

NATIONAL TRANSPORTATION SAFETY BOARD

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



July 23, 2019

MATERIALS LABORATORY FACTUAL REPORT

Report No. 19-033

A. ACCIDENT INFORMATION

Place : Mayport, Florida
Date : December 20, 2018
Vehicle : Piper PA-46-350P
NTSB No. : ERA19LA072
Investigator : Timothy W. Monville, AS-ERA

B. COMPONENTS EXAMINED

Several airplane structure pieces.

C. DETAILS OF THE EXAMINATION

Figure 1 shows a photograph of the as-received pieces of the airplane. The pieces were saw cut on-site from the airplane to facilitate shipping and handling. Description of each item, as marked on each piece, is shown below the figure 1. The metallic pieces were covered with white barnacles and the fracture faces were covered with white oxide deposit consistent with parts that were submerged underwater. The forward spar for the right wing fractured into several pieces. A reconstruction of the forward spar pieces from the right wing is shown in figure 2.

Bench binocular microscope examination of all the as-received pieces revealed they contained fractures on a slant plane with coarse fracture features consistent with overstress separation with the exception of the web on the spar for the right wing that contained two adjoining isolated areas on a flat plane consistent with fatigue cracking, in the areas indicated by brackets "O1" and "O2" in figures 2 and 3. The fatigue cracks emanated from the aft face of the web and intersected the two holes in the web, indicated by brackets "H1" and "H2" in figures 2 and 3. The fatigue cracks propagated in the general direction indicated by arrows in figure 4. The length of fatigue crack "O1" measured approximately 0.09 inch, and the length of fatigue crack "O2" measured approximately 0.4 inch.

The fracture face from piece "1C" was saw cut from the larger piece, along the areas indicated by a dashed line in figure 2, to facilitate examination of the fatigue crack portions. The fracture face "1C" was immersed in a chromic-phosphoric acid solution at elevated temperature to remove oxide scale.¹ Scanning electron microscope examination of fracture face "1C" revealed each of the two flat fracture regions contained barely discernable crack

¹ ASTM G1 *Standard Practice for Preparing, Cleaning and Evaluating Corrosion Test Specimens*, Designation C.1.1.1, ASTM International, West Conshohocken, PA, USA

arrest marks (see figure 5) consistent with fatigue cracking that emanated from the aft face of the web. Fatigue crack "O1" extended through approximately 80% of the wall thickness, in the general direction indicated by arrows in figures 4 and 5, to the approximate areas indicated by dashed lines in figure 4. Fatigue crack "O2" extended through approximately 60% of the wall thickness to the areas indicated by dashed lines in figures 4 and 6. Figures 4 and 6 show partial views of fatigue crack "O2". The fracture areas located outside of the fatigue regions exhibited coarse texture fracture features on a slant plane consistent with overstress separation.

Examination of the electric socket assembly, indicated by arrow item 7 in figure 1, revealed an electrical pin separated from the socket assembly, see figure 7. Bench binocular microscope examination of the electric socket assembly revealed the holes for the pin contained deformation damage consistent with a pin that was forcefully pulled out from the socket.

Frank Zakar
Senior Metallurgist

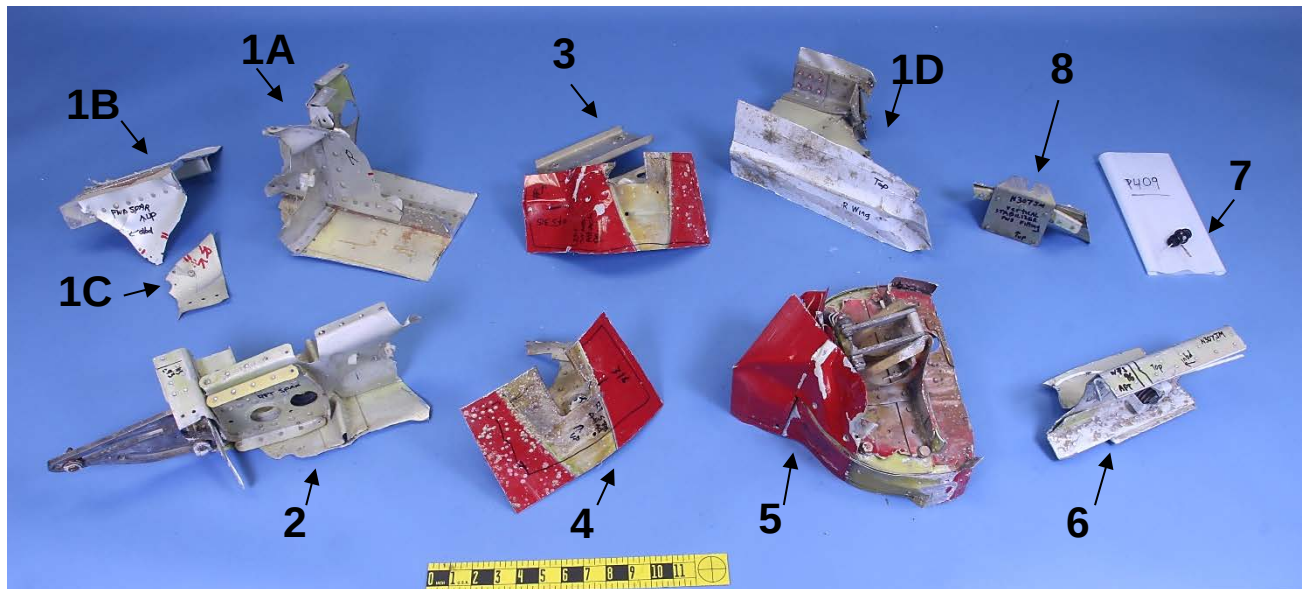


Figure 1. As-received pieces from the airplane.

<u>Item</u>	<u>Description</u>
1A	Spar from right wing
1B	FWD spar from right wing
1C	Web portion from right wing
1D	Spar from right wing
2	Aft spar from right wing
3	Left stabilizer attach point FS315
4	Right stabilizer attach point FS 316
5	Left side FS331
6	Right wing WFS96
7	Separated electric socket with shipping plastic bag in background
8	Vertical stabilizer FWD fitting

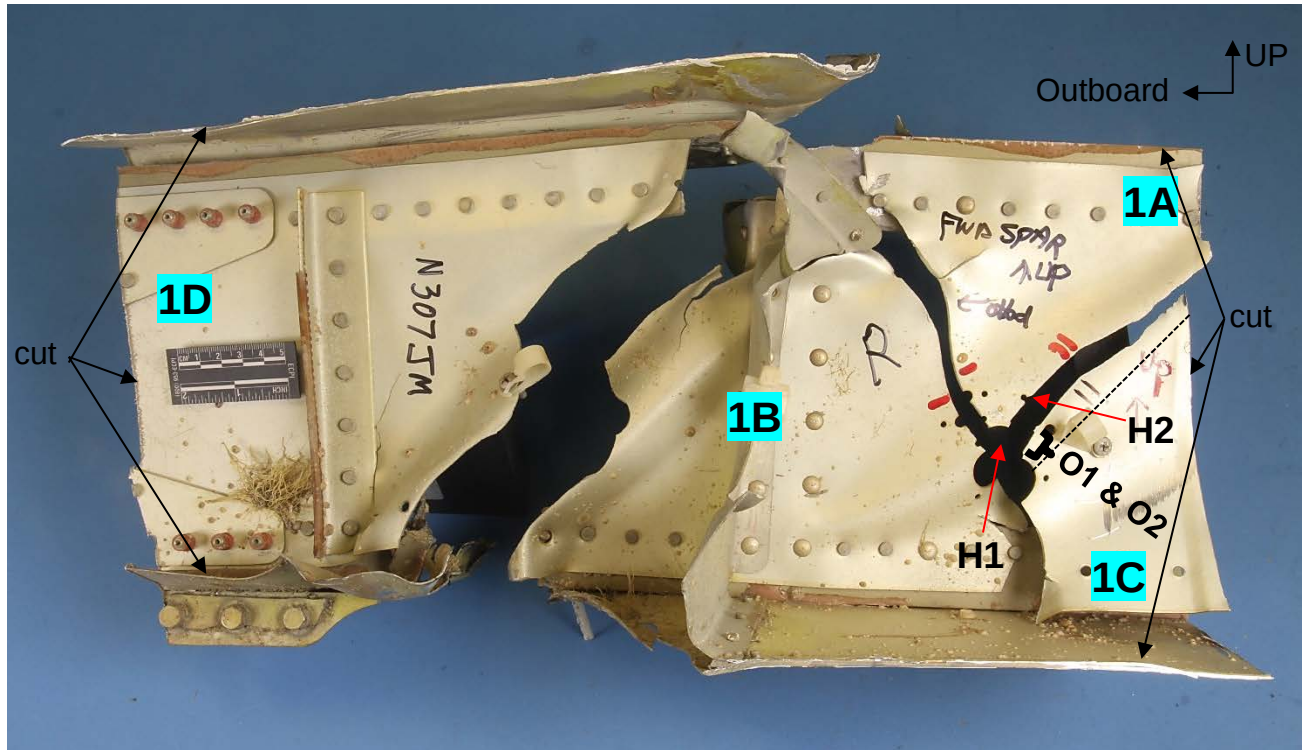


Figure 2. Close-up photograph of a portion of the forward spar for the right wing showing the forward face of pieces "1A" through "1D", as if they were intact.

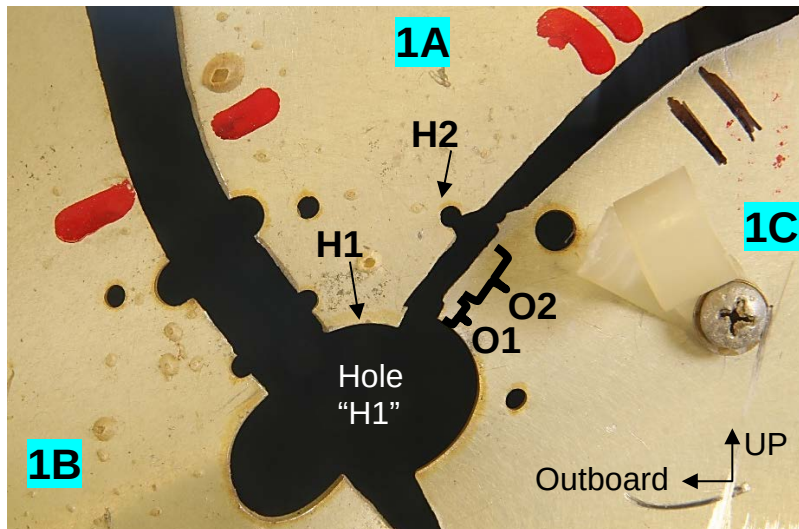


Figure 3. Close-up photograph of the forward face of the web from the right wing that contained two adjoining fatigue cracks indicated by a brackets "O1" and "O2". The fatigue cracks emanated from the aft face of the web and intersected the two holes in the web, indicated by arrows "H1" and "H2". The larger hole "H1" had fractured into three arc segments.

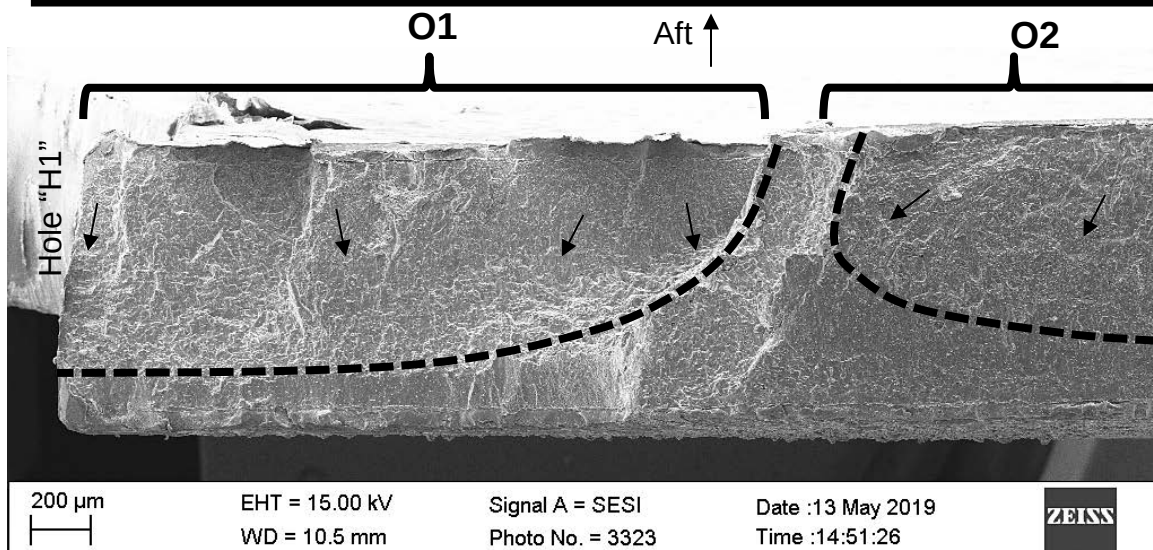


Figure 4. SEM photograph of fatigue crack “O1” and portion of fatigue crack “O2” that emanated from the aft face of the web, after cleaning with chromic acid cleaning solution. Arrows show general direction of fracture propagation. Fatigue cracks terminated approximately in the general area indicated by dashed lines.

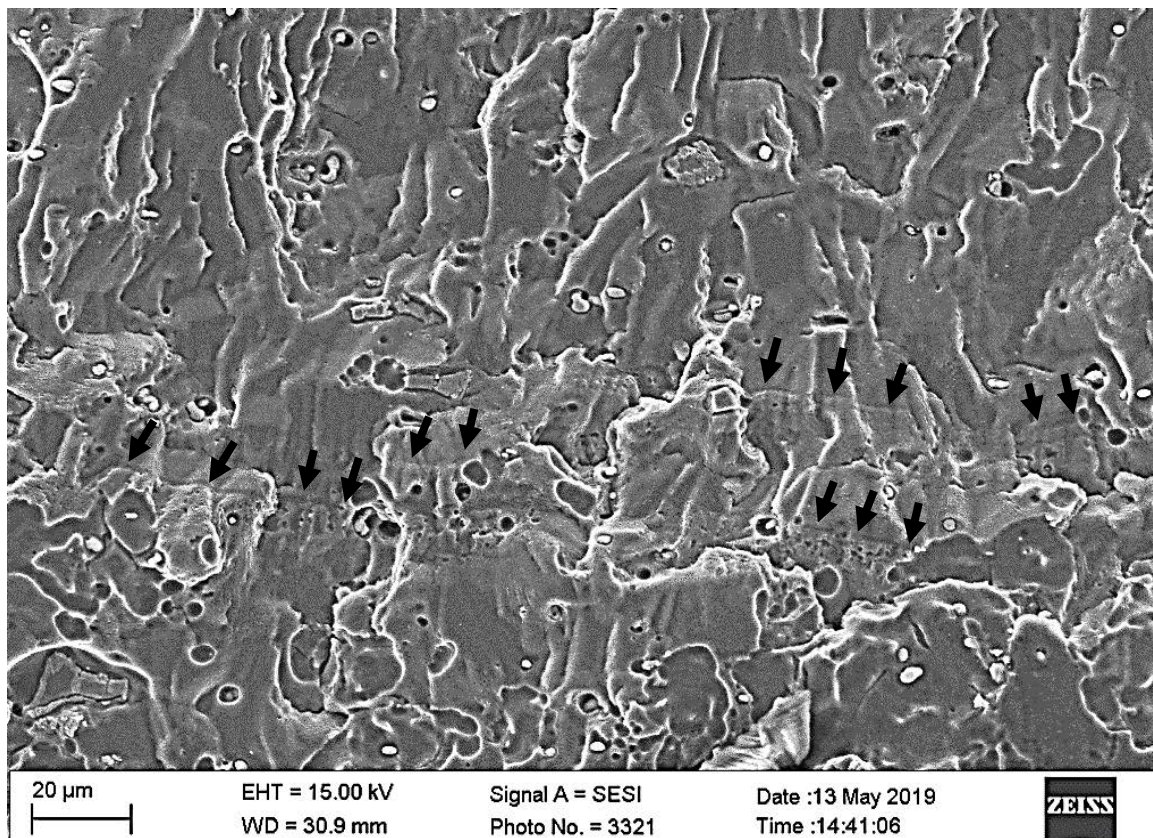


Figure 5. SEM photograph of fatigue origin “O1” showing barely discernable fatigue striations near the fatigue origin, after chromic acid cleaning. Arrows indicate location of several crack arrest marks and they also show the general direction of fracture propagation.

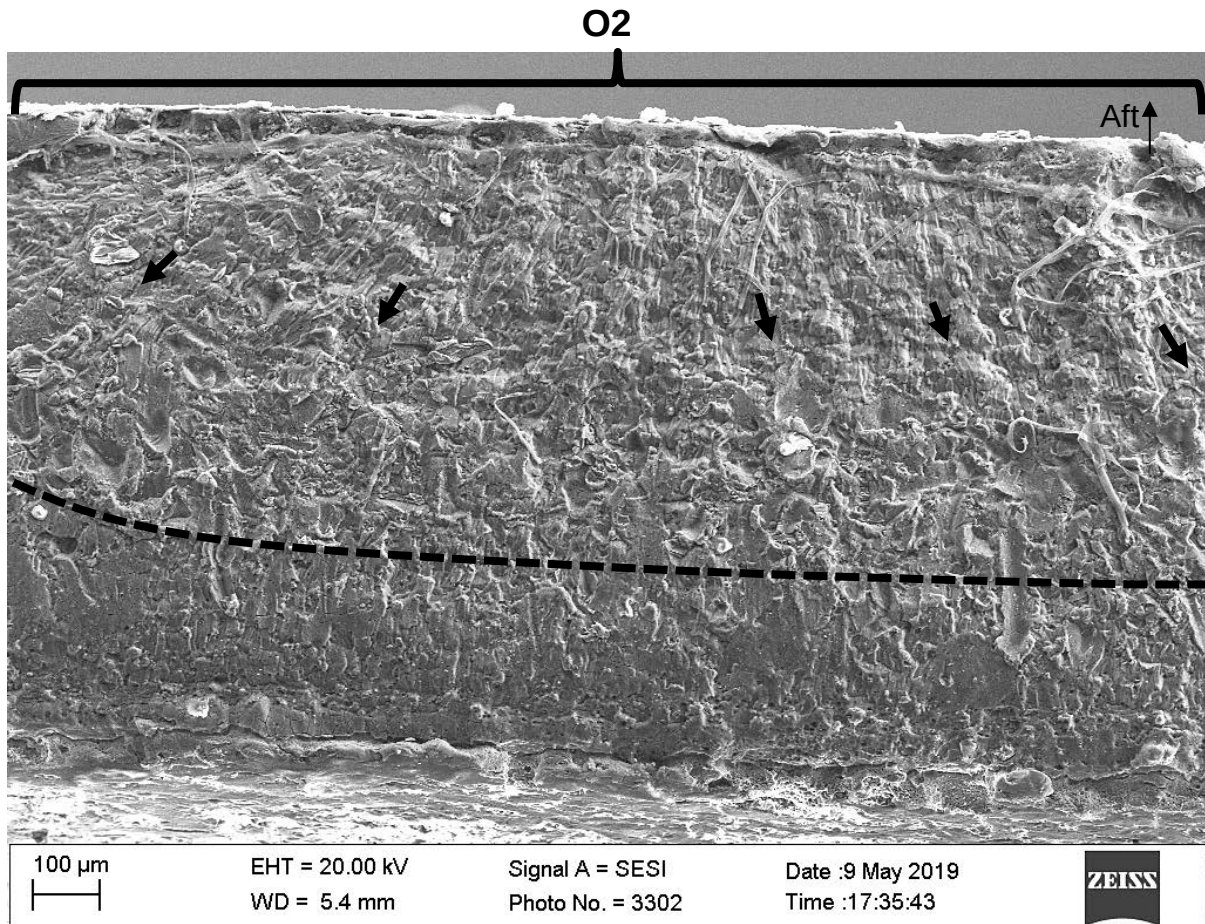


Figure 6. SEM photograph of portion of fatigue crack “O2” showing the fatigue origin, as-received condition prior to cleaning. Arrows show general direction of fracture propagation. Fatigue terminated approximately in the general area indicated by dashed lines.

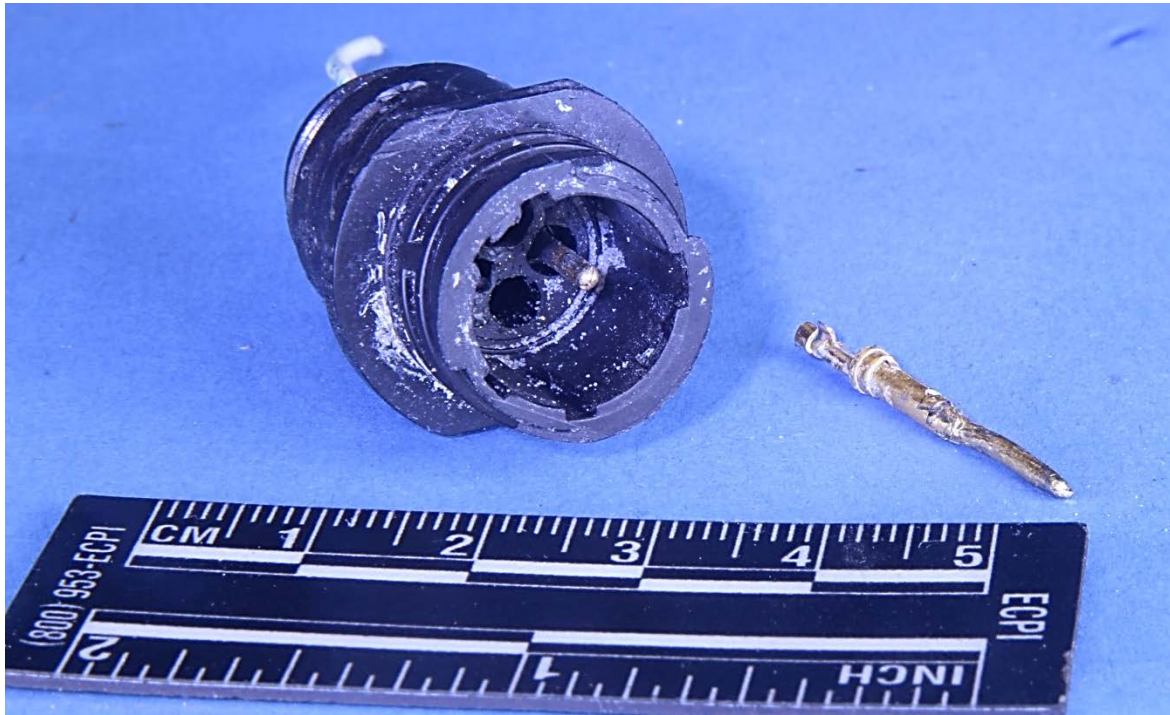


Figure 7. Electric socket assembly (left side) and separated electrical pin (right side). These parts were received in a plastic bag labelled "P409".