NATIONAL TRANSPORTATION SAFETY BOARD

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

September 24, 2010.

MATERIALS LABORATORY FACTUAL REPORT Report No. 10-092

A. ACCIDENT

Place	:	Aleknagik, Alaska.
Date	:	August 9, 2010.
Vehicle	:	DHC-3 Otter, N455A.
NTSB No.	:	ANC10MA068.
Investigator	:	Robert Swaim, AS-40.

B. COMPONENTS EXAMINED

Flaperon control rod.

C. DETAILS OF THE EXAMINATION

The two pieces of the flaperon control rod submitted for examination are illustrated in Figure 1. The control rod consists of a tube with a clevis welded at one end and a rod-end bearing welded on the other end. Examination of the control rod revealed that it had fractured adjacent to the rod-end to produce the fracture faces indicated by the yellow and purple arrows in Figure 1. The rod end was mostly covered in grease. The tube and clevis portions of the control rod were mostly covered in a red paint with the exception of approximately 3.5 inches of the tube adjacent to the fracture face and the area indicated by the green arrow. The unpainted area indicated by the green arrow extended along the length of the tube and displayed a red spattered pattern at its interface with the red painted area.

Features on the fracture faces were matched and the rod-end end of the control rod is illustrated in Figure 2. The red dashed line is a continuation of the rod surface to illustrate the degree of bending that had been applied and the red arrow, identified as “T”, indicates what would have been the tension side of the tube during the bending event. The angle between the axis of the rod-end, indicated by the yellow dashed line, and the red dashed line was measured at 20-degrees. The white arrow indicates an arced indentation located in opposition to the tension side “T”. The radius of the arc was measured at 0.5-inch on an OGP Smartscope[1] and a 1.0-inch diameter aluminum rod was found to be a snug fit in the indentation. The green arrow indicates green paint that was not covered by grease.

[1] The Smartscope is a digital microscope with measuring capabilities.

Examination of the grease indicated by the orange arrow in Figure 2 revealed that it consisted of a black surface layer that changed to a dark tan adjacent to the rod-end surface. Black filaments of a man-made material, of various lengths, were also observed in the grease. A majority of the grease was scraped from the rod-end with plastic forceps and approximately 50% of the sample was spread out on a plastic sample dish. Higher magnification examination confirmed that the black filaments were the only discernible non-grease contaminent.

An examination of the tube and clevis portion of the control rod revealed a longitudinally oriented rubbing mark on the red painted side, opposite to the side illustrated in Figure 1. The rubbing mark initiated 5.75 inches from the center of the clevis attachment hole and was approximately 1.75 inches long. Along a majority of its length the rubbing mark was a uniform 0.08-inch wide. The tube and clevis portion of the control rod is illustrated in Figure 3 with the rubbing mark contained within the yellow box. A purple arrow indicates the fracture face, as in Figure 1, and a white arrow indicates the arced indentation, as in Figure 2. A closer view of the rubbing mark is illustrated in figure 4 with the mark indicated by a yellow arrow. A closer examination of the surface of the rubbing mark revealed a black powder scattered on a relatively smooth and uniformly abraded surface, indicative of a light contact over a period of time.

Visual examination of the fracture faces revealed that the rod-end fracture face appeared to be round and the tube fracture face appeared to be oval. The fracture faces were placed side by side for comparison and are illustrated in Figure 5 with a “T” indicating the tension side, as in Figure 2. The rod-end diameters at the green and white arrows were measured at 0.493-inch and 0.502-inch respectively. The tube diameters at the purple and red arrows were measured at 0.432-inch and 0.518-inch respectively. The orange arrow indicates a mechanically damaged area on the rod-end fracture face and the black arrow indicates the mating fracture face on the tube which was undamaged. A higher magnification image of the rod-end fracture face is illustrated in Figure 6 with a green arrow indicating the tension side and an orange arrow indicating the mechanical damage, as in Figure 5. The red arrows indicate the fracture faces that were inclined at approximately 45-degrees, consistent with an overload event and the black arrow indicates a similar inclined plane that had survived the mechanical damage event.

Derek Nash
Mechanical Engineer

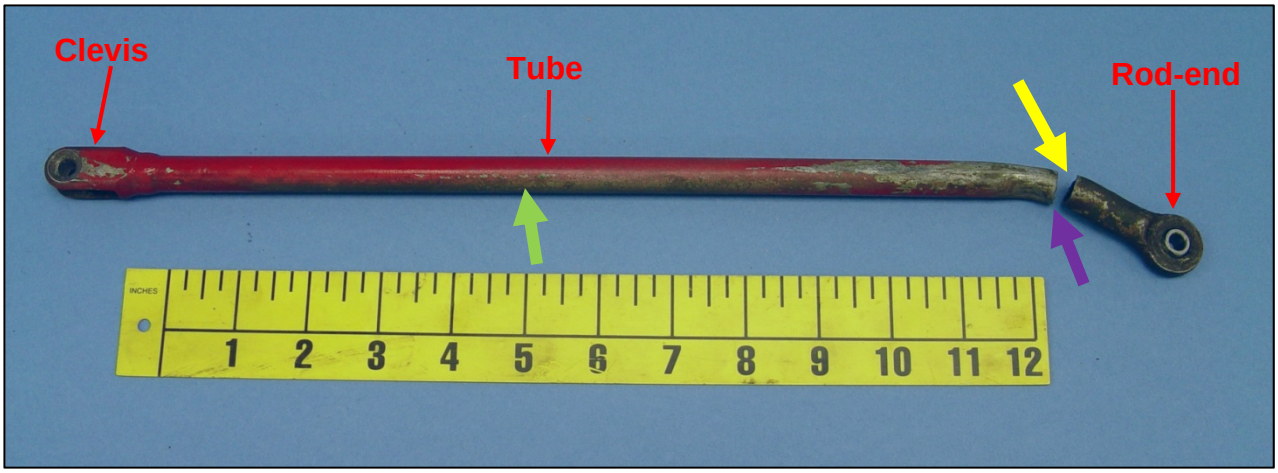

Figure 1. The two pieces of the flaperon rod received for examination.

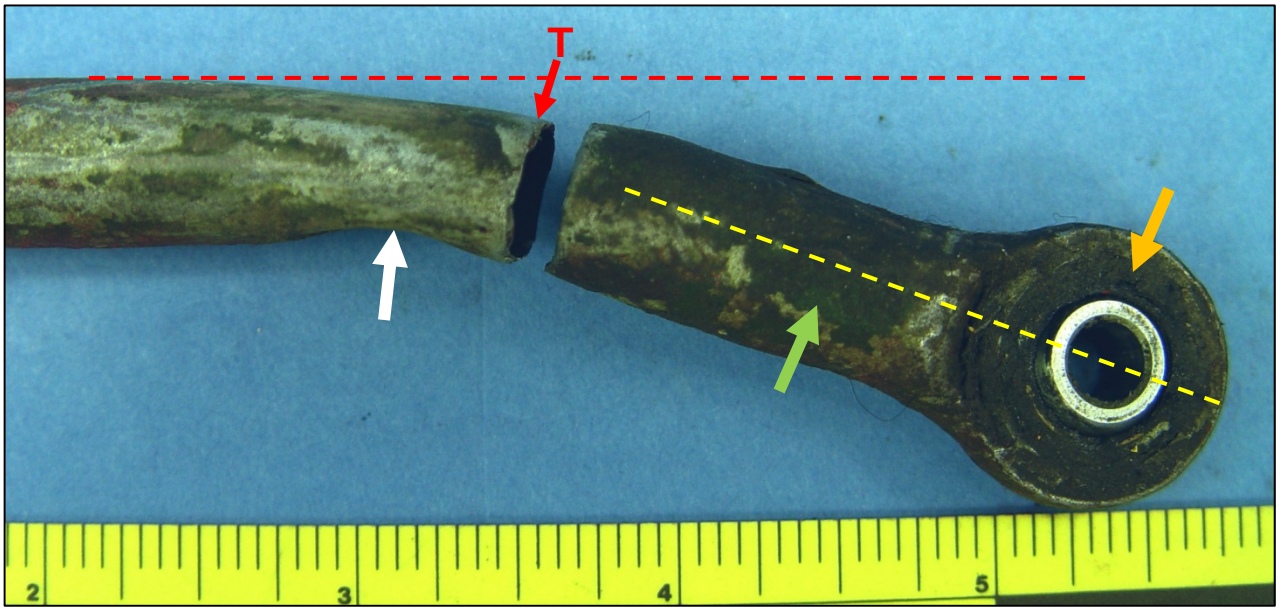

Figure 2. A closer view of the fractured end of the flaperon rod.

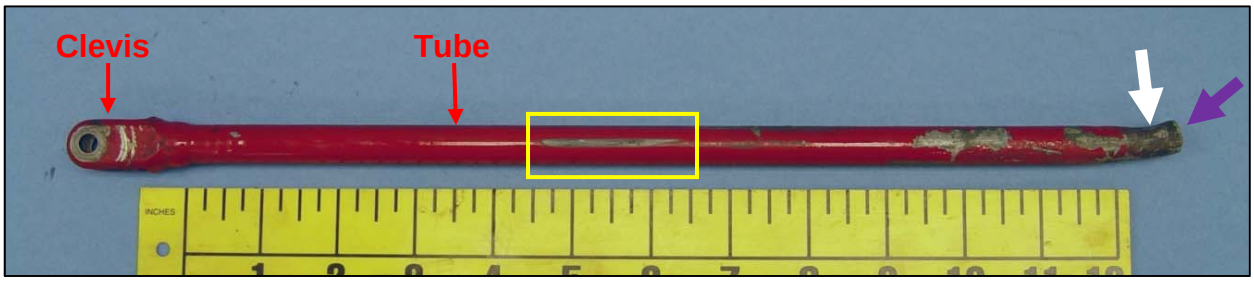

Figure 3. The opposing side of the flaperon rod and clevis illustrated in Figure 1.

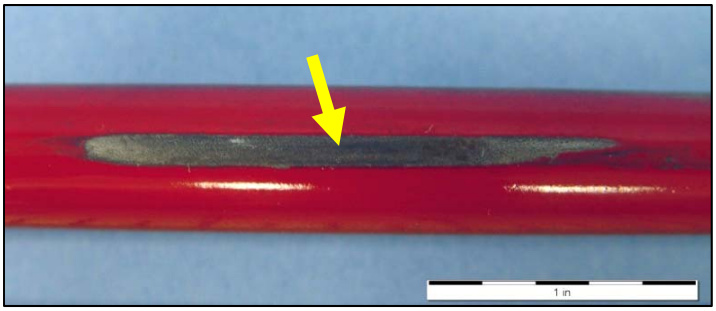

Figure 4. A closer view of the rub mark contained within the yellow box in Figure 3.

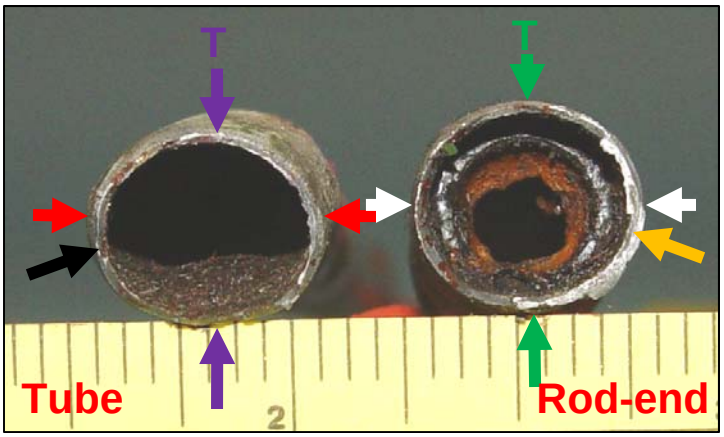

Figure 5. The tube fracture face indicated by the purple arrow in Figure 1 (left) and the rod-end fracture face indicated by the yellow arrow in Figure 1 (right).

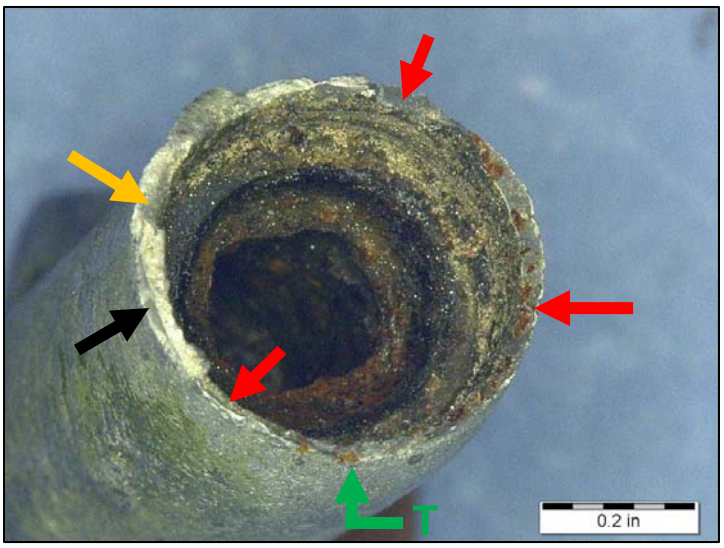

Figure 6. The rod-end fracture face.