

NATIONAL TRANSPORTATION SAFETY BOARD

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



March 1, 2012

MATERIALS LABORATORY FACTUAL REPORT

Report No. 12-021

A. ACCIDENT INFORMATION

Place : Jackson, Mississippi
Date : January 28, 2012
Vehicle : Cessna 172 N427CP
NTSB No. : ERA12IA169
Investigator : Jose L. Obregon, AS-ERA

B. COMPONENTS EXAMINED

McCauley Fixed Pitch Propeller, SN UE062

C. DETAILS OF THE EXAMINATION

The camber face of the as-received propeller is displayed in figure 1. The propeller hub area was impression stamped "1A170E JHA7660" and also "TC P-857" and "PC 3". The prop was reported to have been installed new in 2000 and accumulated approximately 1,807 service hours. The leading edges were reported "cleaned and dressed" about 280 hours previously.

The tip of one blade was fractured approximately 35.8 inches from the prop centerline, as shown in figure 1. The other blade tip measured 38 inches indicating that slightly more than 2 inches of the tip was not received.

Optical examinations of the fracture face revealed fracture markings indicative of fatigue progression in aluminum alloys as shown in figure 2. The fatigue initiated near the leading edge and propagated chordwise (red arrow) through an estimated 60 to 70% of the blade cross section with the remaining fracture consistent with tensile overstress separation. The demarcation between fatigue progress and overstress is indicated by the yellow dashed line in the upper view of figure 2.

On the as-received propeller, approximately 0.1 inch of the fracture face was obscured by a light colored material embedded into the fracture as shown in the upper view of figure 3. The adjacent blade material was deformed and bulged consistent with post fracture impact and displacement of the fracture surface. On-scene images of the blade fracture, as shown in the lower view of figure 2, did not show damage at the leading edge of the blade. To illustrate the extent of damage a digital tracing of the leading edge shape was made from the on-scene image and matched and overlaid on the lower image of figure 3 as a dashed red line.

A sample of the obscuring material was retained and the remainder was removed by successive cleanings in acetone with ultrasonic agitation to reveal the surface shown in the lower view of figure 3. Magnified examinations, optical and scanning electron, found that the larger fracture features remained mostly visible but the fine microscopic details had been obliterated. The macroscopic features indicated that the fatigue initiated in the close vicinity of the leading edge on the flat face side of the blade. The bracket in the lower view of figure 3 indicates the approximate origin location. No significant corrosion or damage was noted on the adjacent intact leading edge of the blade.

Fourier-Transform Infrared (FTIR) spectra of the retained obscuring material identified it as methyl cellulose. FTIR spectral comparisons of the unknown material found a close spectral match with a light colored paper product used as packing dunnage in cardboard shipping container, as shown in figure 4. Inspection of the interior ends of the shipping package revealed crushing and denting of the cardboard in the approximate shape of the blade fracture as shown in figure 5.

X-ray fluorescence analysis¹ identified the blade material as a 2000 series aluminum alloy. Hardness measurements averaging 72.6 HRB² were consistent with a T6 temper condition.

Joe Epperson
Senior Metallurgist



Figure 1. An overall view of the chamber side of the as-received propeller with the fracture at the right.

¹ Using a Thermo Scientific Niton XL3t-980 hand held x-ray fluorescence analyzer.

² HRB. Hardness, Rockwell, B scale. An indentation method of determining the hardness of soft metals and utilizes a 1/16-inch diameter ball indenter and a load of 100 kilograms.

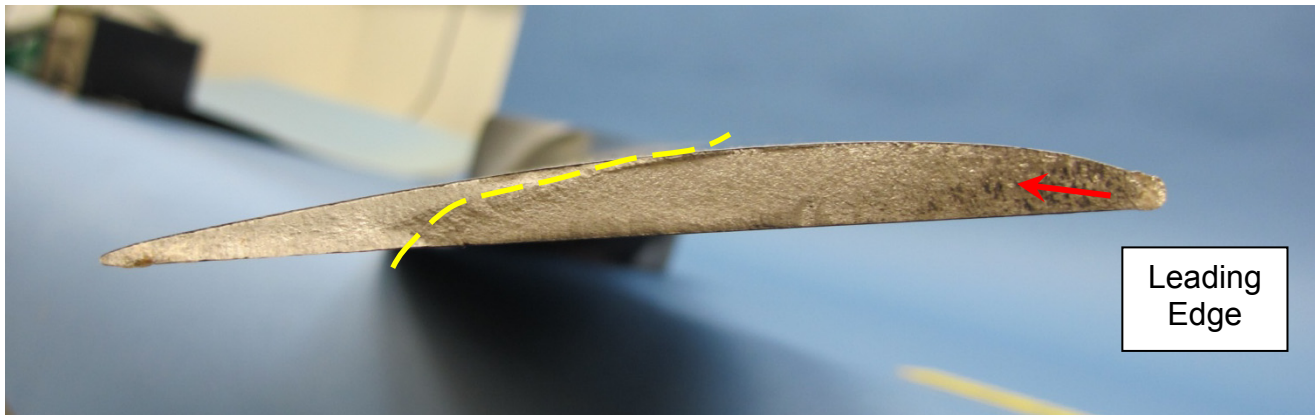
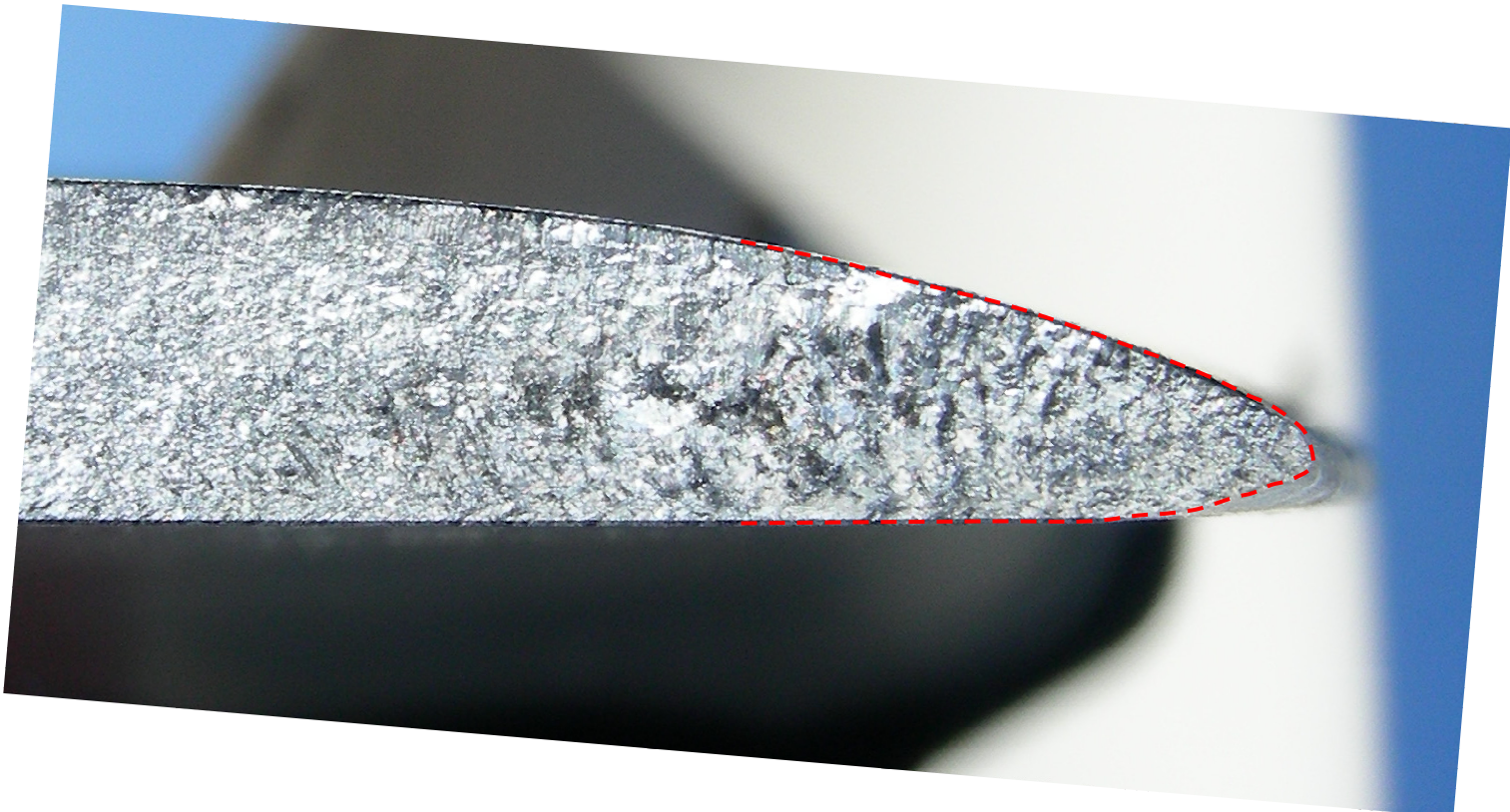


Figure 2. Above, a view of the as-received fracture face showing fatigue progression from the leading edge, red arrow, up to the dashed yellow line. Below, an enlarged and cropped portion of an on-scene image of the fracture showing the leading edge area (dashed red line) with no appreciable damage.



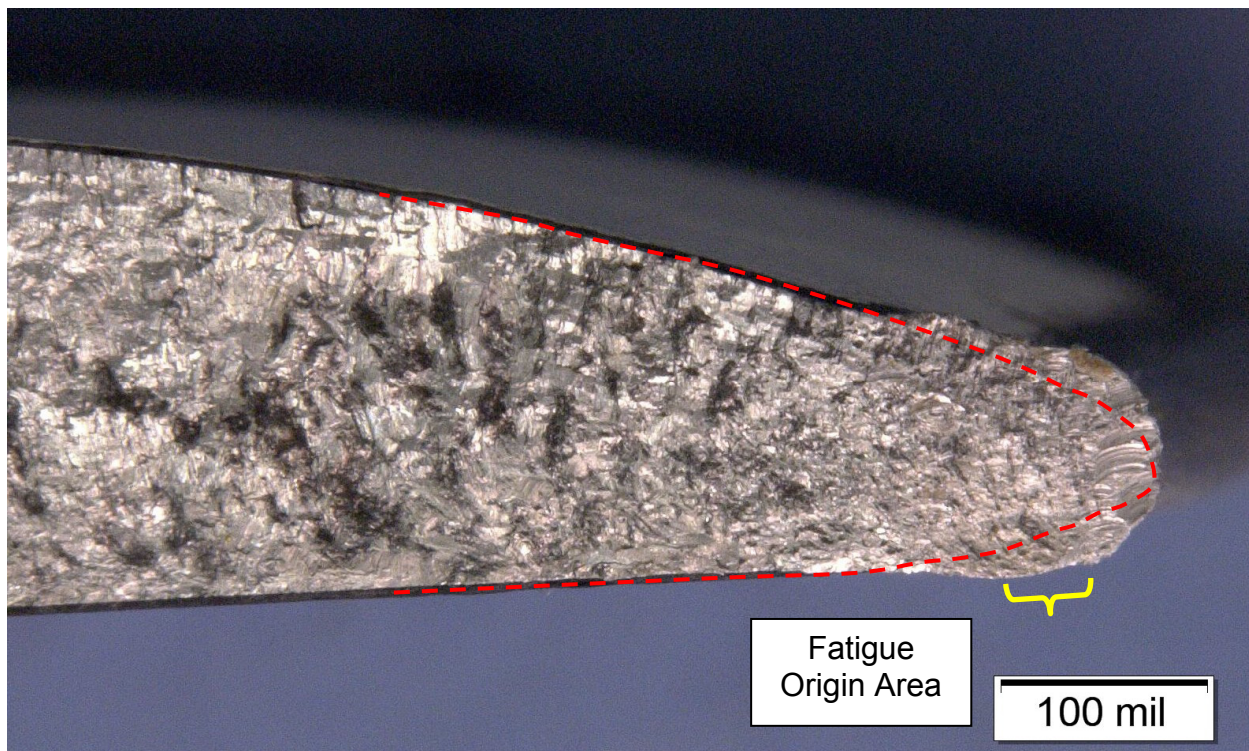
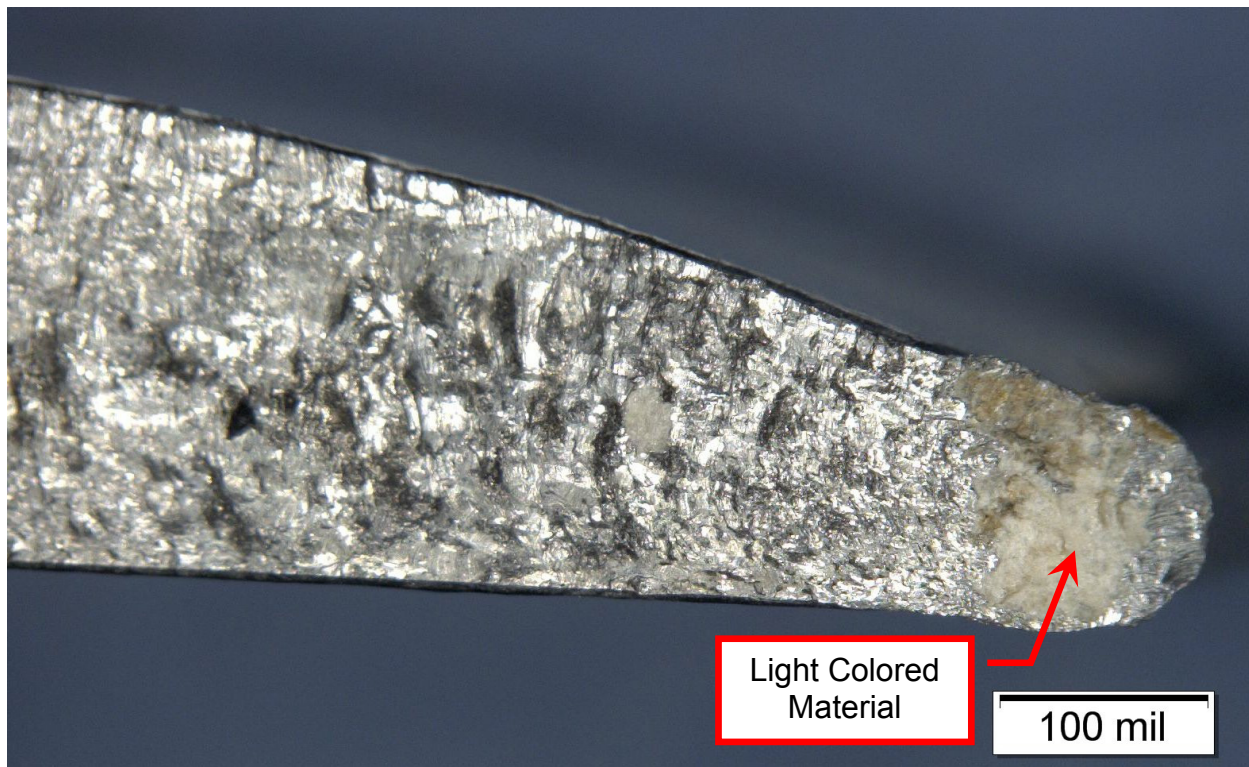
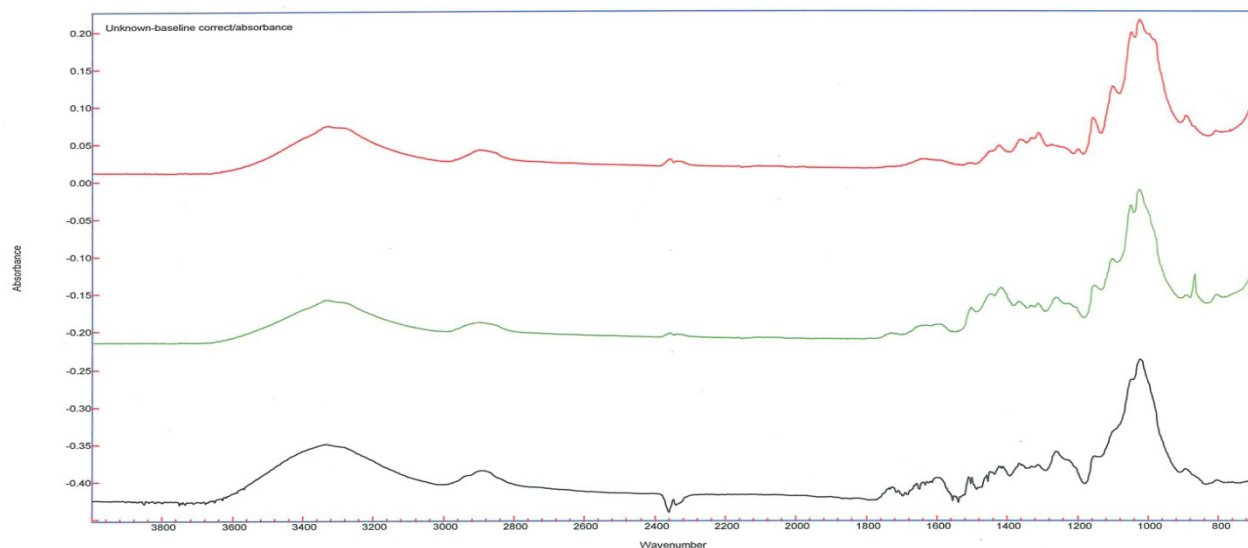


Figure 3. Two magnified view of the leading edge area of the fracture before and after removal of the light colored material. Fracture features indicated fatigue origination in the area of the yellow bracket in the lower view. Dashed red line in lower view denotes the shape of the leading edge before damage.



Name	
White packing paper	—
Brown packing paper	—
Unknown-baseline correct/absorbance	—

Figure 5. FTIR spectra comparing the light colored material from the fracture face (top red line) to the two kinds of paper dunnage in the shipping box (green line white paper, black line brown paper).

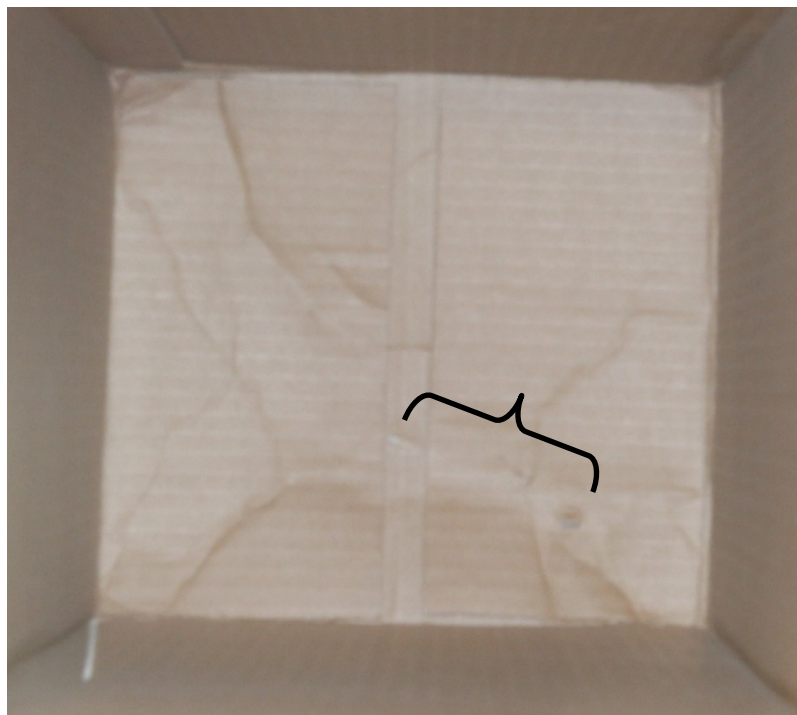


Figure 6. The interior end of the shipping box showing blade shaped crushing (bracket).