

# NATIONAL TRANSPORTATION SAFETY BOARD

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



May 23, 2017

## MATERIALS LABORATORY FACTUAL REPORT

Report No. 17-049

### A. ACCIDENT INFORMATION

Place : Brainerd, MN  
Date : June 17, 2016  
Vehicle : MD Helicopter 369E, N155NR  
NTSB No. : GAA16LA325  
Investigator : Michael Hicks (AS-20)

### B. COMPONENTS EXAMINED

Pieces from a right front windscreen.

### C. DETAILS OF THE EXAMINATION

The windscreen was submitted with the clear polymer shattered into numerous pieces. Figure 1 shows all of the submitted windscreen pieces. As many mating pieces as possible were matched up by examining the fracture surfaces features. A few of the pieces could not be matched to any of the other recovered pieces, and a few groups of pieces could not be matched within the larger collection of the overall windscreen set. The unmatched pieces and groups of pieces are shown in Figure 2. Based on the submitted pieces, a significant portion of the windscreen was not recovered.

The following part markings, shown in Figure 3, were observed in one corner of the windscreen, on a portion still attached to the border:

S/N MD-582  
369D290027-4

TECH-TOOL PLASTICS  
[REDACTED]  
Ft. Worth, Texas 76108  
[REDACTED]

TECH Tool Plastics  
3694502-2  
FAA PMA MONC  
369 500N 600N

The fracture surfaces had features consistent with fast, brittle fracture in a polymer. A fracture surface on a representative piece is shown in Figure 4. This piece had cracks that progressed in opposite directions, as indicated by the black arrows. Mist regions on the fracture surface are indicated by the red brackets and rib markings are indicated by the yellow dotted lines<sup>12</sup>.

The black arrows in Figures 1, 2, and 5 indicate the direction of crack propagation based on analysis of the fracture surface features. The features on the pieces were consistent with fracture occurring from the external surface of the windscreen, rather than the internal surface that faced into the helicopter cabin. Figure 5 shows cracks that had not progressed far enough to result in discrete windscreen pieces. The tips of the cracks had not propagated through the thickness of the windscreen, and portions of uncracked windscreen were visible adjacent to the internal surface.

The cracks shown in Figure 5 emanated from the center of the windscreen and propagated towards the outer edge of the windscreen. Similarly, the overall pattern of the cracking (illustrated in Figure 1) appeared to be from the center of the windscreen towards the outer edge. No cracks were observed emanating from the bolt holes circling the outer edge of the windscreen.

The pattern of crack propagation and the cracks emanating from the external surface was consistent with the windscreen separating due to impact force applied from outside the aircraft.

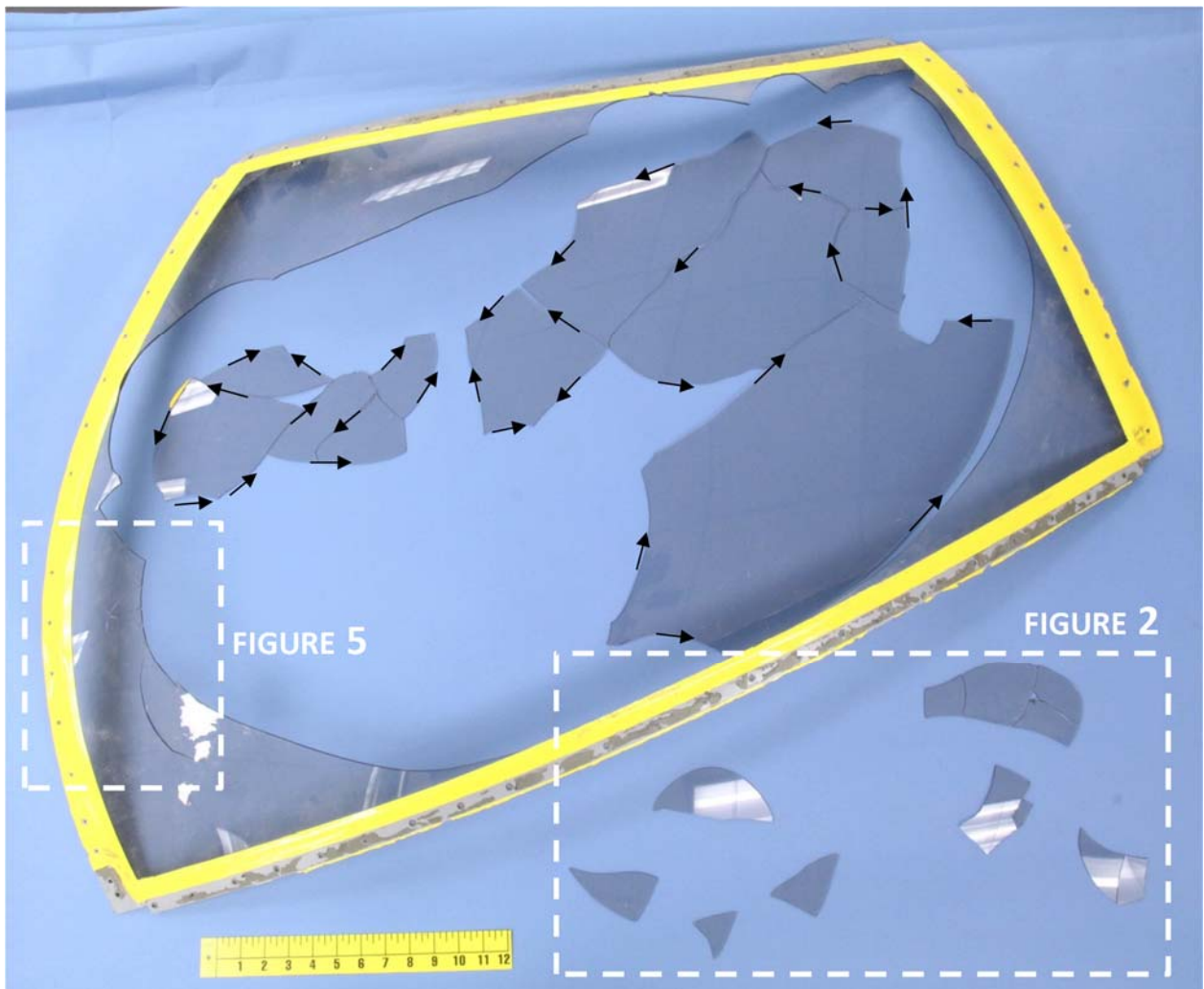
Samples were collected to look for snarge on the external surfaces of the windscreen pieces by Dr. Carla Dove of the Smithsonian's Feather Identification Lab at the National Museum of Natural History. No evidence of feathers or bird DNA were detected in any of the samples.

Adrienne V. Lamm  
Materials Engineer

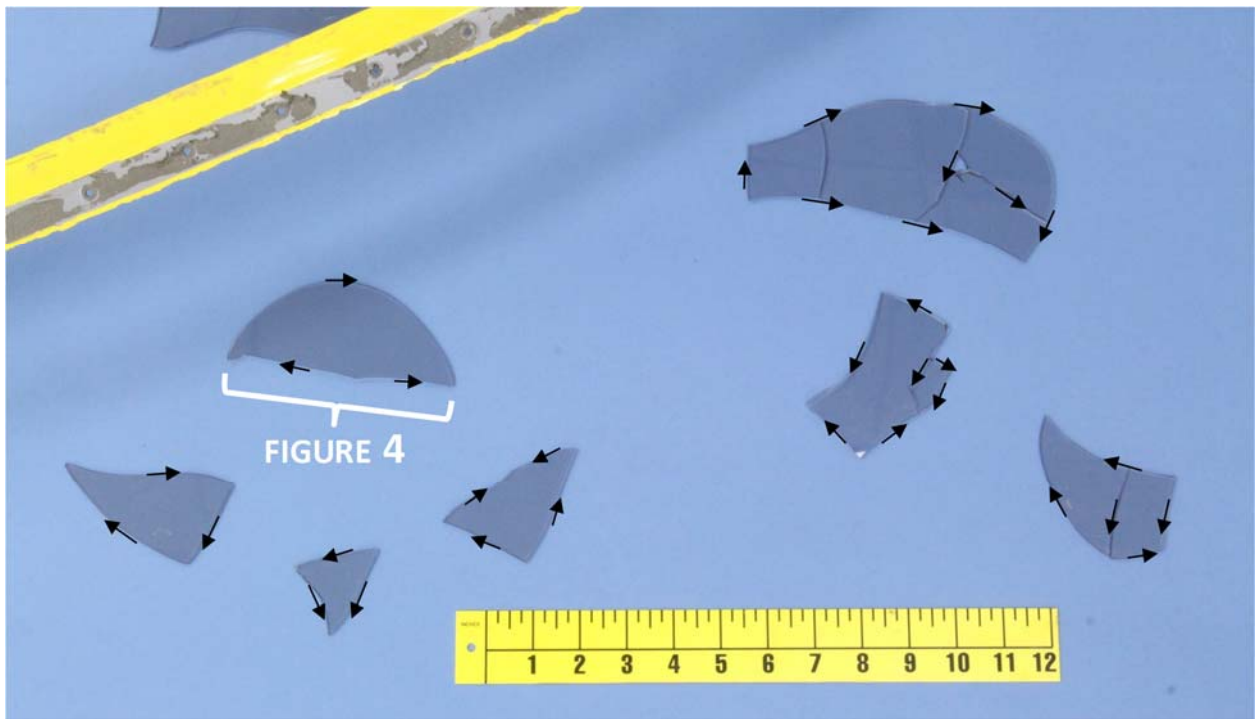
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<sup>1</sup> A mist region is an area on a fracture surface in a polymer near the crack origin area. The mist region may be associated with crack acceleration just prior to rapid crack growth.

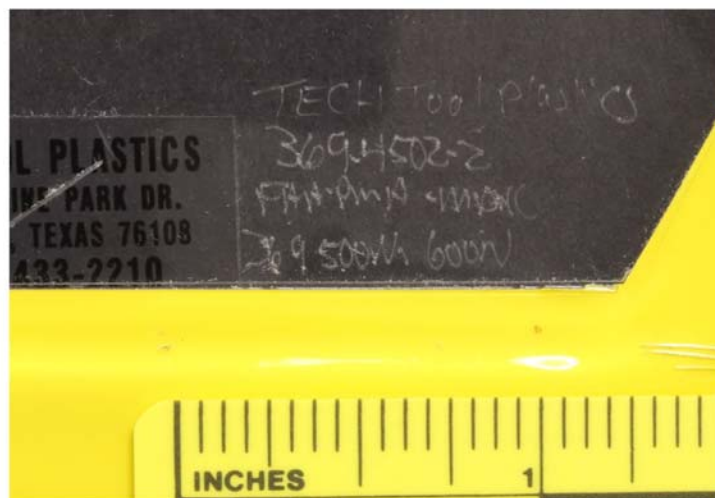
<sup>2</sup> Rib markings are curved crack front markings in polymers. Rib markings are the result of crack arrest or sudden changes in crack velocity.



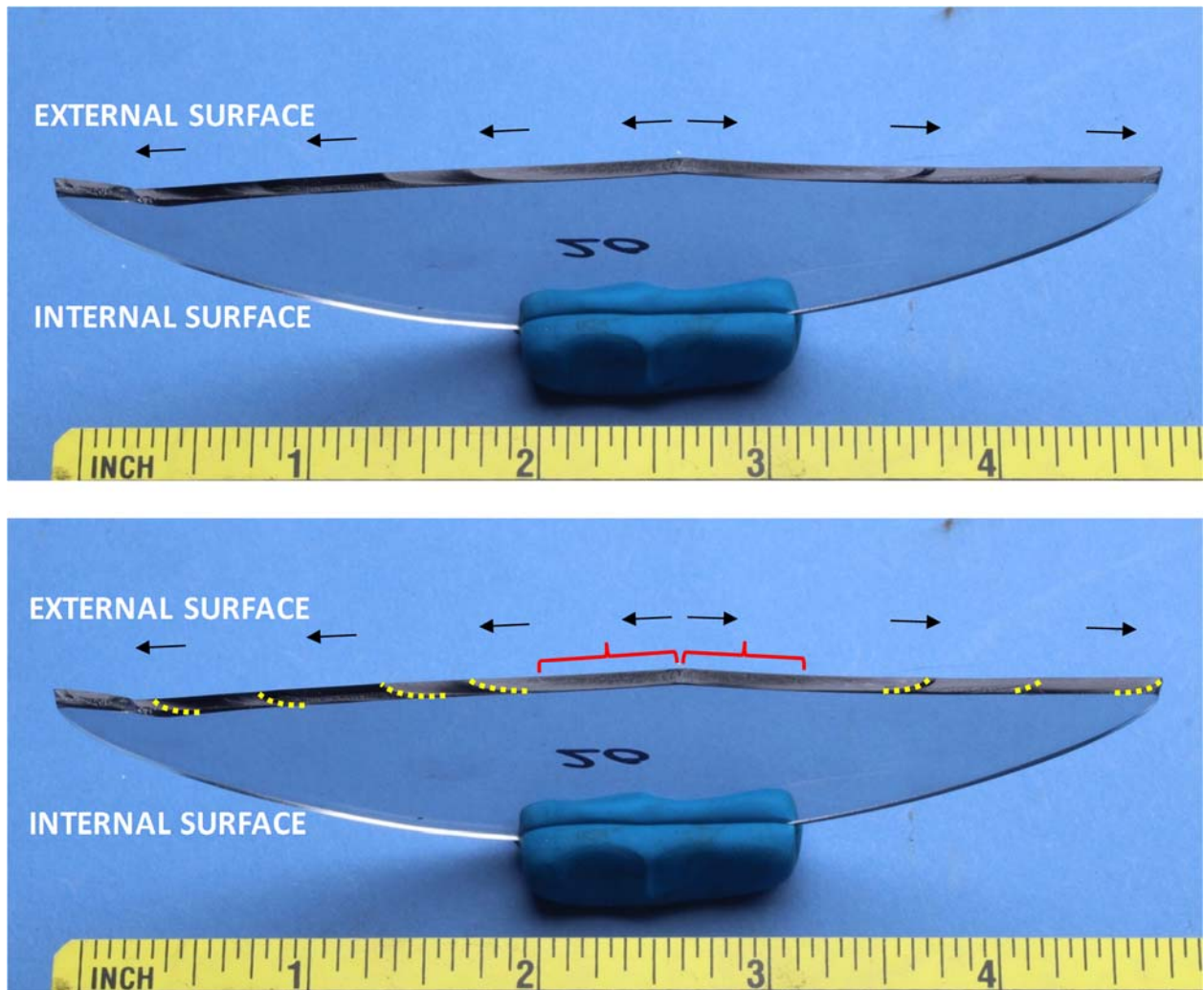
**Figure 1:** Overall photo of the submitted pieces of the windscreen. The black arrows indicate the direction of crack propagation.



**Figure 2:** Close-up photo of pieces of the windscreen that could not be matched up with the larger collection of puzzled together pieces. The black arrows indicate the direction of crack propagation.



**Figure 3:** Close-up photos of the part markings on one corner of the windscreen.



**Figure 4:** Close-up photo of a fracture surface on a representative piece of windscreen. This piece had cracks that progressed in opposite directions, as indicated by the black arrows. Mist regions (red brackets) and rib markings (yellow dotted lines) were visible on the fracture surface.



**Figure 5:** Close-up photo of cracks that had not progressed all the way through the thickness of the windscreen.