NATIONAL TRANSPORTATION SAFETY BOARD

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

September 18, 2018

MATERIALS LABORATORY FACTUAL REPORT Report No. 18-059

A. ACCIDENT INFORMATION

Place	:	New York, New York
Date	:	March 11, 2018
Vehicle	:	Airbus Helicopter AS350 B2
NTSB No.	:	ERA18MA099
Investigator	:	Chich Shin, AS-40

B. COMPONENTS EXAMINED

Engine fuel shutoff lever snap wire (two pieces); and white residue found inside of nitrogen bottle (cylinder) for the emergency float system.

C. DETAILS OF THE EXAMINATION

Figure 1 shows a photograph of the as-received snap wire for the engine fuel shutoff lever that fractured into two segments and figure 2 shows a photograph of a clear plastic envelope that contained a cotton swab with white residue that was found inside a nitrogen cylinder for the emergency float system.

The shortest wire segment was ultrasonically cleaned with a commercial detergent to remove debris from the surface. Scanning electron microscope examination of the shortest fractured wire segment revealed the fractured ends exhibited elongation deformation and micro-void coalescence features consistent with ductile overstress deformation. The other ends contained a “v” groove appearance consistent with a cut end. According to French Standard NFL 23-321, “Wire to Break, Copper”, revision September 2000, the diameter of the snap wire is specified to be in the range between 0.27 mm and 0.33 mm (0.011 and 0.013 inch). The diameter of the shortest wire segment measured approximately 0.019 inch (0.48 mm), slightly greater than specified diameter. A 0.2-inch (5 mm) length segment was cut from the shortest fractured wire segment and it was metallurgically mounted. The face of the metallurgical mount that contained the wire was ground with grit paper to expose the core. Energy dispersive spectroscopy (EDS) analysis of the core portion of the snap wire produced a spectrum that contained a major elemental peak of copper and minor elemental peaks of zinc, silicon and carbon, consistent with a brass alloy (see figure 3). EDS spectrum of the outer surface of the same snap wire prior to encasing it in the metallurgical mount produced a spectrum with the same elemental peaks.

Table 1 shows the approximate tensile strength of oxygen-free copper and several copper alloys (copper with up to 20% zinc). The tensile strength of pure copper (oxygen-free) is in the range between 32 kilo-pounds per square inch (ksi) and 66 ksi; for 95% copper (5% zinc) is in the range between 34 ksi and 64 ksi; and for low brass (20% zinc) is in the range between 42 ksi and 125 ksi.[1]

The nitrogen cylinder for the emergency float system reservoir was made from an aluminum bottle reinforced with external carbon fiber reinforcement. EDS analysis of a white residue that was found inside of the nitrogen cylinder produced EDS spectra that contained elemental peaks of aluminum, oxygen, silicon, sulfur and carbon (see figures 4 and 5). The proportion of the elemental peaks varied from one location to another within the same residue. Another white residue was analyzed by Fourier Transform Infrared Spectroscopy (FTIR). The FTIR spectrum contained elements that were also present in the EDS spectra. A search of the reference library revealed the FTIR spectrum of the residue did not match a specific product/substance.

Frank Zakar
Senior Metallurgist

[1] ASM Metals Handbook Desk Edition, 1985.

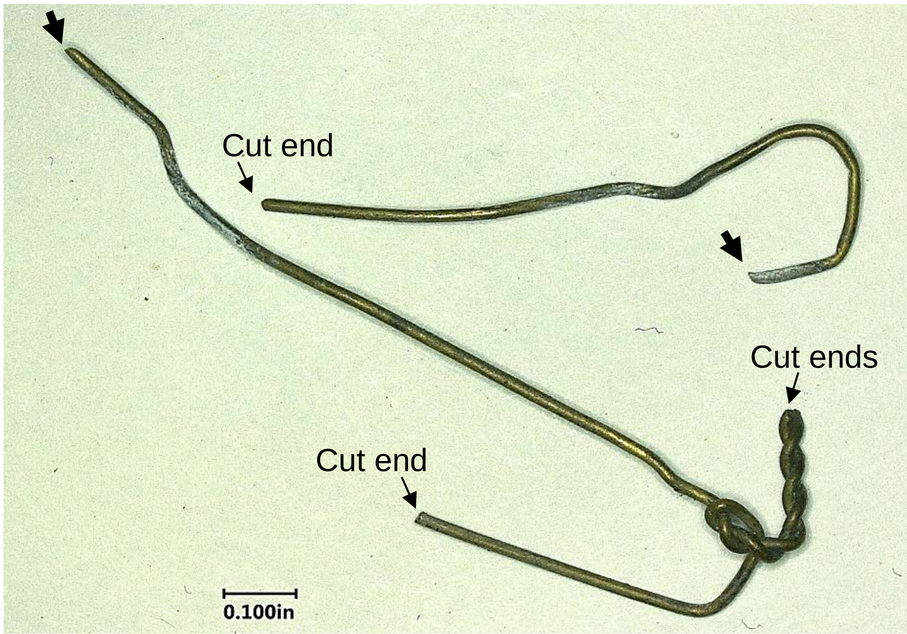

Figure 1. Photograph of the as-received pieces of the snap wire for the engine fuel shutoff lever. Unmarked arrows indicate fractured ends.

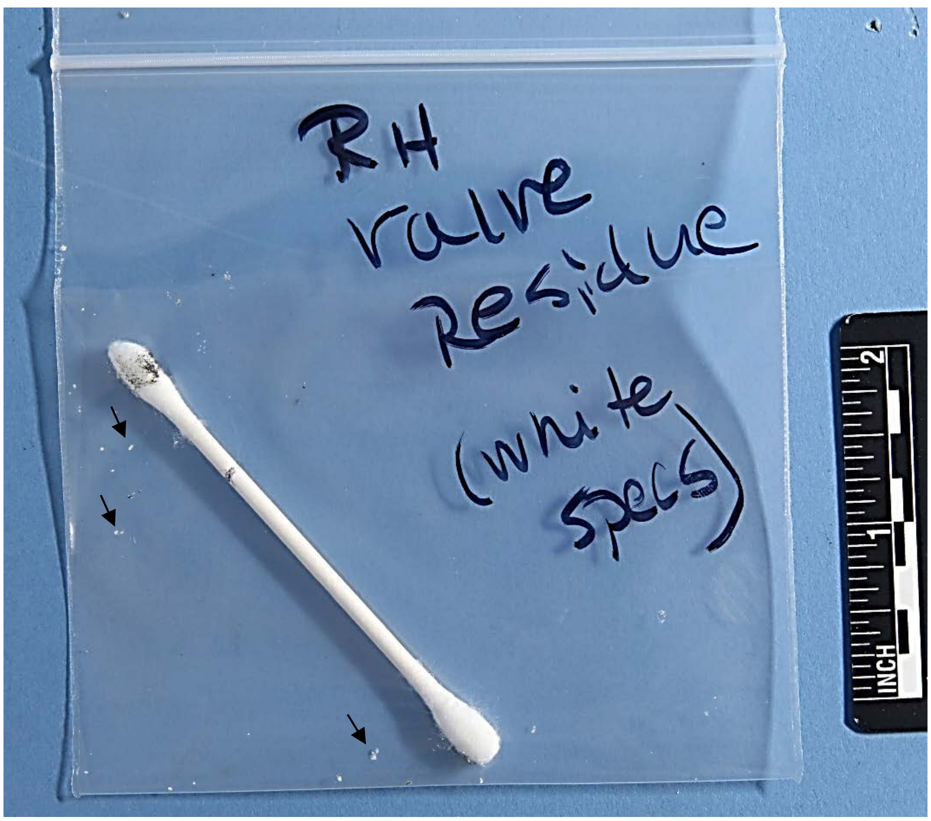

Figure 2. As-received cotton swab with white residue found inside the nitrogen cylinder for the emergency float system. Arrows point to several white residue particles.

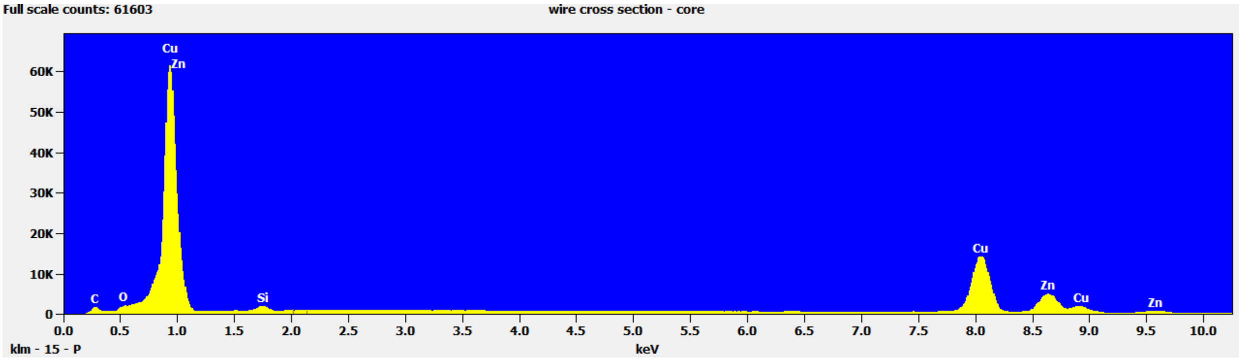

Figure 3. EDS spectrum of the core portion of the snap wire showing major elemental peaks of copper and minor elemental peaks of zinc, silicon and carbon.

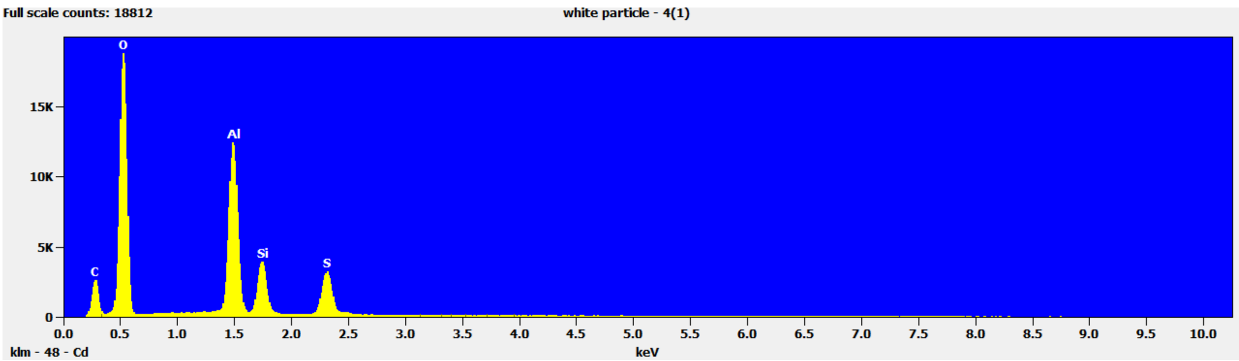

Figure 4. EDS spectrum of a white residue that was found inside of nitrogen cylinder for the emergency float system showing elemental peaks of oxygen, aluminum, silicon, sulfur, and carbon.

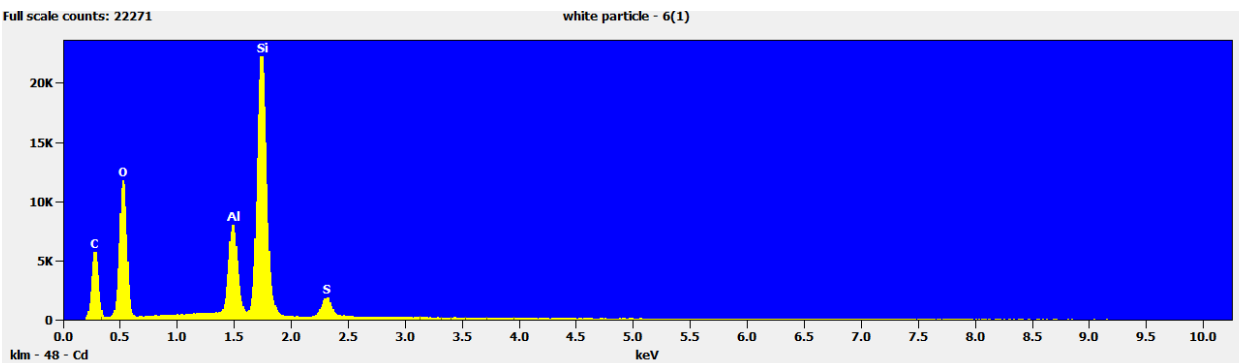

Figure 5. EDS spectrum of the same white residue as in figure 4 but analyzed at a different location. This EDS spectrum shows the same elemental peaks as in figure 4 but the intensity of each elemental peak is different when compared to the same respective elemental peak in figure 4.

Table 1. Approximate Tensile Strength for Copper and Several Grades of Copper Alloys	
Metal	Approximate Tensile Strength Range (Kilo-pounds per square inch)
Copper (oxygen-free)	32 - 66
95% Copper (5% zinc)	34 - 64
80% Copper (20% zinc)	42 - 125