

NATIONAL TRANSPORTATION SAFETY BOARD

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



July 15, 2022

MATERIALS LABORATORY FACTUAL REPORT

Report No. 22-042

A. ACCIDENT INFORMATION

Place : Pembroke Park, Florida
Date : August 28, 2020
Vehicle : Aero Commander Aircraft 500-S, N900DT
NTSB No. : ERA20LA297
Investigator : Timothy Monville, AS-ERA

B. COMPONENTS EXAMINED

Fuel Quantity Transmitter

C. DETAILS OF THE EXAMINATION

The as-received parts are shown in figure 1. The red arrow points to the part of interest; the fuel transmitter assembly. Figure 2 is the manufacturer's part number tag affixed to the side of the assembly along with its serial number. Figure 3 is a top view inside the assembly with the red arrow pointing to the area where the white connecting wire broke. Figure 4 is an x-ray image revealing the broken wires within the intact insulation coating. The distance between the two fractured ends was measured to be approximately 0.012 inches. The wire was then removed from the fuel transmitter assembly for further examination as shown in figure 5. The estimated total length of the wire (before fracture) was 1.57 inches. According to an engineering drawing for the wire, the specified length is [REDACTED] inches. The wire insulation coating was then cut as shown in figure 6 with the insulation coating stripped off to expose the fracture surfaces of the individual wires. After cleaning the tips of the wires ultrasonically in acetone, the exposed wire fracture surfaces were examined in a scanning electron microscope (SEM).

Figure 7 is a side view of a group of the wires showing no appreciable necking of the wires adjacent to the fracture faces. Solder (tin-lead) was found to be deposited near the fractures of a few wires, consistent with wetting by solder applied at the lug. Figure 8 is a SEM image with arrows pointing to the solder deposits around the outside of the wires. The color inset is an energy dispersive spectrometric (EDS) overlaid image of the tips of two joined wires. The color code is as follows; copper is red, silver is cyan, tin is blue, and lead is yellow. Due to a shadowing effect, not all of the overlaid SEM inset image is populated with color-coded x-ray pixels.

After cleaning many of the individual wires revealed intergranular fracture surface features with fatigue striations in various directions on some individual grains. No ductile fracture features, such as microvoids, were observed on any of the wire fracture surfaces. Several wires had mechanically damaged fracture faces with few features to examine.

Figures 9 – 11 show fatigue striations found on many of the fractured wire surfaces. Figure 10 is a closeup of the yellow boxed area in figure 9 with yellow arrows indicating fatigue striations. In all three images, note the intergranular grain structure of the fracture surface.

EDS confirmed the wire was silver coated, and standardless semi-quantitative results of the copper wire fracture surface EDS analysis are shown in figure 12.

Edward Komarnicki
Engineering Technician



Figure 1.) As-received parts with red arrow pointing to the fuel transmitter assembly with float.

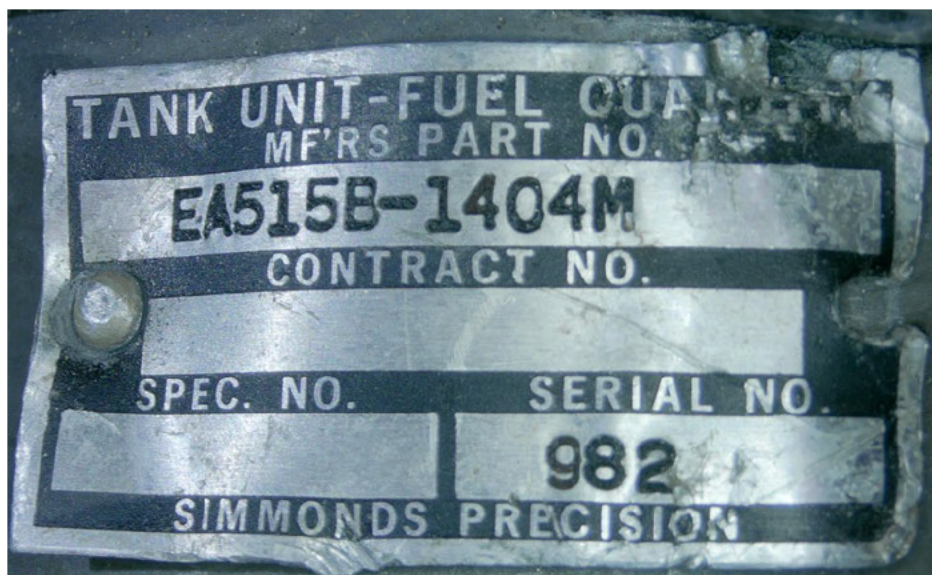


Figure 2.) Manufacturer's part number tag on fuel transmitter assembly.

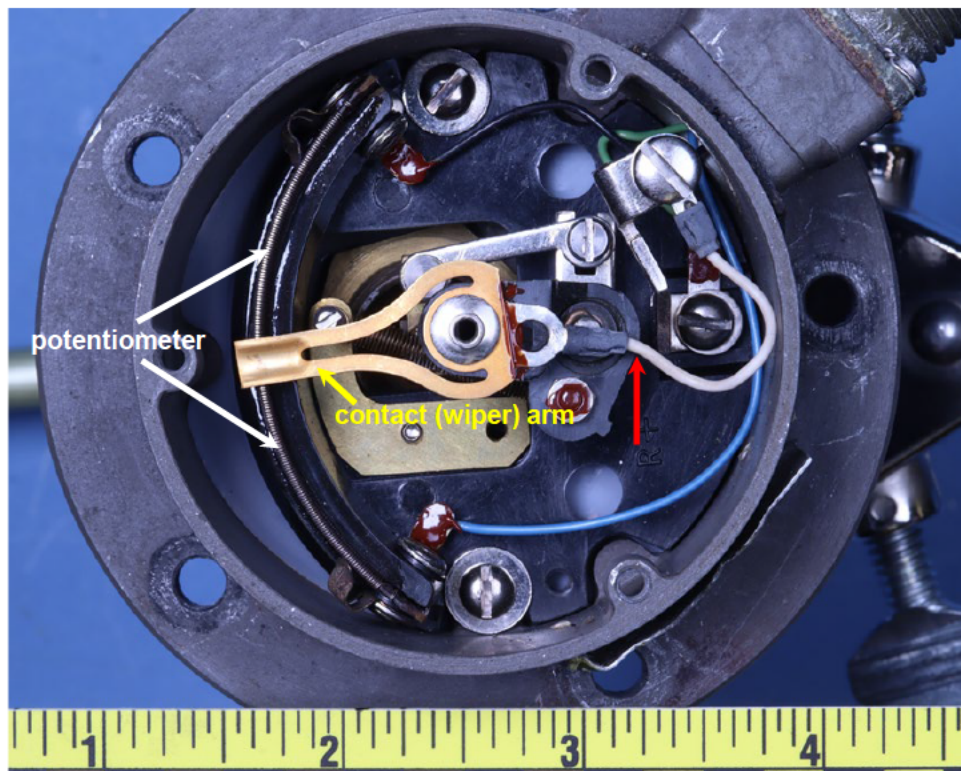


Figure 3.) Top-down view of fuel transmitter assembly with red arrow pointing to the broken wire with insulation intact.

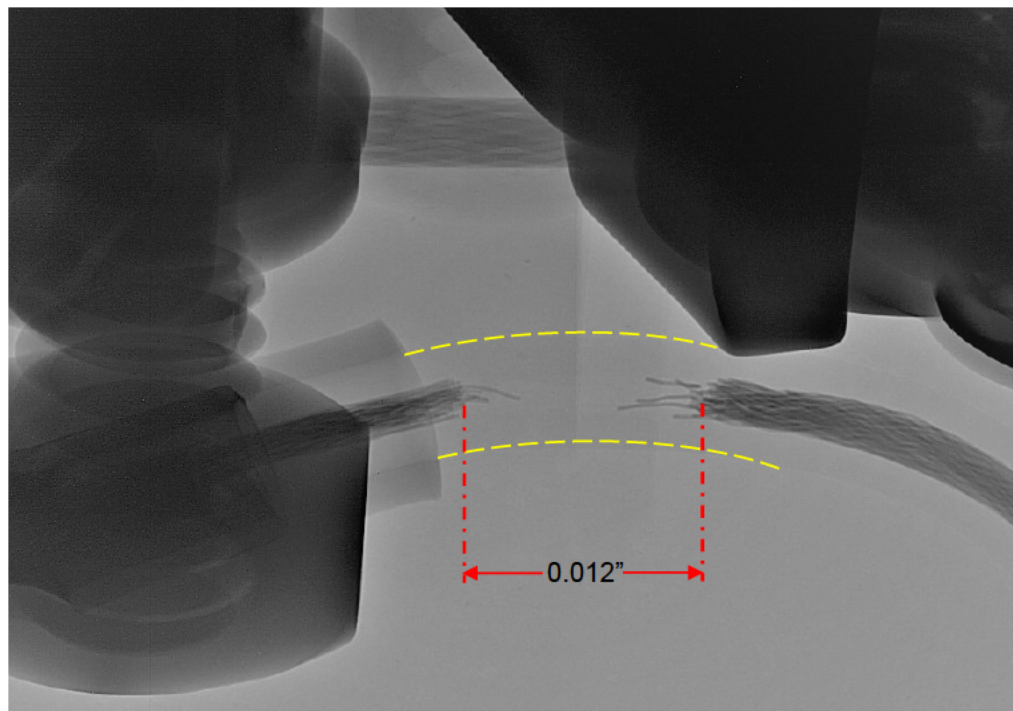


Figure 4.) X-Ray image of broken wire as assembled. The yellow dash lines correspond to the outside diameter of the wire insulation coating.

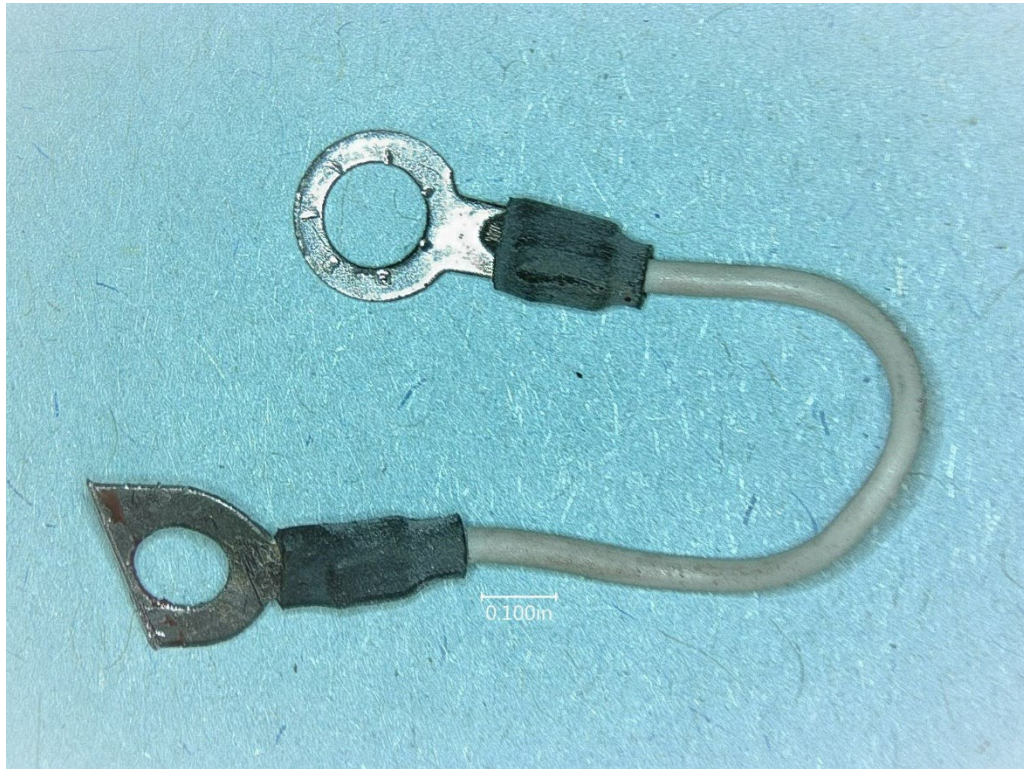


Figure 5.) White connecting wire prior to cutting. The manufacturer specifications indicate that the wire is 26 AWG and the conductor is silver plated copper with 66/44 stranding.

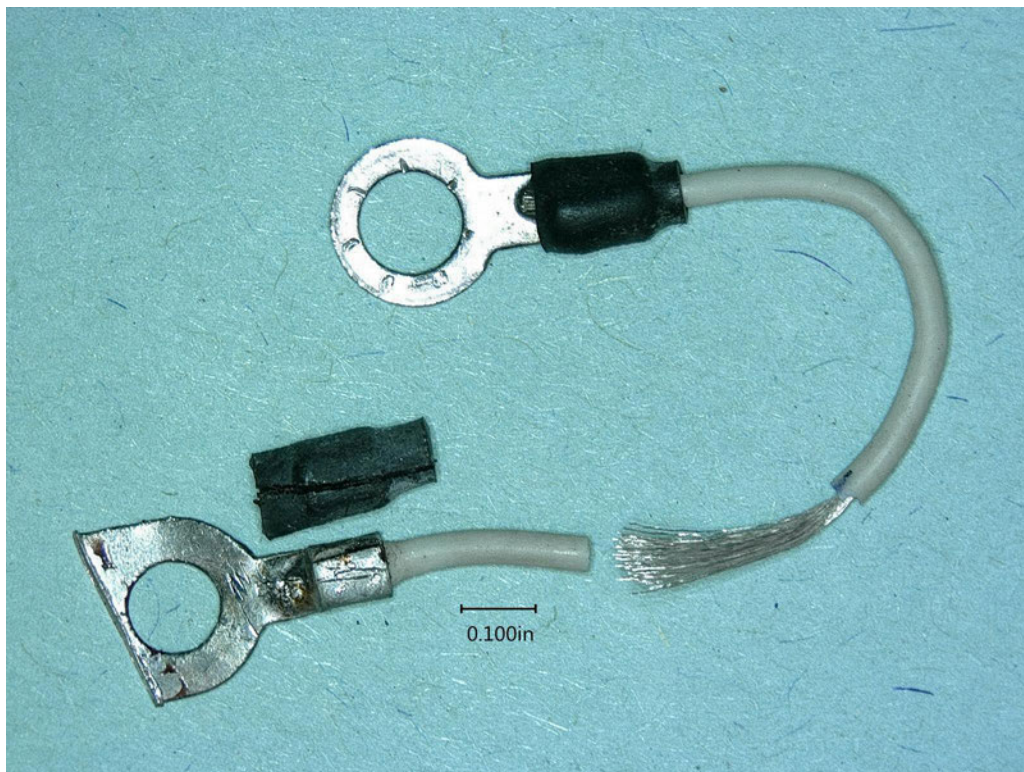


Figure 6.) White connecting wire after cutting.

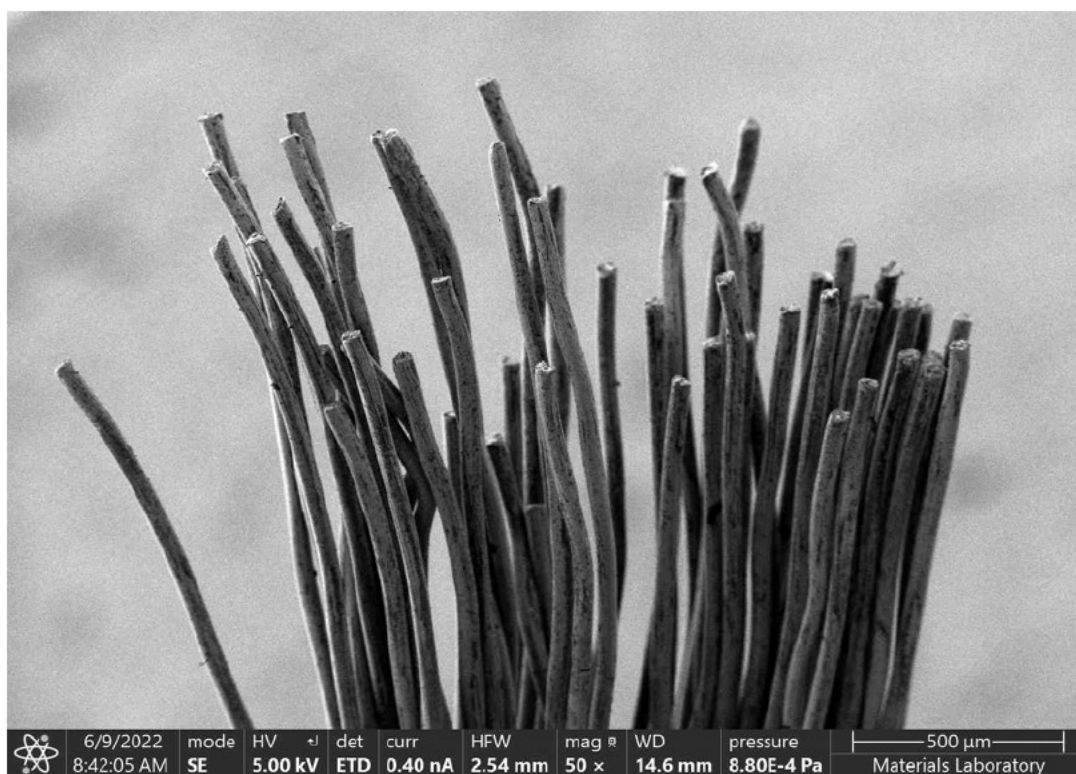


Figure 7.) Side view SEM image of the wires as a group.

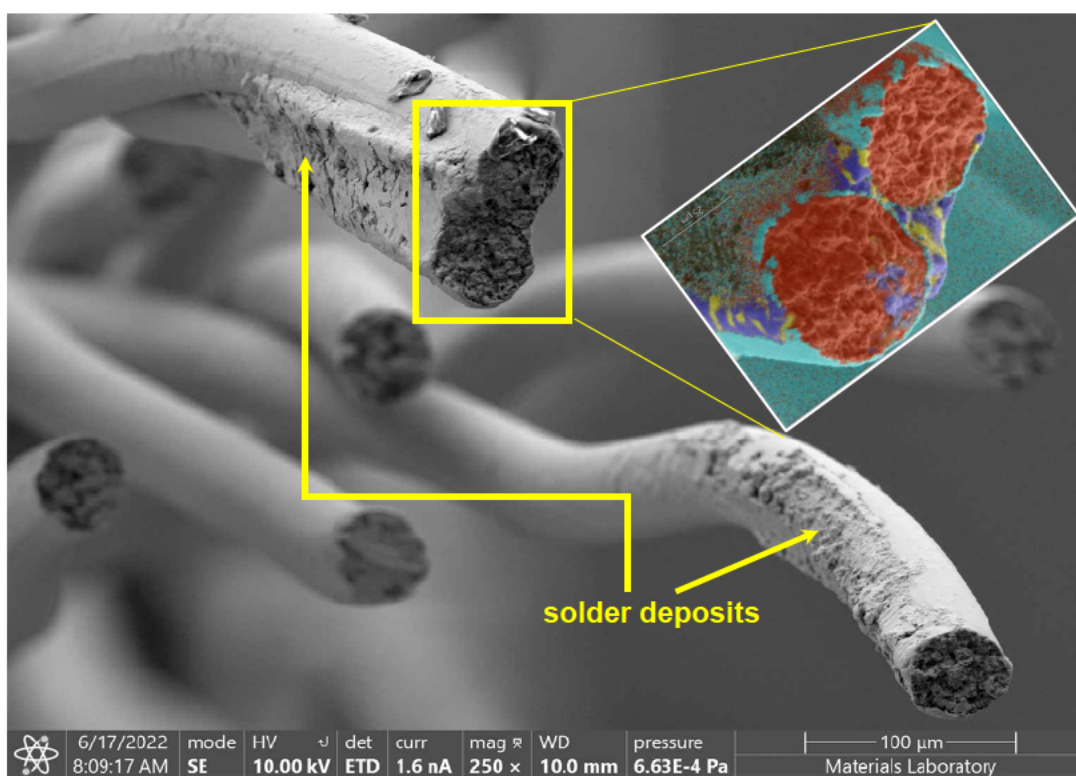


Figure 8.) Solder deposits on the outer diameter of wires including solder-jointed wires (yellow box) with EDS map inset.

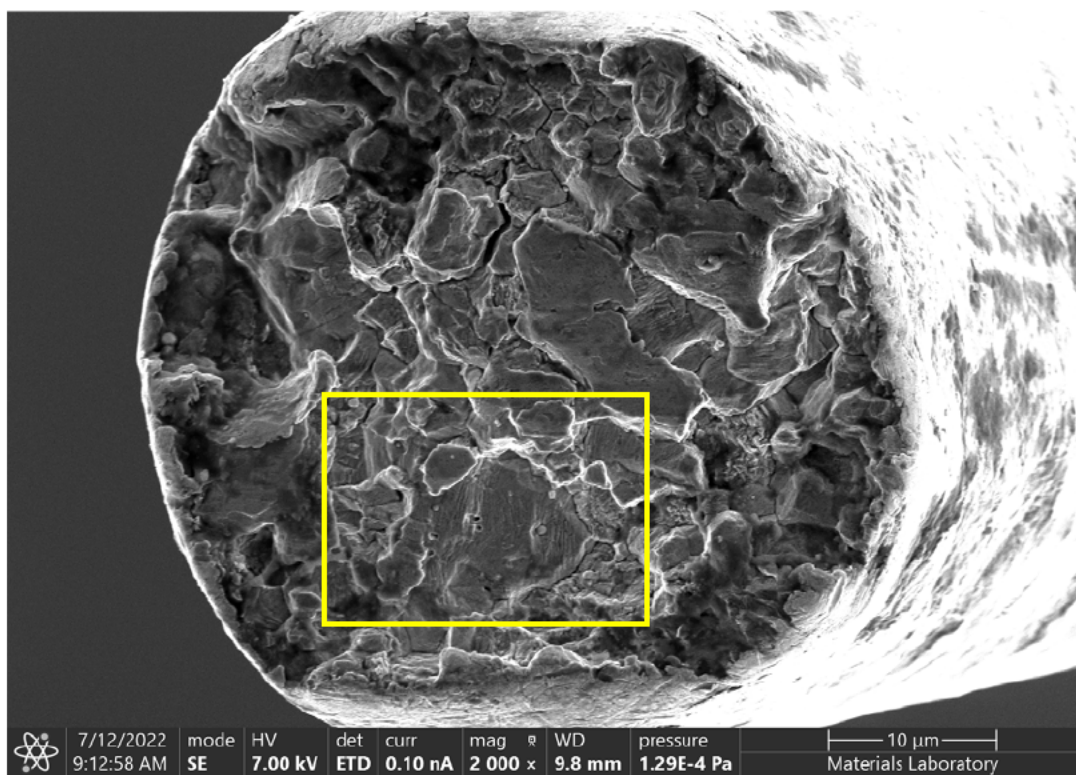


Figure 9.) Typical fracture surface on one of the silver-coated wires.

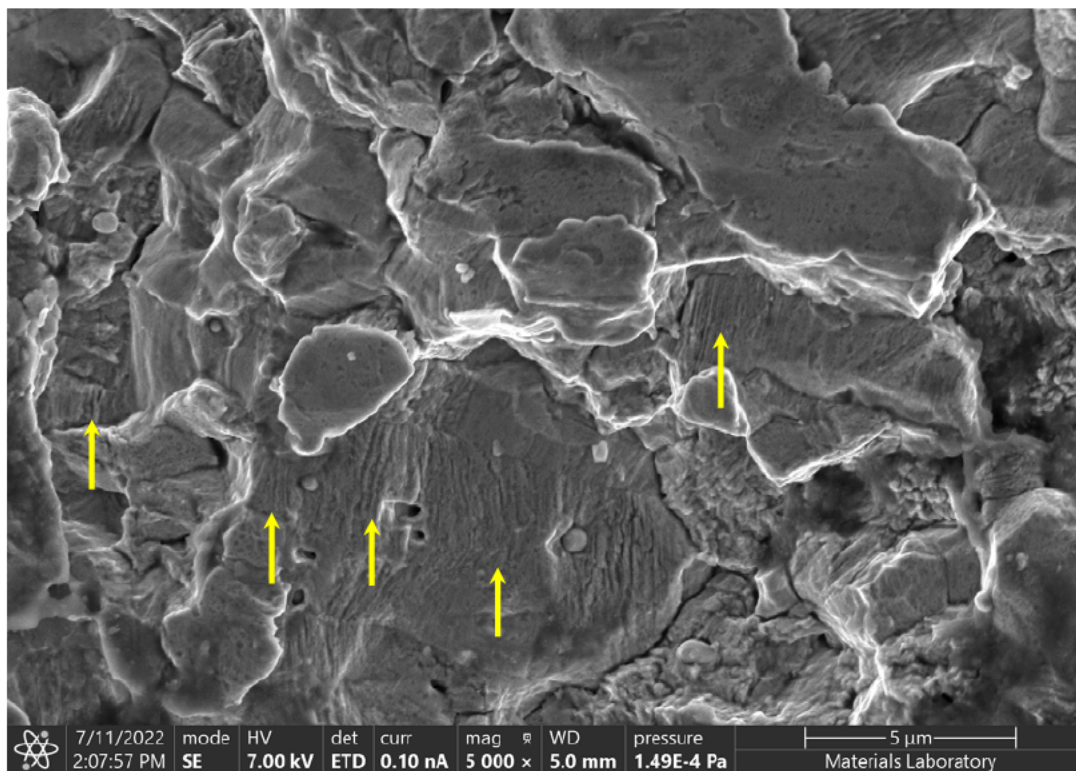


Figure 10.) Image of the yellow boxed area in figure 9 with arrows showing fatigue striations.

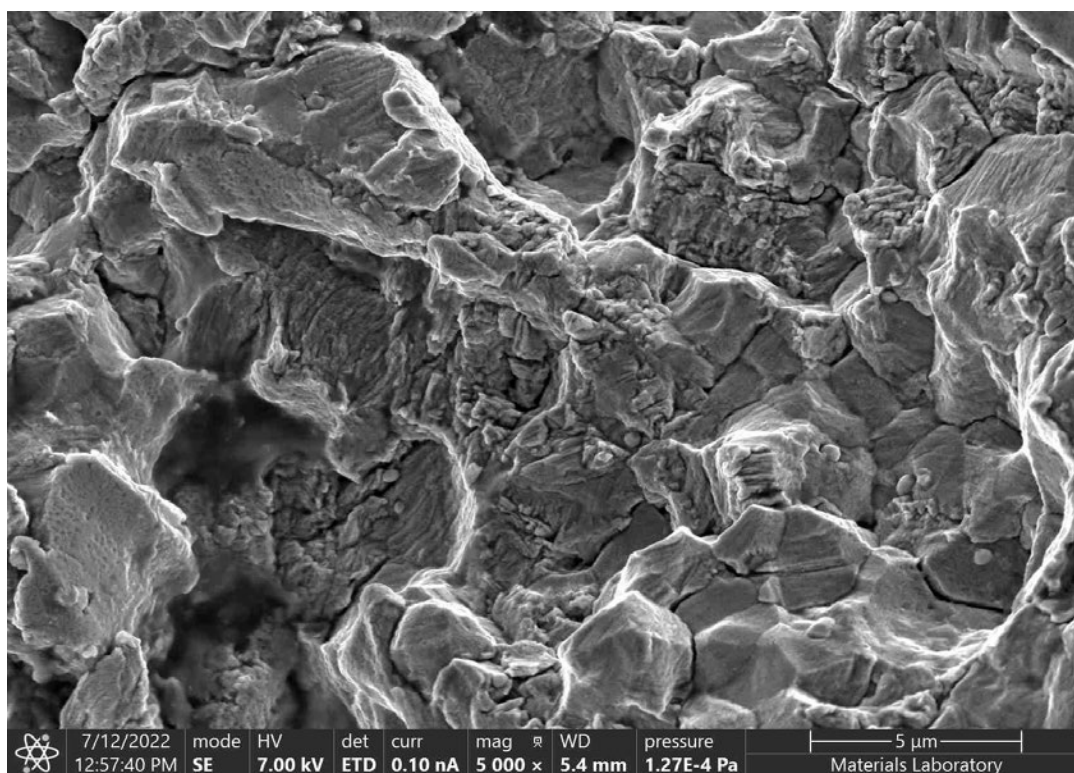


Figure 11.) Intergranular fracture surface with more striations.

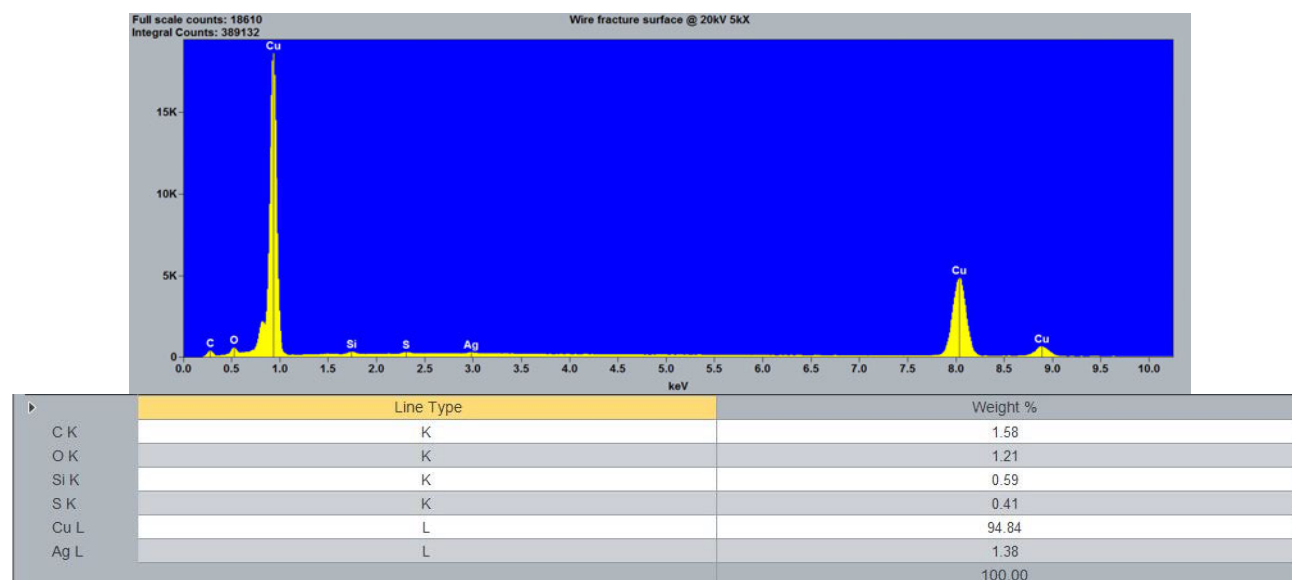


Figure 12.) EDS spectrum of wire fracture surface and semi-quantitative composition.