National Transportation Safety Board
Office of Research and Engineering
Washington, DC 20594

DCA22MA193

MATERIALS LABORATORY

Factual Report 23-023

March 30, 2023

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A. ACCIDENT INFORMATION

Location: Freeland, Washington
Date: September 4, 2022
Vehicle: de Havilland Aircraft DHC-3 Otter, N725TH
Investigator: Adam Huray

B. COMPONENTS EXAMINED

Lower skin panel section from the horizontal stabilizer that contained a fracture.

C. EXAMINATION PARTICIPANTS

Specialist — Frank Zakar, NTSB, Washington, DC

D. DETAILS OF THE EXAMINATION

Figures 1 through 6 show photographs of the as-received lower skin panel section from the horizontal stabilizer, with the exception of figure 3(b) which shows a photograph that was taken after cleaning. The panel, about 6.5 inches long and 3.5 inches wide, was cut from the horizontal stabilizer and contained a puncture with the ruptured flap portion that was deformed up. A 1.3 inch portion of the puncture, in the area indicated by bracket "W" in figures 1, 2, and 4, exhibited a deformed curved pattern that was consistent with the shape and size of the barrel outer diameter. The curved pattern contained deformation consistent with the barrel portion pressing toward the right and against the panel. The portion of the flap that remained attached to the panel was located on the forward side of the flap. The length of the flap in the forward-aft orientation measured approximately 2.6 inches and the width in the left-right orientation of the flap measured approximately 2.3 inches.

Examination of the bottom surface of the panel (white painted side) revealed evidence of a circular impression that was located within the flap portion, see figure 3. In several areas of the impression the paint layer had fractured and exposed the bare metal surface. The outer diameter portion of the impression in the left-right orientation measured approximately 1.85 inches, consistent with the specified nominal outer diameter of the barrel portion of the stabilizer (1.85 inches). The outer diameter of the impression mark in the in the forward-aft orientation measured approximately 1.98 inches. The bottom surface of the flap in areas all around the impression mark and within the impression mark was covered with translucent red grease. The forward side of the flap in an isolated area indicated by arrows "H" in figure 4 contained circular dent marks consistent with the forward end of the barrel impacting the flap.

Examination of the top surface of the panel (green painted side) revealed evidence of paint that was peeling. In areas of peeled paint, the bare metal surface was exposed. The top surface showed no evidence of gouge or impression marks.

Bench binocular microscope examination of the flap portion revealed the fracture face exhibited coarse features on a slant plane consistent with overstress separation, with no evidence of a pre-existing crack, such as a fatigue crack. The fracture face contained a straight (flat) length portion at the aft end of the flap that measured approximately 1.2 inches, in the areas indicated by arrows "F" in figures 1 through 6. The aft end of the barrel also contained a 1.2 inches straight (flat) length portion, in the area indicated by arrows "G" in figures 4 through 6, that coincided with the straight flat length portion "F". The deformation found in the 1.2-inches flat areas are consistent with barrel portion pushing up and through the bottom panel.

The flap and panel portions were cut along the areas indicated by dashed lines in figure 1, to facilitate X-ray energy dispersive spectroscopy (EDS) analysis of the fracture faces. The flat panel portion was specified as an aluminum alloy, whereas the lock wire was specified as carbon steel spring wire that was to be coated with cadmium or zinc. EDS analysis was performed on the aluminum panel fractures to determine whether cadmium or zinc was transferred to the aluminum fracture faces. EDS analysis of the flap and panel in areas that contained gouge or mechanical damage revealed no evidence of cadmium or zinc elemental peaks.

Submitted by:

Frank Zakar
Senior Metallurgist

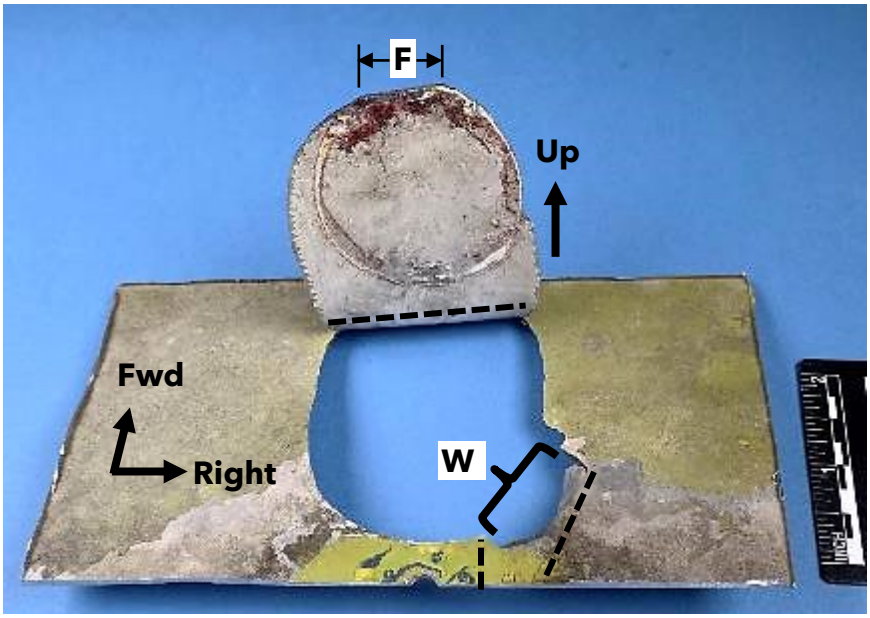

Figure 1. Lower skin panel section from the horizontal stabilizer in the as-received condition that contained a puncture with a ruptured flap portion that was deformed up. Green painted surface represents the top surface of the panel whereas the white painted surface represents the bottom face. "Fwd" indicates forward.

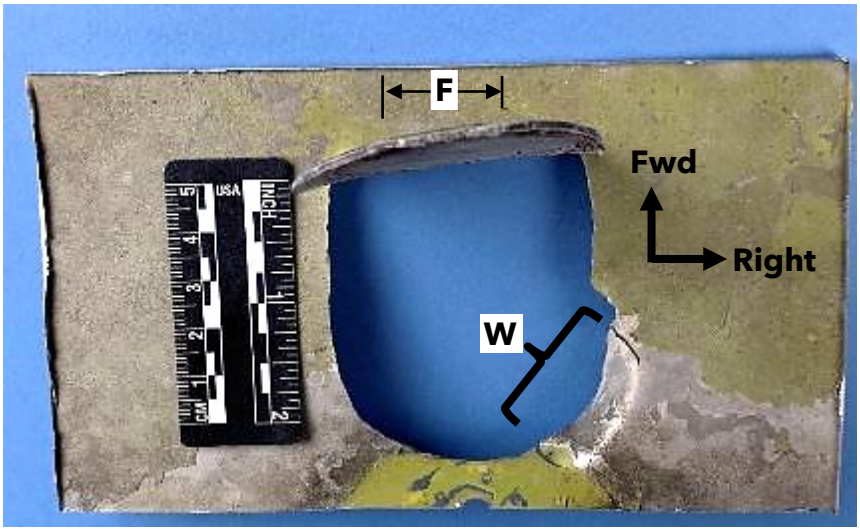

Figure 2. View looking down at the lower skin panel section from the horizontal stabilizer, in the as-received condition. Green painted surfaces represent the top surface of the panel.

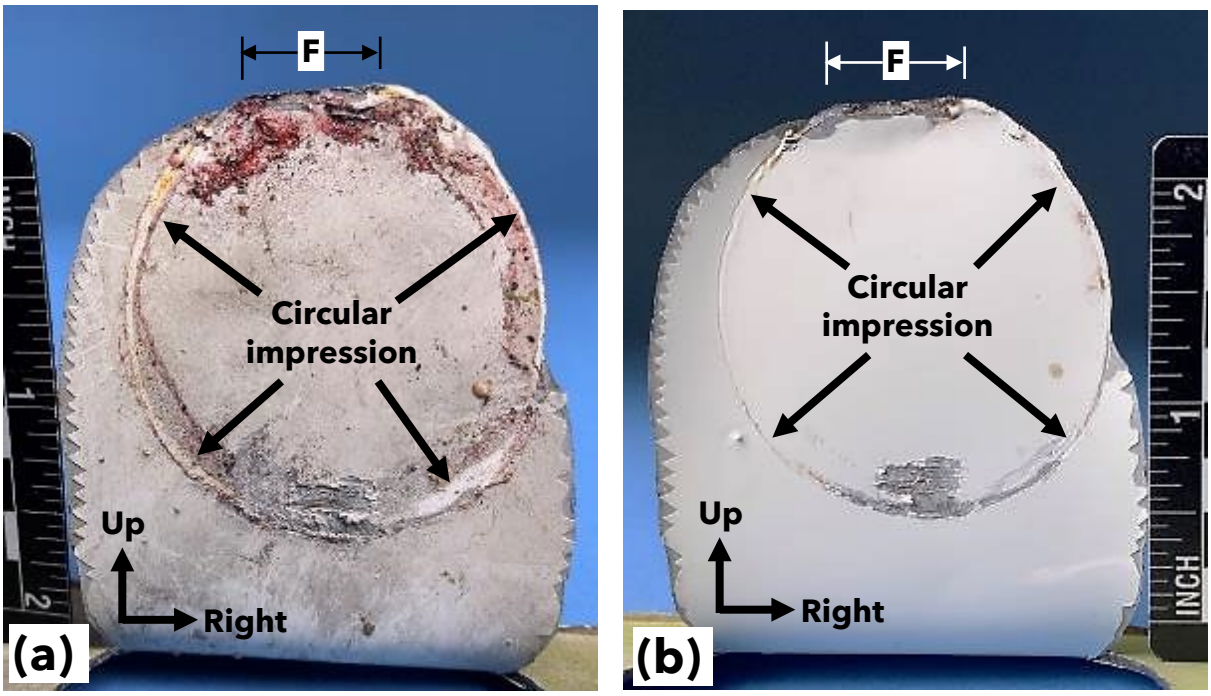

Figure 3. View looking at the bottom surface of the ruptured flap portion in the (a) as-received condition and (b) after cleaning with detergent showing a circular impression.

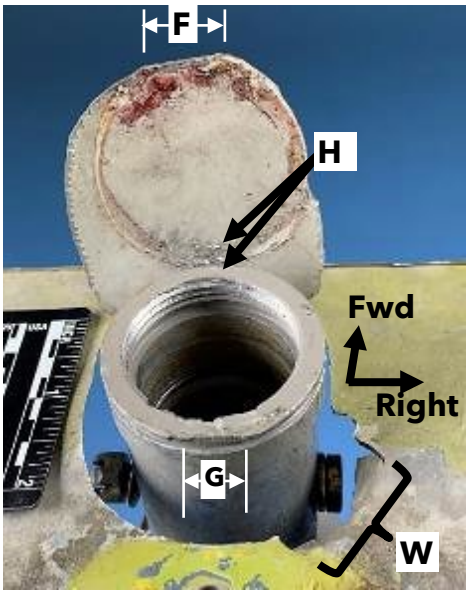

Figure 4. View looking down and forward at the lower skin panel for the horizontal stabilizer, in the as-received condition, with the barrel portion of the horizontal stabilizer actuator inserted into the open end of the ruptured flap portion. Green painted surfaces represent the top surface of the panel.

Figure 5. Side view of the flap portion with the top face of the barrel facing the bottom of the flap. The outer surface of the barrel at the aft end ,in the area indicated by arrow "G", and the aft end of the flap, in the area indicated by arrow "F", exhibited downward deformation. Areas indicated by arrows "F" and "G" in this figure correspond to areas between arrows having the same letter designations in other figures of this report. In this figure, the barrel portion of the horizontal actuator was not inserted into the open end of the ruptured flap portion.

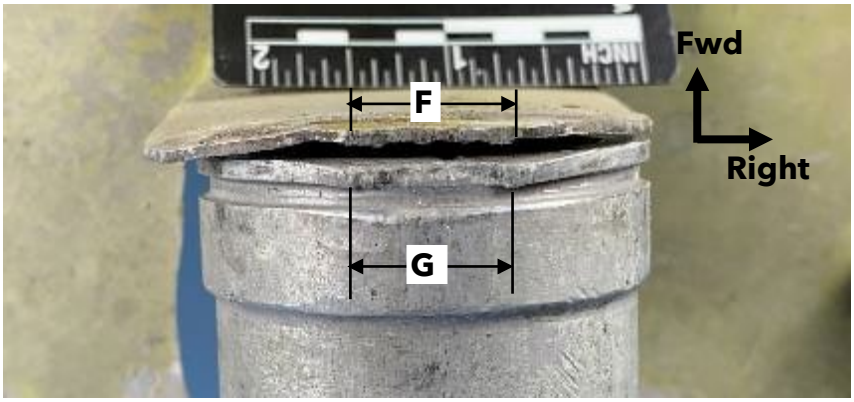

Figure 6. Side view of the flap portion looking down with the barrel portion pressing against the bottom face of the flap showing the straight (flat) length portion of the fracture at the aft end of the flap, area between arrows "F", and corresponding flat length portion of the fracture on the barrel, area between arrows "G". In this figure, the barrel portion of the horizontal actuator was not inserted into the open end of the ruptured flap portion.