

# National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA23LA013

## **MATERIALS LABORATORY**

Factual Report 23-065

August 17, 2023

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## **A. ACCIDENT INFORMATION**

Location: Woodstock, Virginia  
Date: October 8, 2022  
Vehicle: Schempp-Hirth Discus CS, N520RJ  
Investigator: Robert Gretz (AS-ERA)

## **B. COMPONENTS EXAMINED**

Canopy remnants

## **C. EXAMINATION PARTICIPANTS**

Specialist Adrienne Lamm  
National Transportation Safety Board  
Washington, D.C.

## **D. DETAILS OF THE EXAMINATION**

The canopy from the subject glider separated while in flight, shortly after tow release. Two remnant pieces of canopy were located and subsequently submitted to the NTSB Materials Laboratory for evaluation. The two remnant pieces are shown in Figures 1 and 2.

The overall shape and clear edges without any adherent paint on the smaller piece (Figure 1) was consistent with it originating somewhere in the center of the canopy. The fracture surfaces were examined under a 5x to 50x zoom stereo microscope. All the fracture surfaces had features consistent with overstress.

The larger piece of canopy had two edges with adherent paint - a parabola-shaped edge along the short side and a straight edge along the long side, as shown in Figure 2. The shape of the piece and location of the adherent paint was consistent with the piece originating from the aft left side edge of the canopy.

A straight fracture surface extended from near the aft edge of the piece forward, terminating in a drilled hole. Yellow arrows in Figure 3 point to the hole. The profile of the straight portion from the canopy piece fracture surface and the drilled hole is traced in the top of Figure 4 and compared to a photo of the glider frame from the on-scene investigation shown in the bottom of Figure 4. The on-scene photo shows that the flat fracture surface resulted from a crack that extended forward above one edge of the latch (red bracket). The crack was previously observed, and the hole was drilled as an attempt to halt crack propagation.

Close-up views of the hole in the canopy piece are shown in Figure 5. The straight fracture surface from the original crack extended into the hole from the right

side of the images. The fracture surface from the canopy piece separation extends out of the hole towards the bottom left corner of the hole. A secondary crack (red arrows) extends out of the hole diametrically opposite the separation fracture surface.

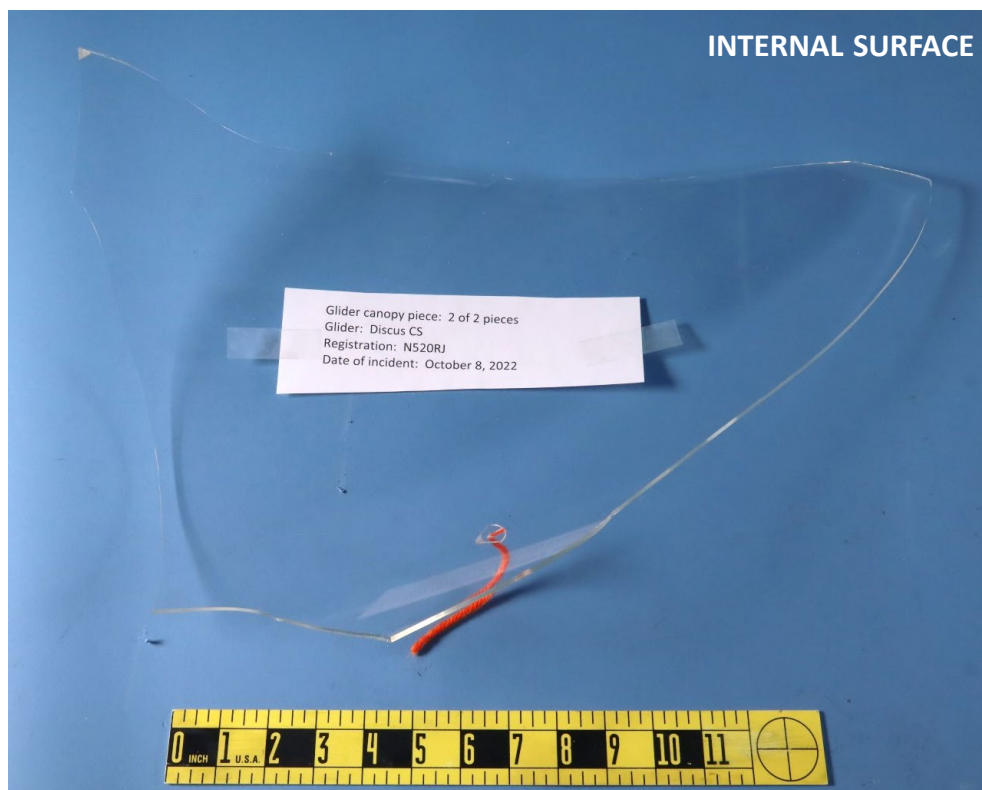
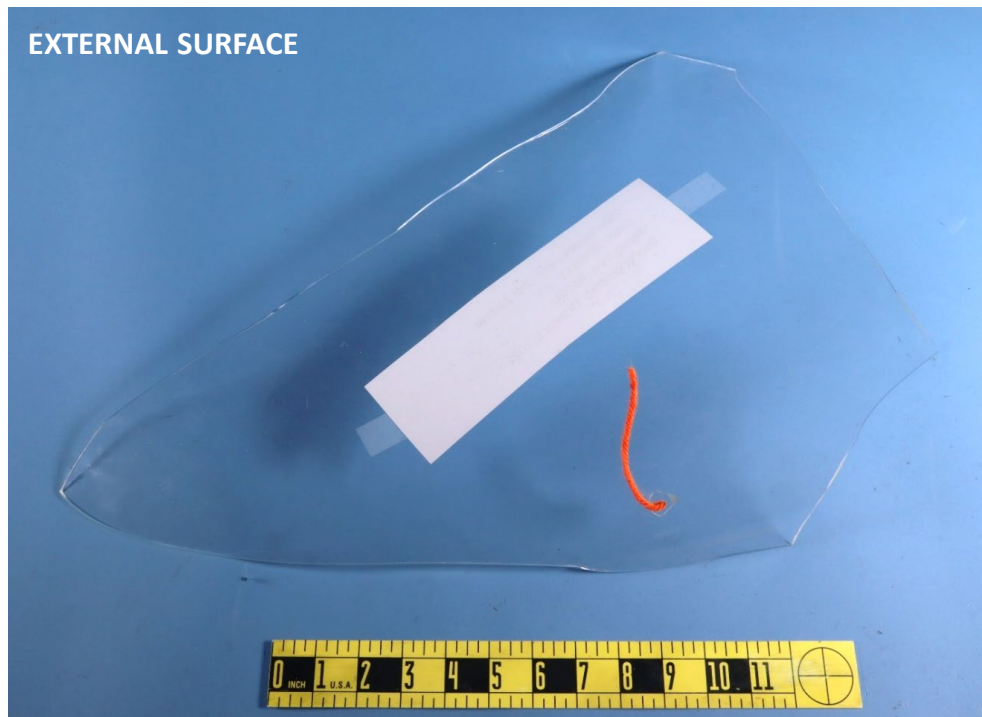
A portion containing the fracture surfaces surrounding the hole was sectioned from the canopy piece. The fracture surface is documented in the as-received condition in the top image of Figure 6. The fracture surface was sputter coated with a thin layer of gold-platinum alloy to improve opacity of the transparent canopy material and highlight the fracture surface features. The fracture surface with the sputter coating is shown in color in the center image of Figure 6 and in black and white in the bottom image of Figure 6.

The fracture surface is shown at higher magnification in Figure 7. White arrows indicate the crack propagation direction on the fracture surface. Rib markings indicated the original crack initiated and propagated from the external surface, as shown in the orange highlighted rectangle. Approximately halfway along the straight fracture surface, rib markings begin emanating from the internal surface, indicating a transition in the stress state driving crack propagation. The transition from external surface to internal surface crack propagation is traced by the yellow dotted line in the green highlighted rectangle. The original crack continued to propagate from the internal surface up to the drilled hole, as shown in the red highlighted rectangle. The separation fracture surface also propagated from the internal surface, initiating at a corner of the drilled hole profile.

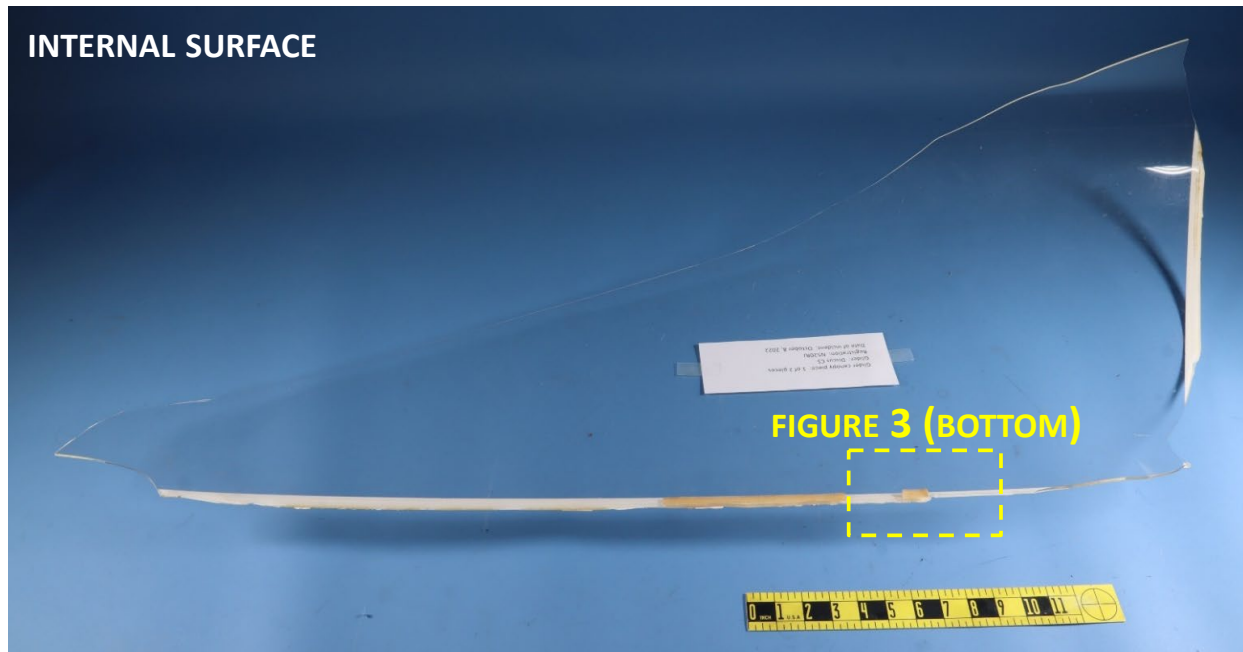
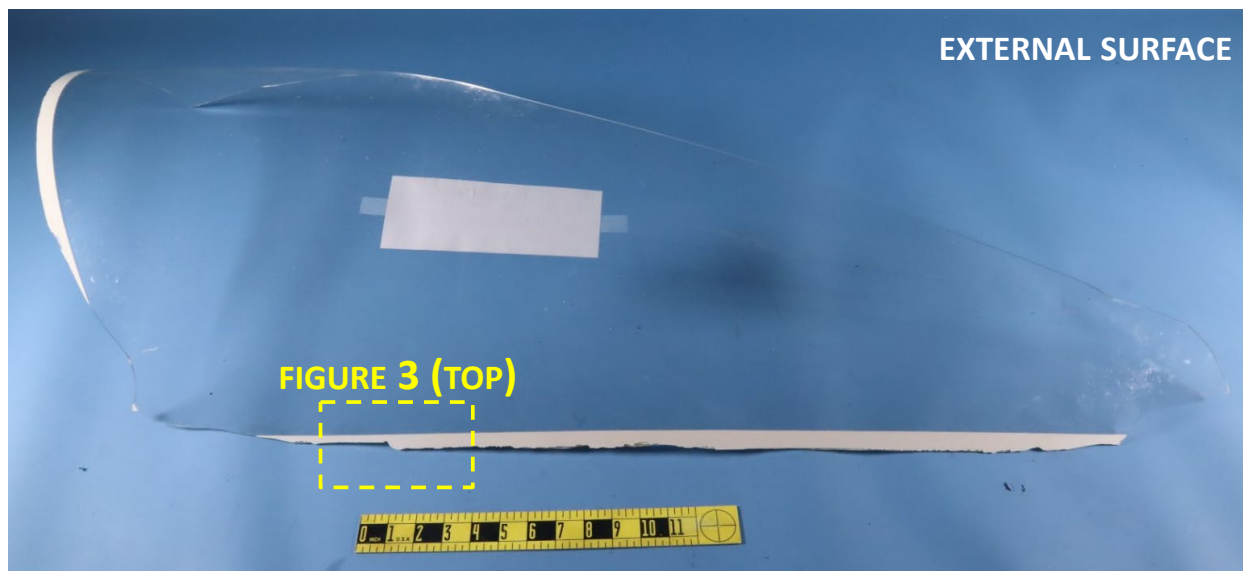
The length of the secondary crack observed on the internal surface is compared to the crack depth visible beneath the fracture surface in Figure 8. Because of the transparent nature of the canopy material, the secondary crack can be seen beneath the fracture surface, as indicated by the red bracket in the top image of Figure 8. The secondary crack also initiated at a corner of the drilled hole profile and propagated from the internal surface.

Submitted by:

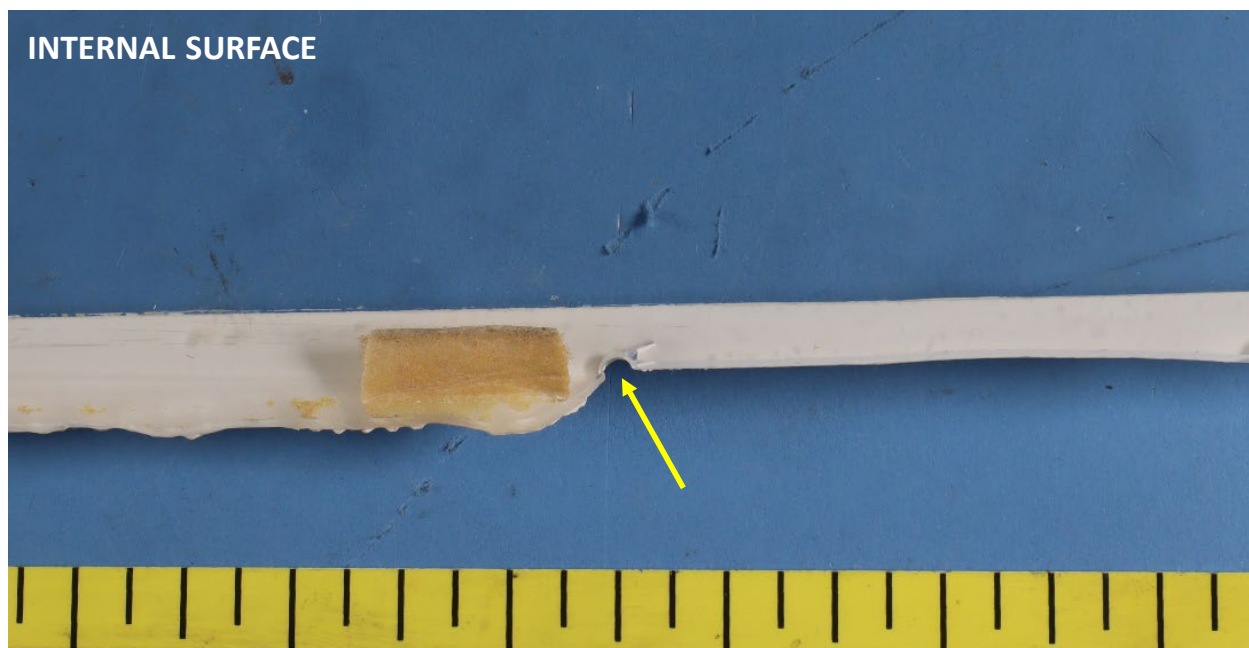
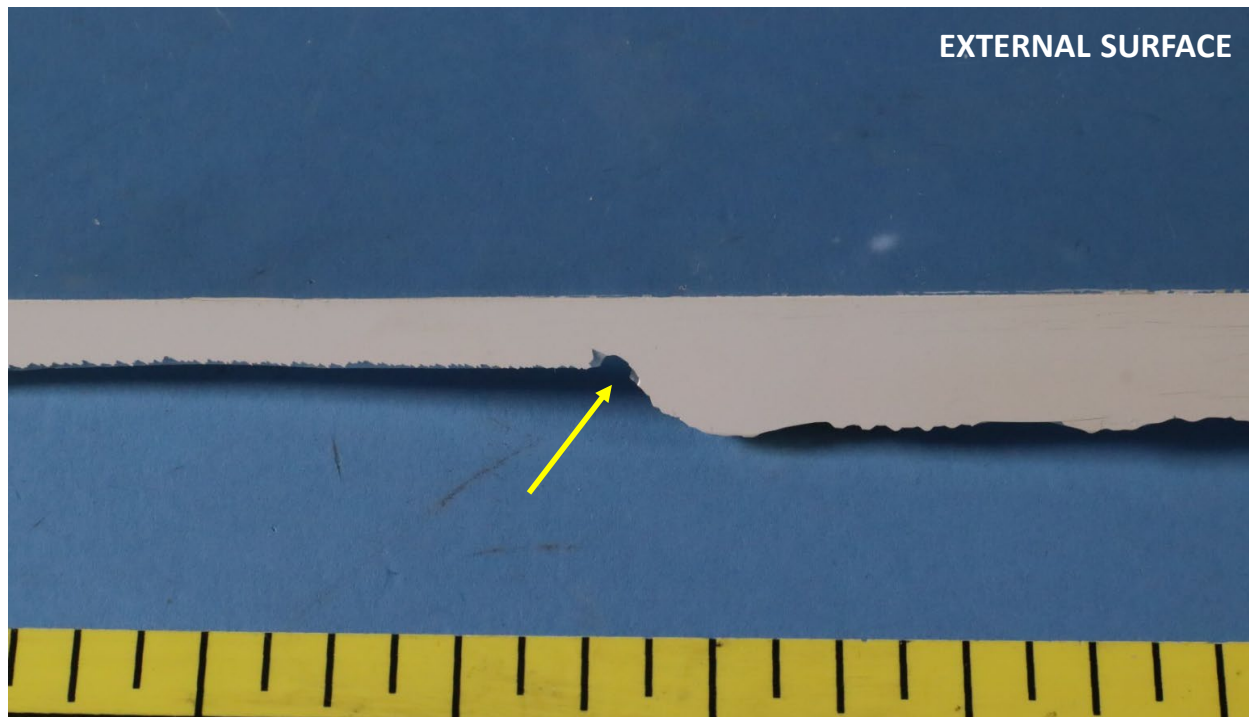
Adrienne V. Lamm  
Materials Engineer



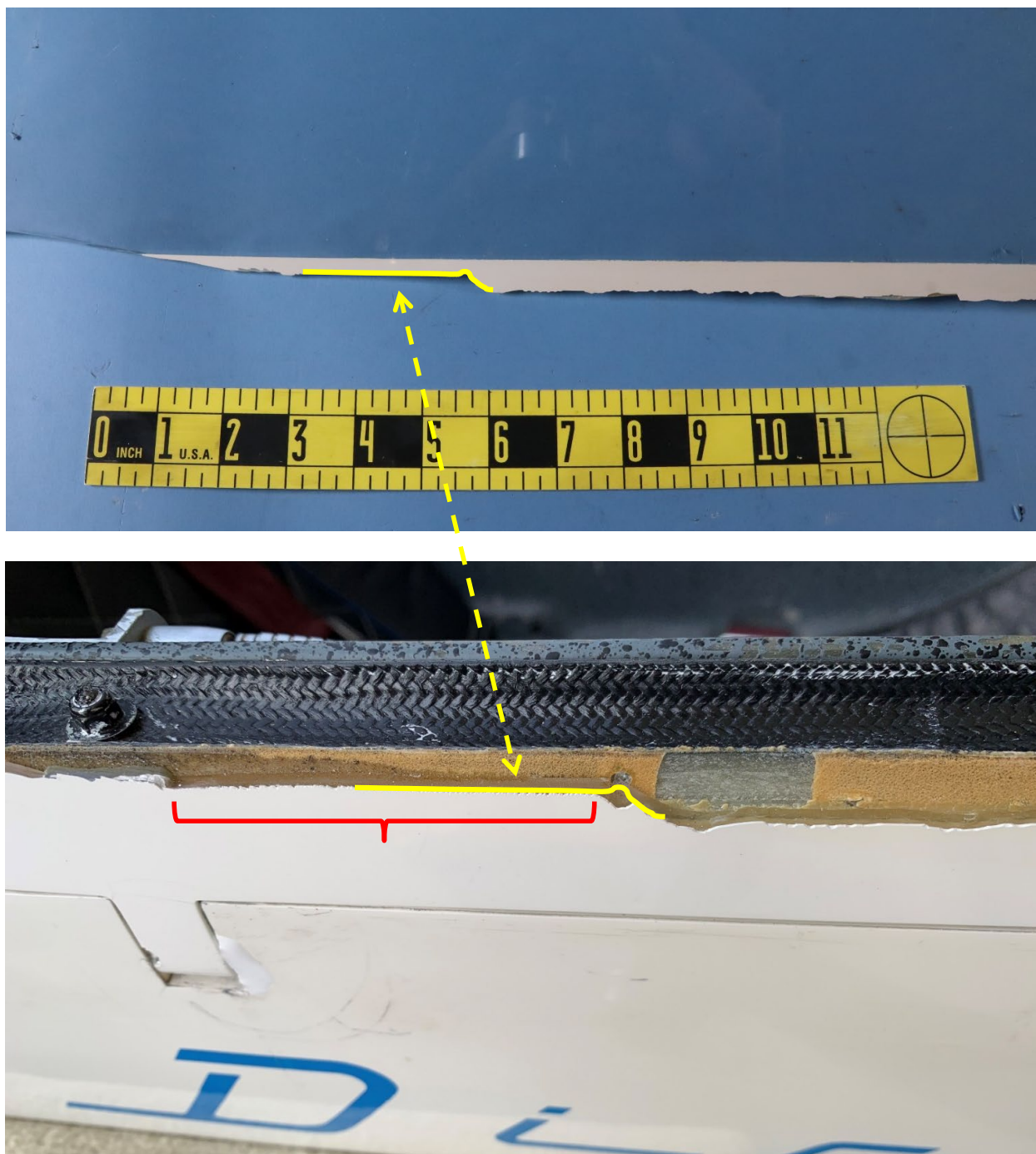
**Figure 1.** Macro photos showing the smaller canopy remnant piece.



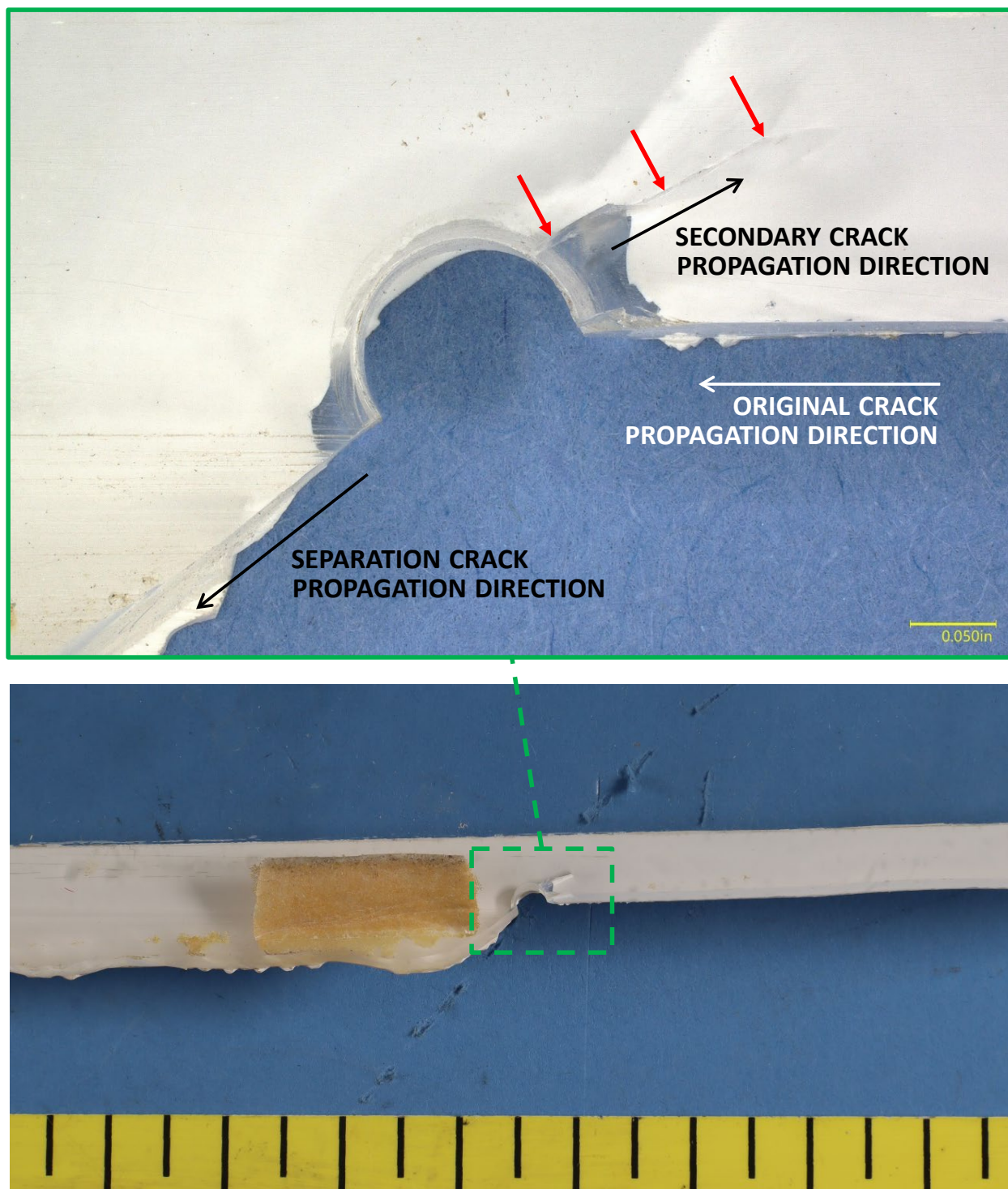
**Figure 2.** Macro photos showing the larger canopy remnant piece.



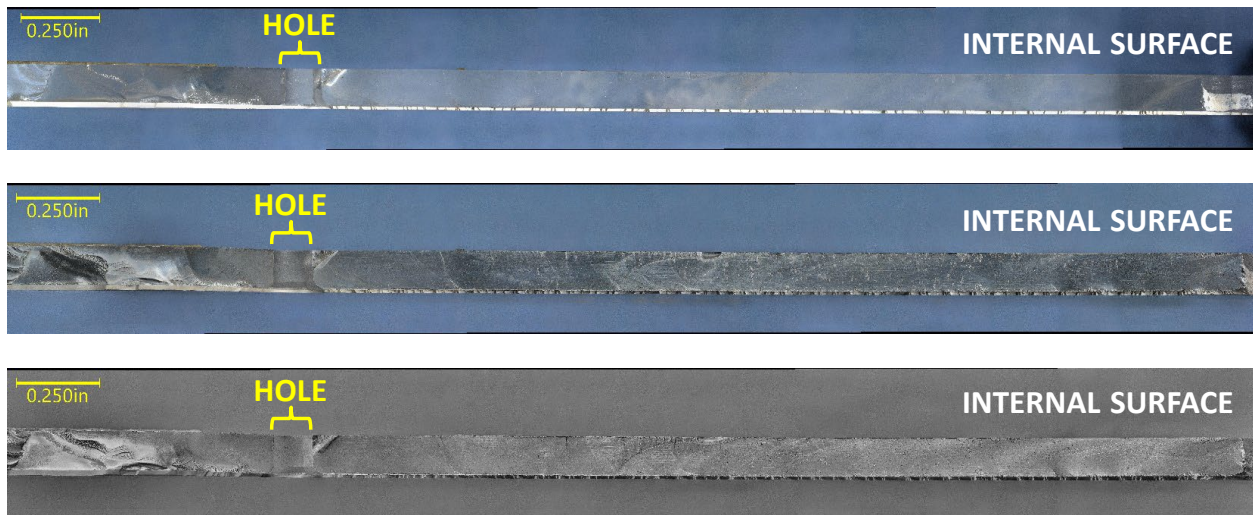
**Figure 3.** Close-up photos showing the hole (yellow arrows) drilled in the larger canopy remnant piece.



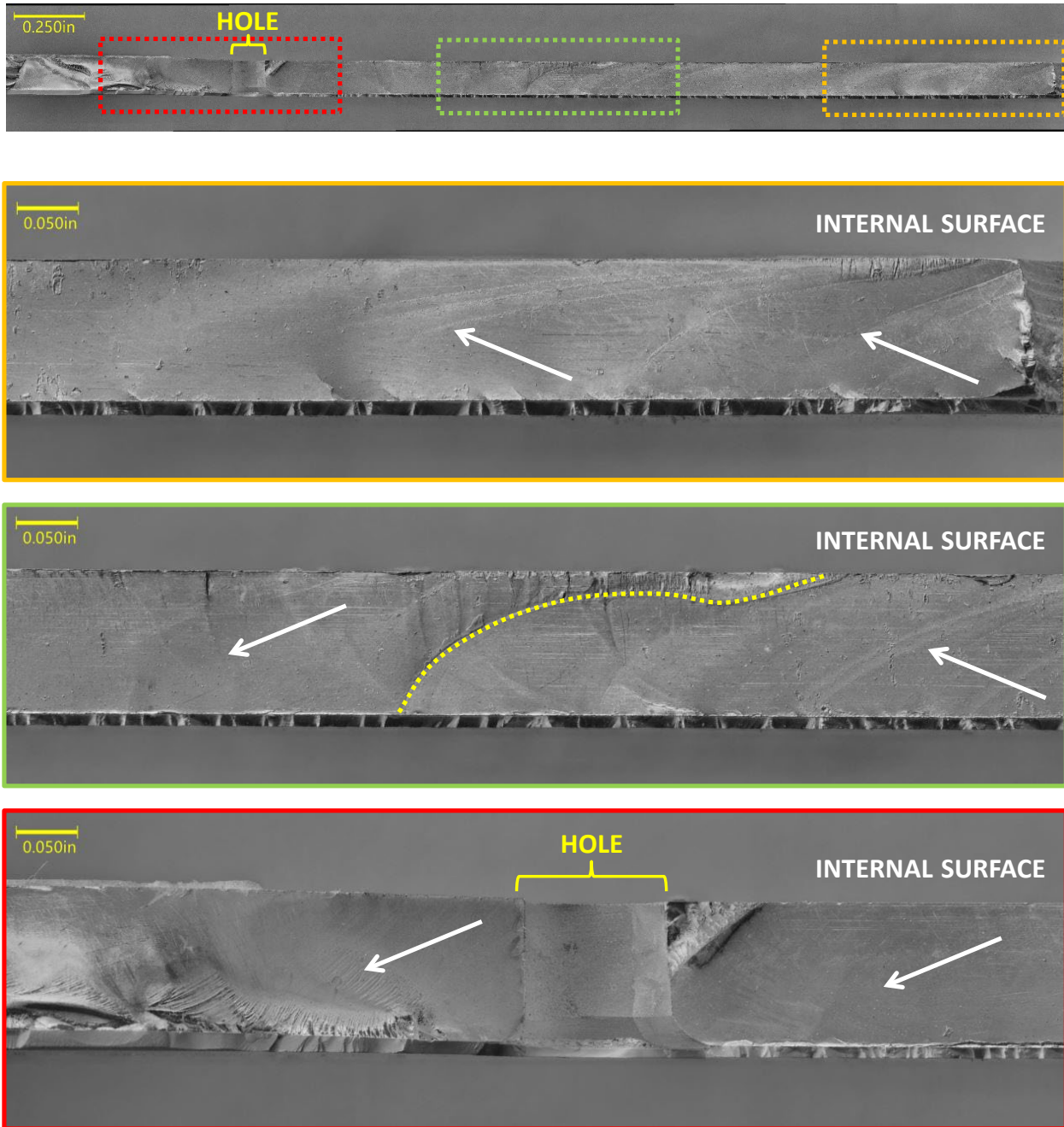
**Figure 4.** The top image is a close-up photo (top) of the larger canopy remnant piece. The bottom image is a photo from on-scene of the glider body. The yellow lines compare profiles of the two canopy fracture surfaces. The red bracket indicates the length of the original canopy crack.



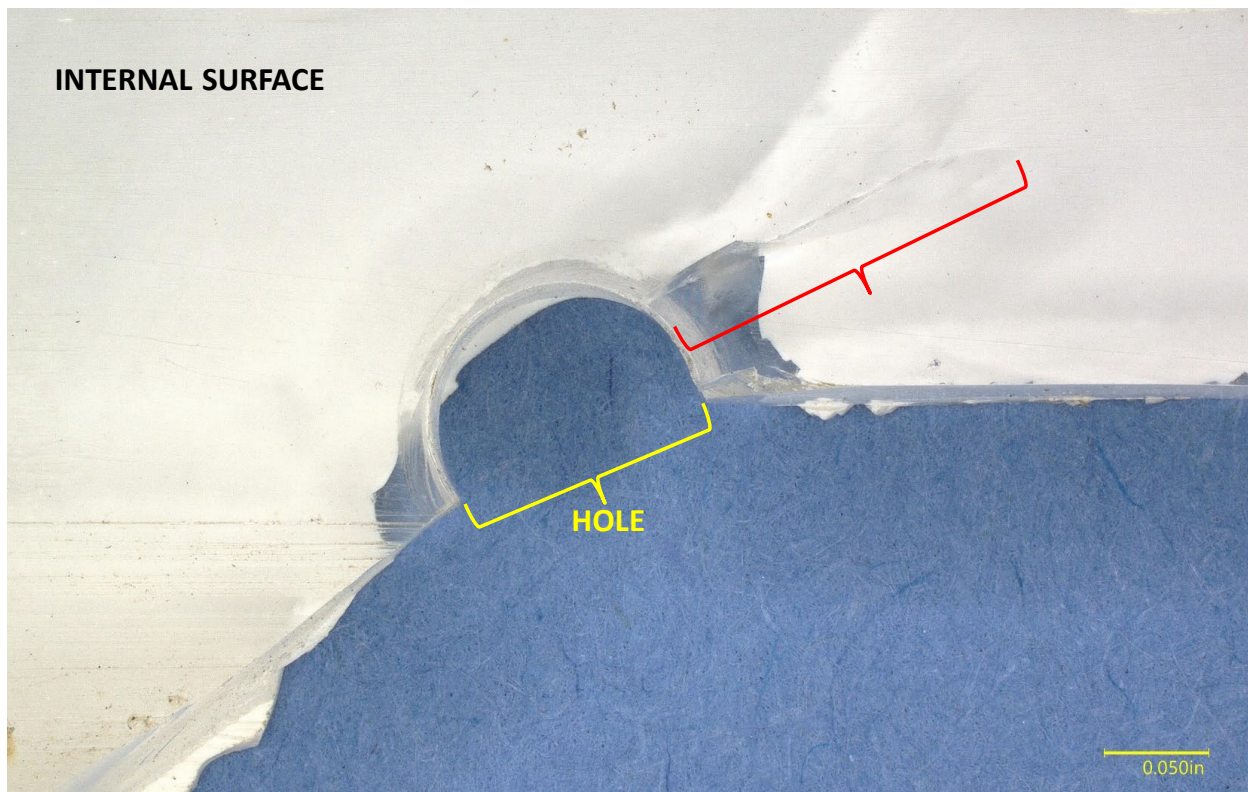
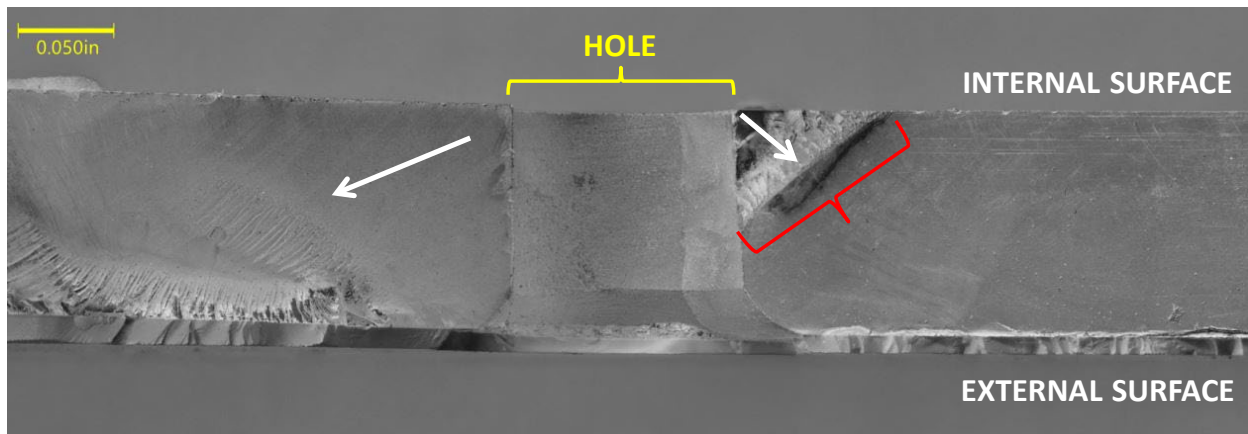
**Figure 5.** Close-up photo (bottom) and digital microscope image (top) of the larger canopy remnant piece. The red arrows point to a secondary crack and the direction of crack propagation for each crack is indicated.



**Figure 6.** Digital microscope composite images of the fracture surface in the (top) as-received condition, (center) with a sputter coating applied and viewed in color, and with a sputter coating applied and viewed in black and white.



**Figure 7.** Digital microscope images of the fracture surface with a sputter coating applied and viewed in black and white. Each dotted rectangle outlines the area shown in the image bordered in the corresponding color at higher magnification. The white arrows indicate the direction of crack propagation. The yellow dotted line traces the transition from external surface to internal surface crack propagation.



**Figure 8.** (Top) Digital microscope image with a sputter coating applied and viewed in black and white. The white arrows indicate the direction of crack propagation. (Bottom) Digital microscope image of the internal surface of the larger canopy remnant piece. The red brackets indicate the secondary crack branching from the drilled hole.