NATIONAL TRANSPORTATION SAFETY BOARD
Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

May 25, 2018

MATERIALS LABORATORY FACTUAL REPORT Report No. 18-041

A. ACCIDENT INFORMATION

Place	:	Peach Springs, Arizona
Date	:	February 10, 2018
Vehicle	:	Airbus Helicopter (Eurocopter) EC-130 B4, N155GC
NTSB No.	:	WPR18MA087
Investigator	:	Chihoon Shin (AS-40)

B. COMPONENTS EXAMINED

Fractured Fenestron control cable.

C. DETAILS OF THE EXAMINATION

Figure 1 shows a photograph of the as-received Fenestron control cable. Figure 2 shows the cross section of the control cable. Figure 3 show close-up photographs of the fractured ends of the moveable center blade, ball cages, and outer races. Connection between the mobile end rod and the center blade is accomplished by means of a crimping process. The end of the center blade was manufactured with a reduced width portion. The reduced width portion of the center blade is to be inserted into the open end of the mobile end rod and, in turn, the outer surface of the rod end is to be crimped so that the reduced width portion of the center blade is retained inside of the mobile end rod.

Visual examination of the mobile end rod revealed the outer surface contained evidence of three deformed crimp bands. Each crimp band extended around the diameter of the end rod. The crimp bands were located approximately 0.05-inch, 0.5-inch, and 0.9-inch from the open end of the end rod. The center blade contained transition radii on opposite sides of the blade in an area between the width and reduced width portion. Fracture of the center blade was located approximately 0.3 inches from the transition radii. When looking at the end rod, fracture of the center blade corresponded to a distance of approximately 0.3 inch from the open end of the end rod.

Bench binocular microscope examination of the control cable revealed the fracture face of the center blade was on a slant plane relative to the length of the blade. For the purpose of this examination, the outer cages were arbitrarily labeled “X” and “W”, to identify the orientation of the parts relative to each other. Each outer cage contained a fracture that intersected a round slot for a ball. The ball cages are to be manufactured from Teflon. The exposed portions of the ball cages had fractured into multiple pieces. The outer flexible casing is to be made from Rilsan, a tradename used to describe a

Polyamid 11 (Nylon 11) polymer that is manufactured by Arkema.[1] The outer flexible casing appeared black and was solidified, consistent with exposure to severe heat.

The center blade and outer races were saw-cut in the areas near to their respective fracture faces, to facilitate examination of the fracture faces. The fracture faces were ultrasonic cleaned with acetone. Scanning electron microscope examination of the fractured center blade and outer races revealed the fracture faces contained micro-void coalescence fracture features consistent with ductile overstress separation, with no evidence of a pre-existing crack (such as a fatigue crack). Figure 4 shows an EDS spectrum from the center blade. The EDS spectrum contained a major elemental peak of iron, and minor elemental peaks of chromium, nickel, molybdenum, silicon, manganese, and carbon, consistent with a stainless steel alloy. The EDS spectra from the outer races were similar to that from the center blade.

Frank Zakar
Senior Metallurgist

[1] Source is https://www.arkema.com/en/products/product-finder/product-viewer/Rilsan-Polyamide-11-Resin/

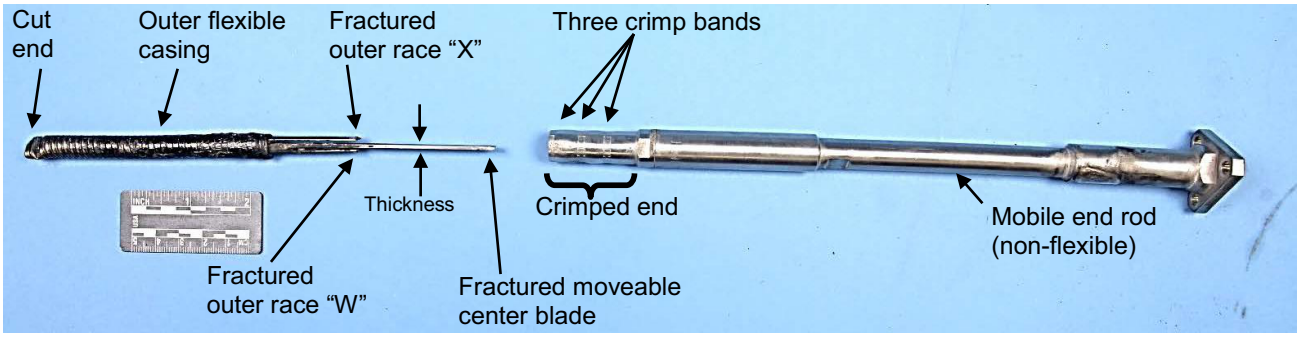
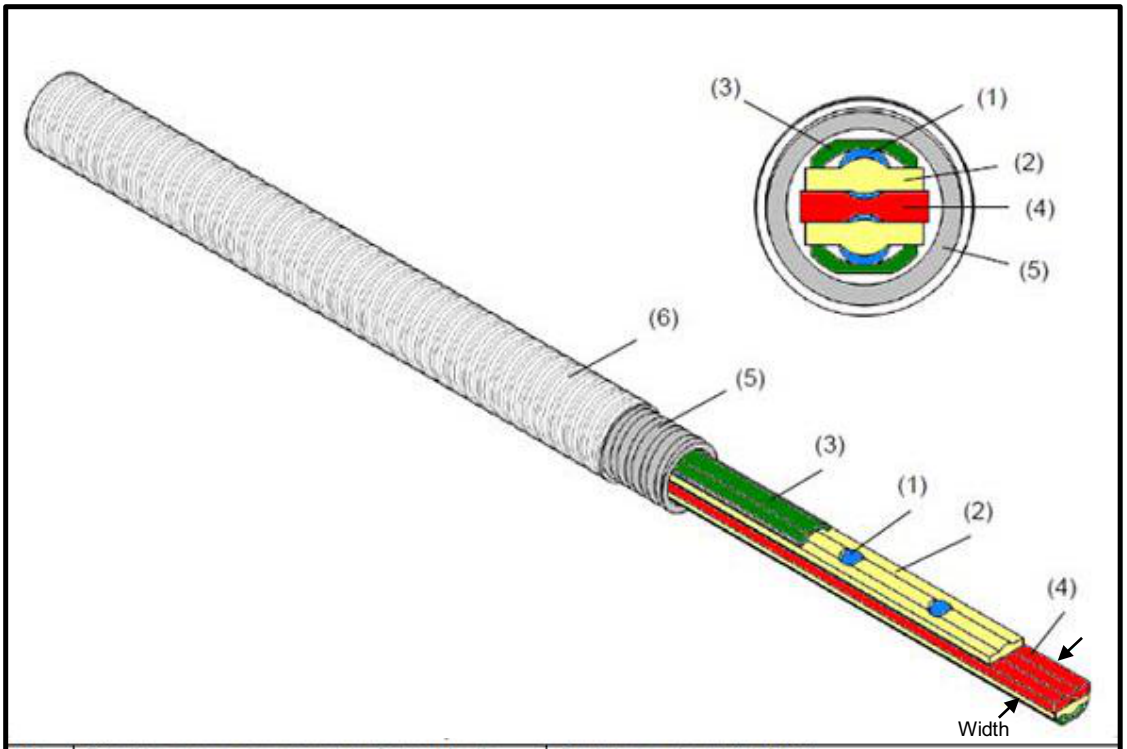


Figure 1. Photograph of the as-received Fenestron control cable.



(1)	Double-row arrangement of steel balls	Stainless steel (1.4311)
(2)	Ball cage	PTFE
(3)	Two outer races	Stainless steel Z7 CN 18-09
(4)	Moveable center blade	Stainless steel Z7 CN 18-09
(5)	Inner flexible casing	Stainless steel Z6 CN 18-09
(6)	Outer flexible casing	Rilsan

Figure 2. Diagram of the Fenestron control cable showing a cross section and description of the internal cable parts. Source: Airbus

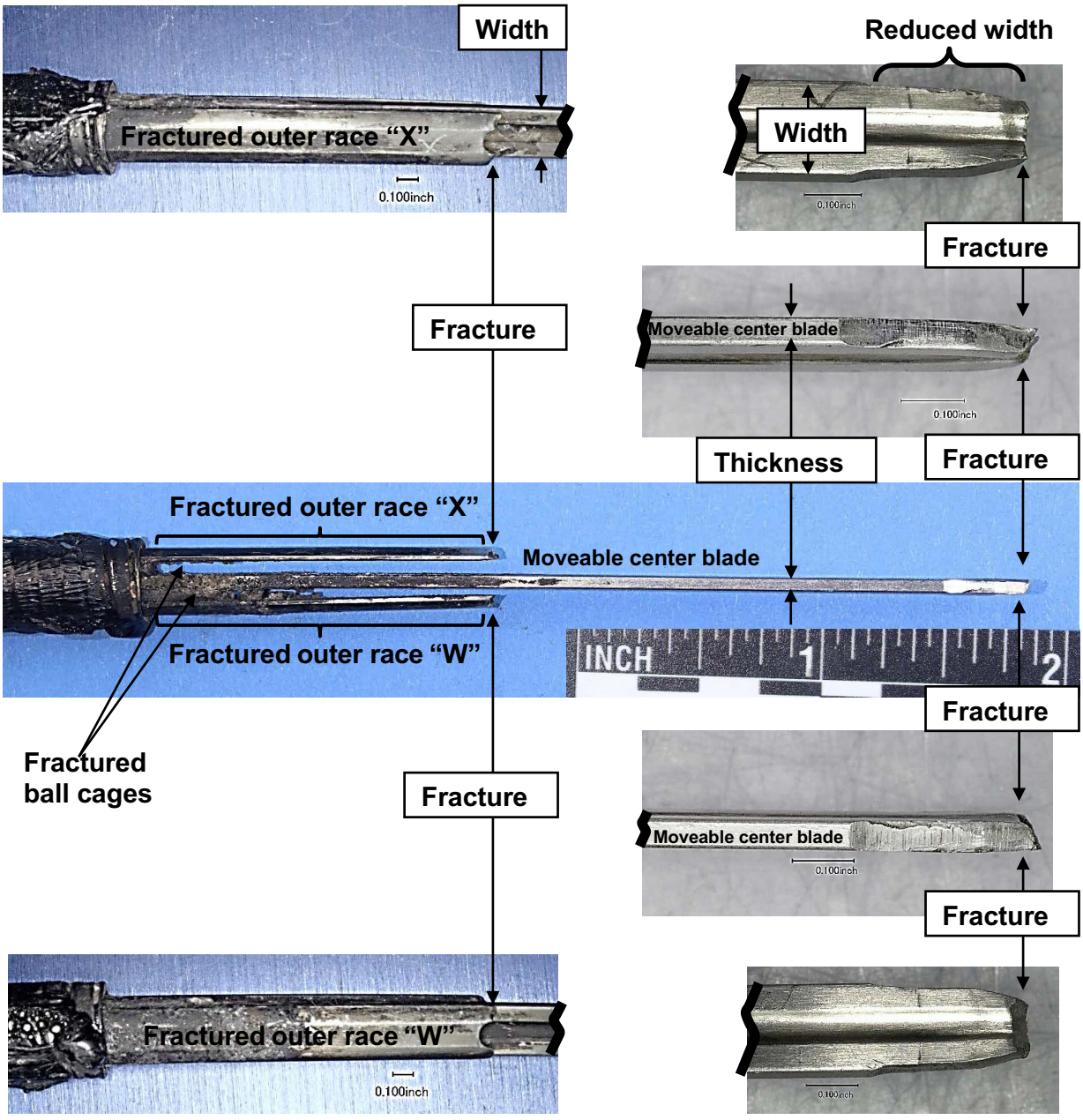


Figure 3. Various views of the fractured moveable center blade and outer races "X" and "W".

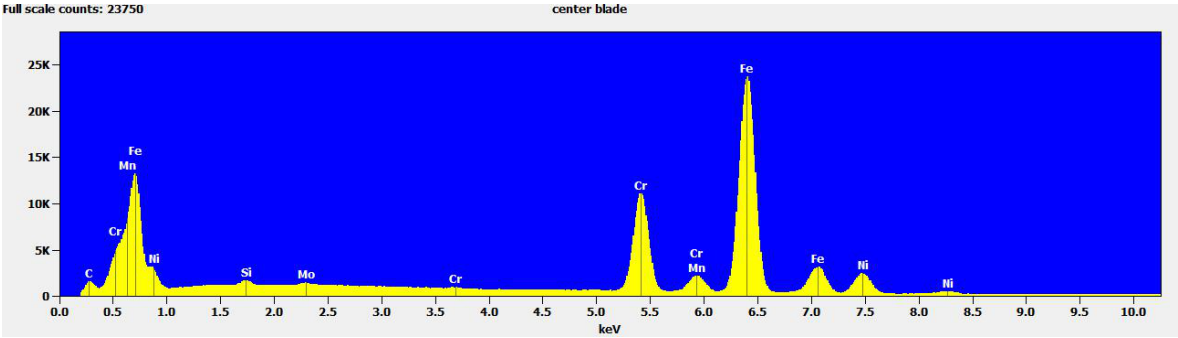


Figure 4. EDS spectrum of the center blade.