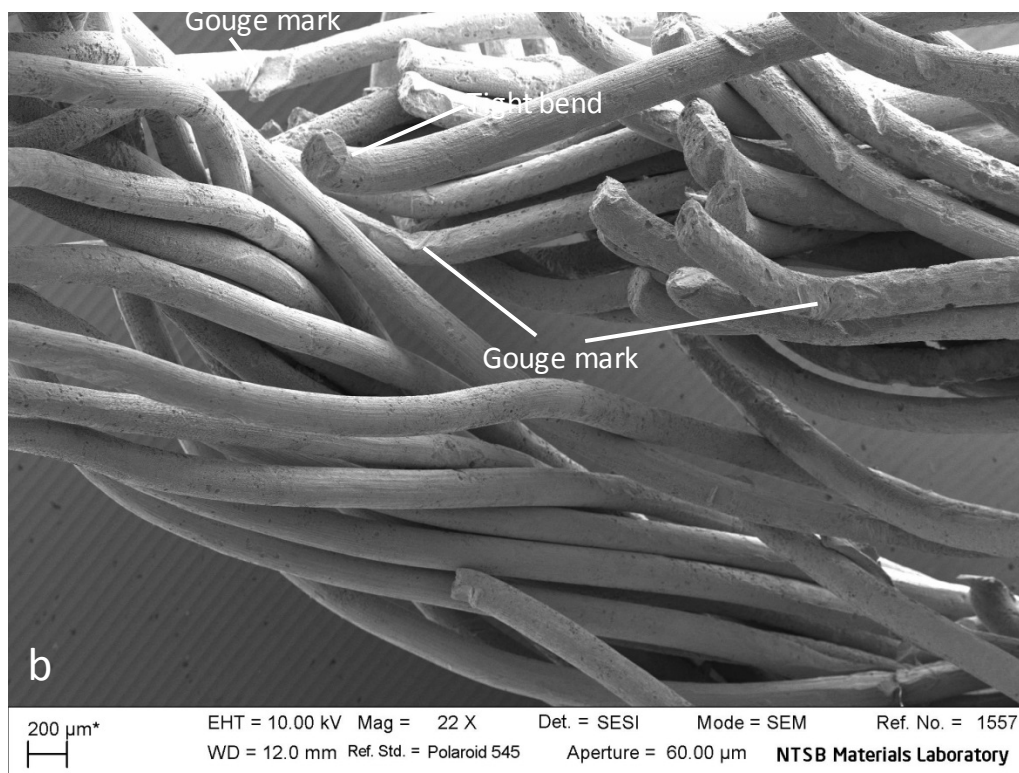
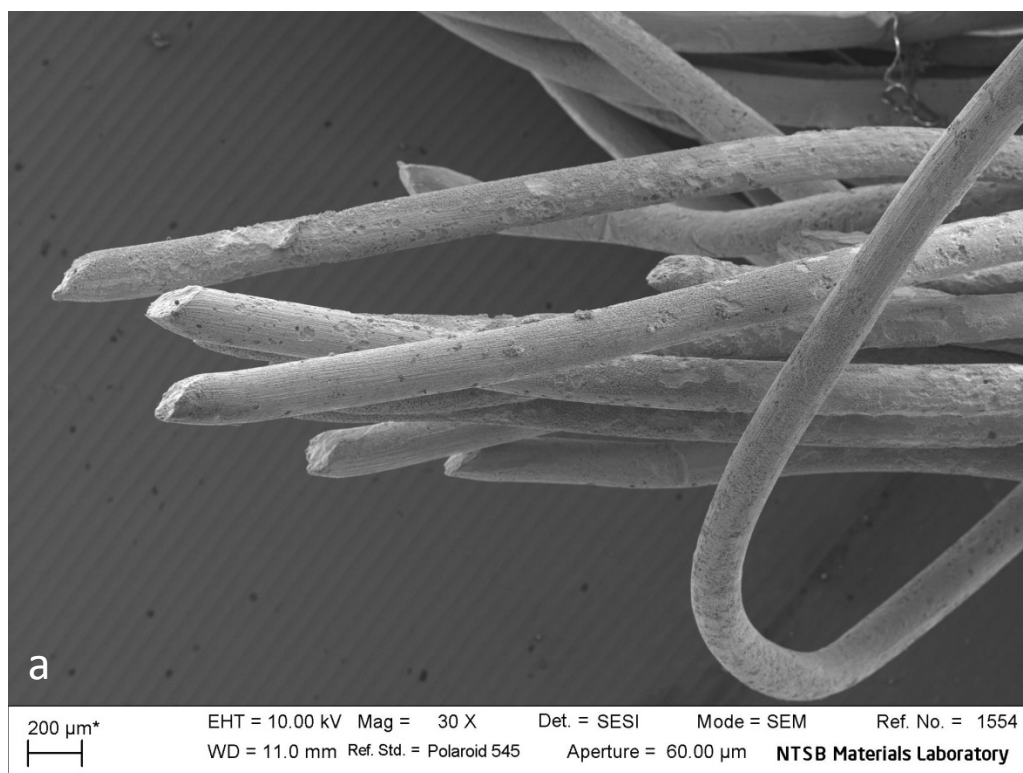


Figure 8 SEM micrographs of “wire rope fracture A.” View a showing generalized necking at the fracture wire ends, with concomitant shear lips. View b shows gouging scars and tight bends at the ends of some fractured wires.

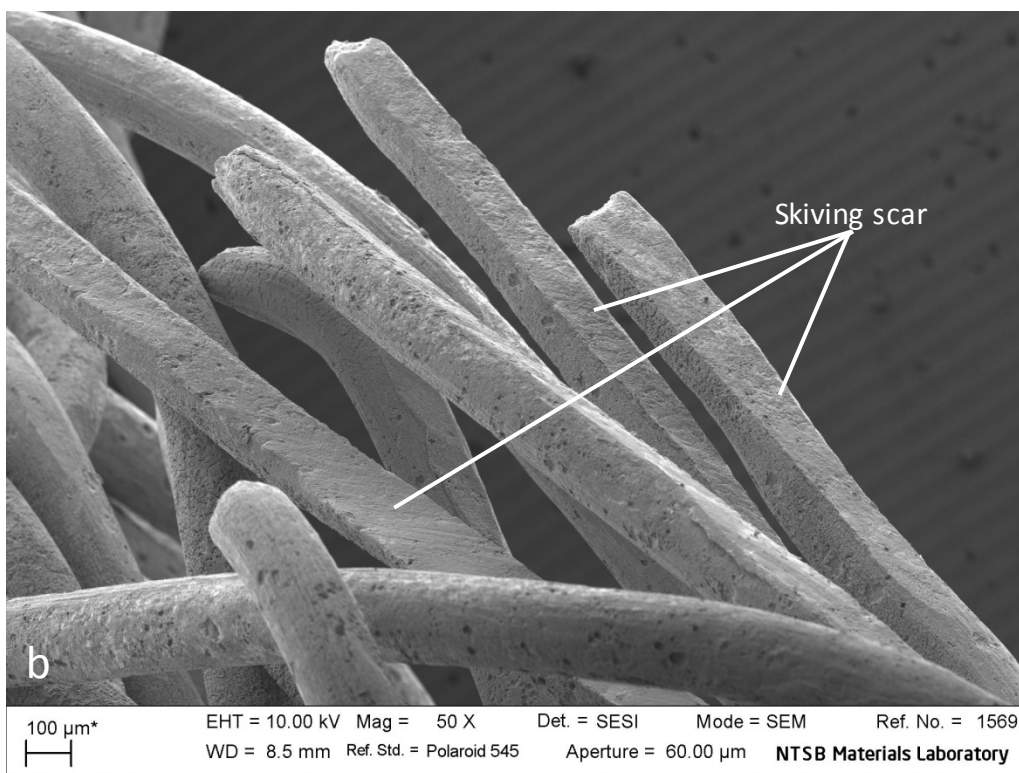
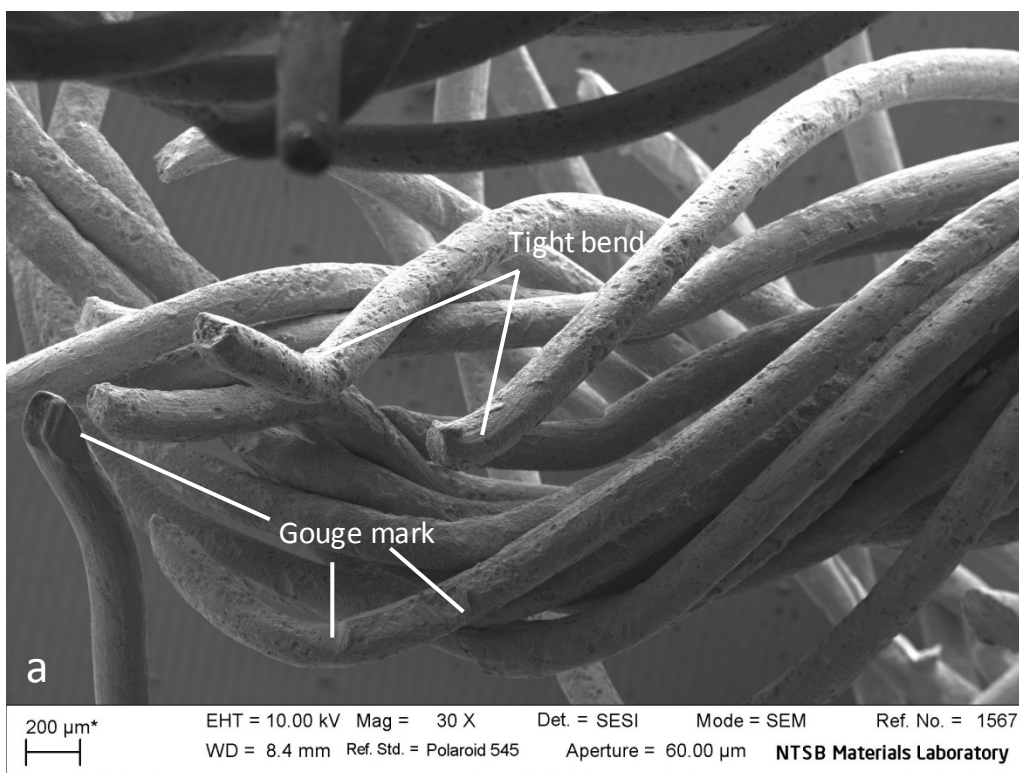


Figure 9 View a shows gouging scars and tight bends at the ends of some fractured wires. View b shows skiving scars on the wire surfaces.

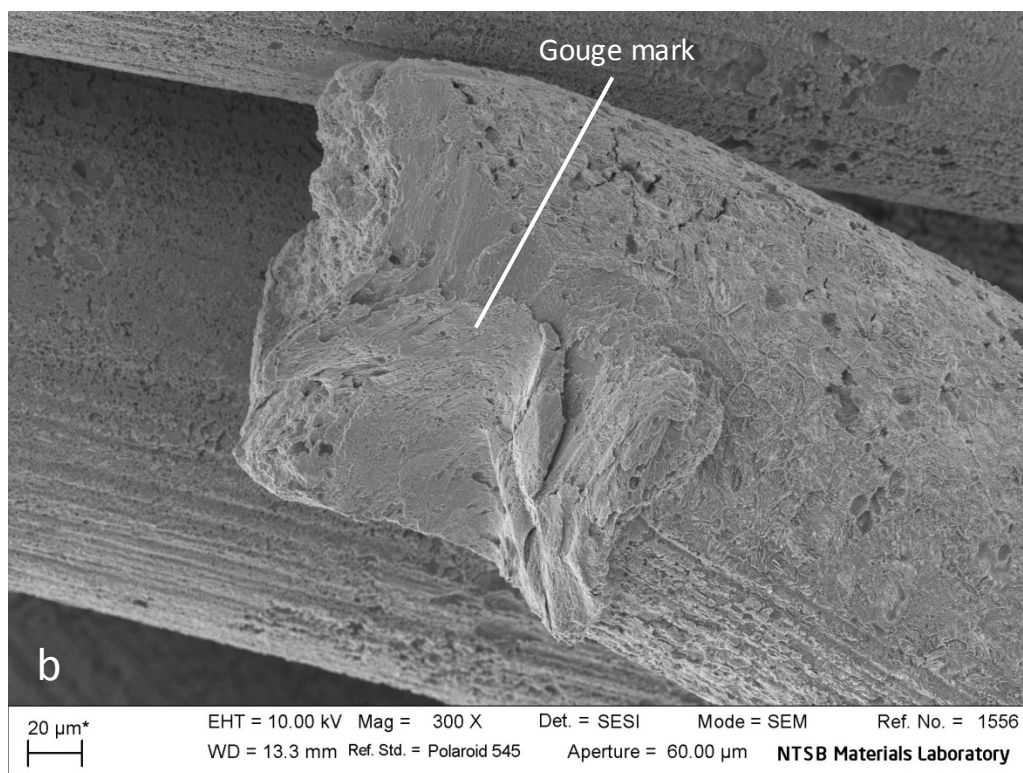
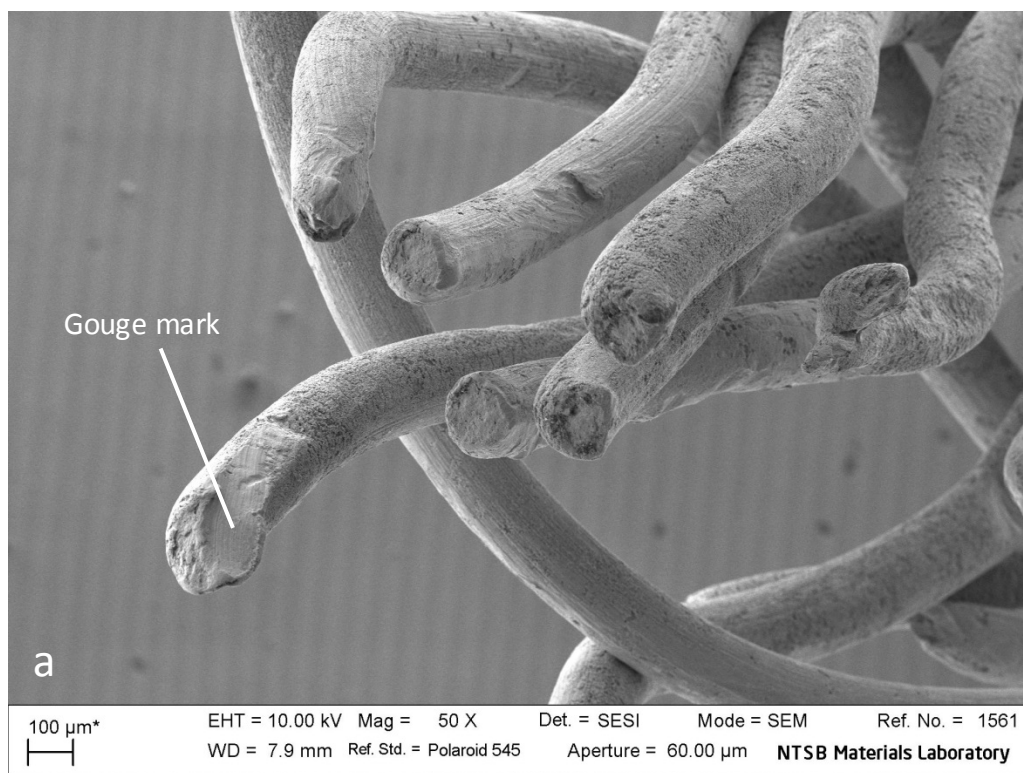


Figure 10 View a and b show gouging scars at the wire fracture surfaces.