

NATIONAL TRANSPORTATION SAFETY BOARD

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



January 24, 2020

MATERIALS LABORATORY FACTUAL REPORT

Report No. 20-003

A. ACCIDENT INFORMATION

Place : Stuart, Florida
Date : November 1, 2019
Vehicle : Grumman OV-1D, N10VD
NTSB No. : ERA20FA027
Investigator : Timothy W. Monville, AS-ERA

B. COMPONENTS EXAMINED

Flight control cable.

C. DETAILS OF THE EXAMINATION

An overall view of the submitted control cable is shown in figure 1. The control cable was separated at the location encircled by an ellipse in figure 1 leaving a longer length of the cable attached to a bellcrank and a shorter segment with an eye end fitting shown to the left in figure 1. Metal tabs on the bellcrank were deformed and fractured with rough matte gray fracture features consistent with ductile overstress fracture.

The separated ends of the control cable are shown in figures 2 and 3. The ends of the wires on each side of the cable separation had parallel grooves with deformation lips on one side consistent with sliding contact in one direction. Heat tinting was observed at the tips of several of the wires as indicated in figure 4 consistent with high-speed sliding contact as the wires were severed.

The shorter cable piece was cut using metal shears to facilitate further examination of the sliding contact marks on the separated end using a scanning electron microscope (SEM). The surfaces were examined as received and were partly covered with deposits consistent with particles entrained in grease. However, multiple embedded particles were observed in areas of sliding contact as shown in figure 5. The particles had smooth surface texture and appeared dark gray relative to the light gray color of the wire when viewed using a backscattered electron detector in composition mode.¹ The cable end that had been cut in the lab using metal shears was similarly examined, and no embedded particles were observed on the wire ends cut in the lab.

¹ SEM images produced using a backscattered electron detector in composition mode have contrast that is associated with atomic weight of the elements in the image. Areas with elements having higher atomic weights appear as a relatively lighter shade of gray compared to areas having elements with lower atomic weights.

The embedded particles were analyzed using energy-dispersive x-ray spectroscopy (EDS). The particles consistently had relatively high peaks of aluminum and oxygen. An EDS spectrum of the larger embedded particle in figure 5 is shown in figure 6.

The overall appearance of parallel sliding contact marks with heat tinting and embedded particles with high peaks of aluminum and oxygen are consistent separation due to a cut from an aluminum oxide abrasive wheel. All wires had a similar cut appearance with no evidence of any wire fractures.

Matthew R. Fox, Ph.D.
Senior Materials Engineer



Figure 1. Overall view of the submitted control cable assembly. The location of the cable separation is indicated by an ellipse.



Figure 2. Separated end of the longer cable piece.

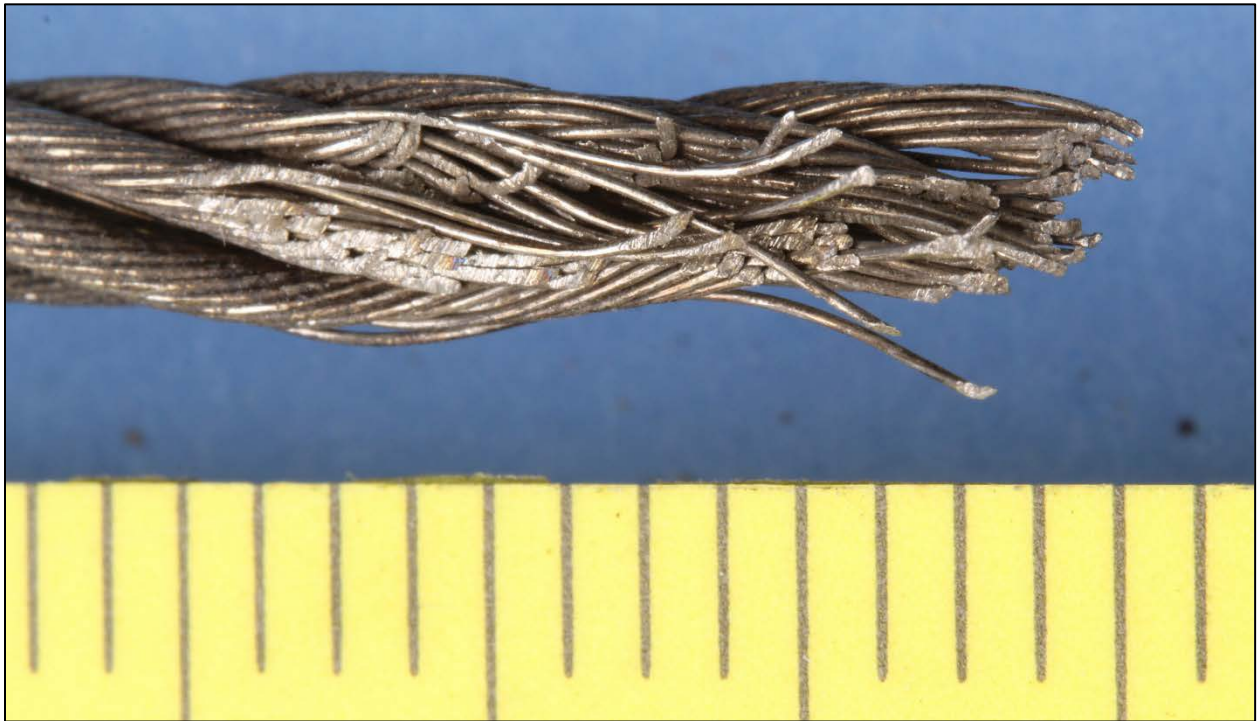


Figure 3. Separated end of the shorter cable piece.

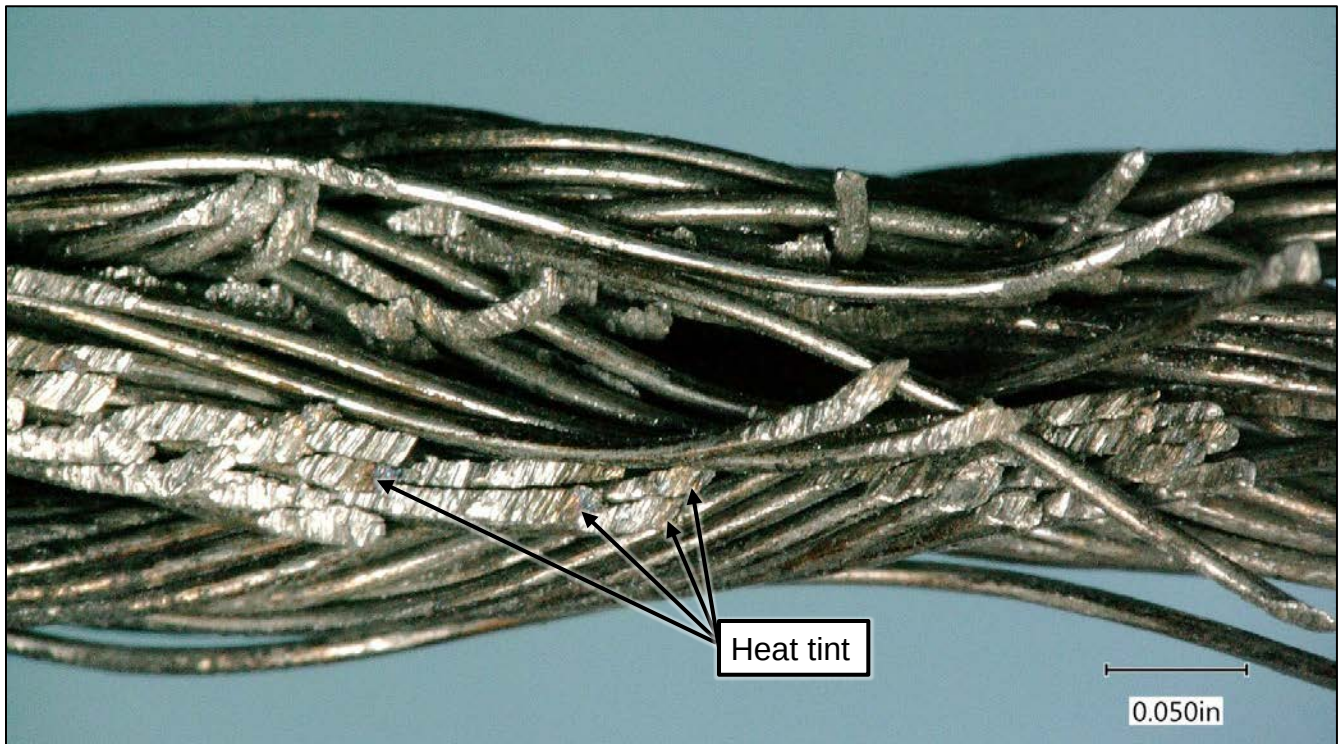


Figure 4. Closer view of sliding contact marks on the cable wires on the shorter cable piece. Several wires show heat tinting as indicated.

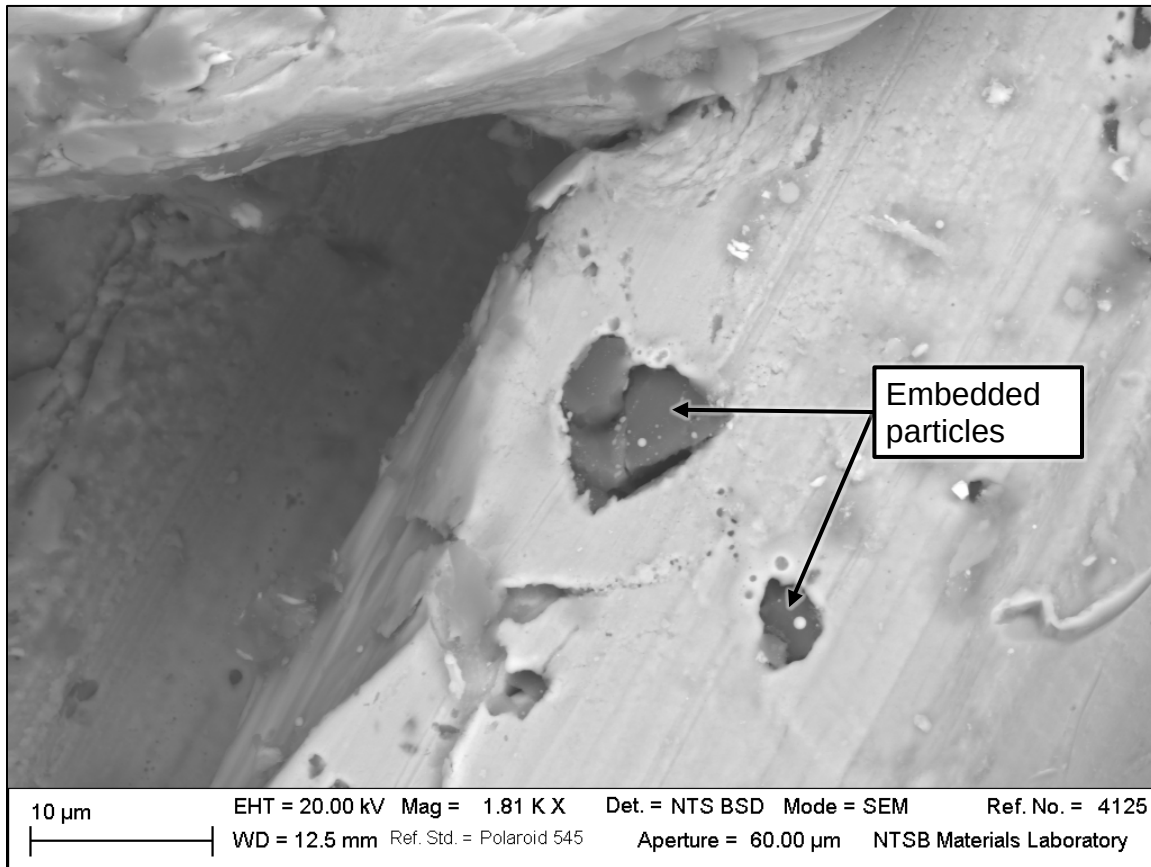


Figure 5. SEM image of embedded particles in the ground surface of the control cable as viewed using a backscattered electron detector in composition mode.

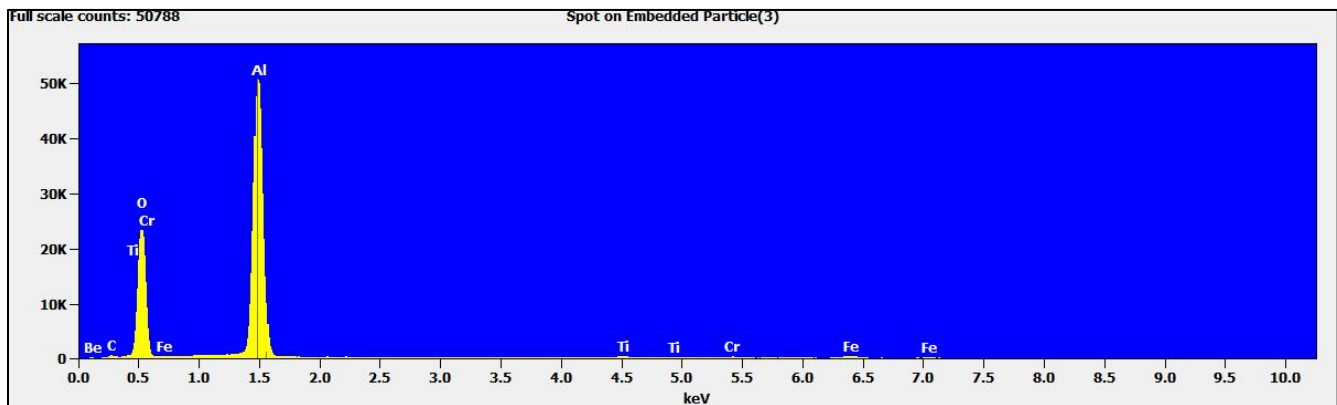


Figure 6. EDS spectrum acquired in spot mode focused on the larger embedded particle shown in the previous figure.