NATIONAL TRANSPORTATION SAFETY BOARD

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

March 9, 2015

MATERIALS LABORATORY FACTUAL REPORT Report No. 15-025

1. ACCIDENT

Place : Summerfield, FL
Date : April 6, 2014
Vehicle : Van's RV-7, N57DC
NTSB No. : ERA14FA182
Investigator : Dennis Diaz, AS-ERA

2. COMPONENTS EXAMINED

Section of horizontal stabilizer spar

3. DETAILS OF THE EXAMINATION

On April 6, 2014, an experimental amateur-built RV-7 was substantially damaged when it impacted terrain near Monroe Airpark, Summerfield, Florida. The commercial pilot and the passenger were fatally injured. According to witnesses, during the descent, the wings were nearly level before the airplane impacted the ground in a nose low, left bank attitude. These accounts were consistent with information garnered from a video of the accident captured from the ground. The airplane came to rest upright about 10 feet beyond the initial impact point, and the landing gear had collapsed. The fuselage displayed significant aft crush damage in the area of the firewall, instrument panel, and cockpit. Control continuity was traced from each flight control surface to the cockpit area.

A section of the horizontal stabilizer spar was submitted to the NTSB Materials Laboratory for further examination. Figure 1 shows the fractured halves of the submitted horizontal stabilizer spar section. The spar had fractured on the left side (aft looking forward), perpendicular to the direction of the part. The fracture was located along four rivet holes in the spar, all of which exhibited elongation in the part direction. There was also an "L-shaped" crack on the right side of the assembly, approximately 0.25 inches long, which had terminated at a rivet hole.

As shown in Figure 2, there was out-of-plane buckling on the spar outboard of the fracture and crack on the spar section. This buckling was located at two tears on the lower portion of the right side of spar. This was consistent with damage incurred to the part at ground impact. No indications of wear or corrosion were observed on the submitted spar section.

Figure 3 and Figure 4 illustrate closer views of the left side fracture and right side crack, respectively. Small portions of the fracture and crack exhibited features consistent with progressive cracking. Figure 5 and Figure 6 illustrate these progressive cracking regions (Figure 6 shows the right side crack after backcutting and intentionally opening the crack in the laboratory). These thumbnail-shaped areas were generally flat perpendicular to the part direction, and they exhibited crack arrest and ratchet marks. The progressive portion of the right side crack was approximately 0.15 inch long, and the progressive portion of the left side fracture was approximately 0.25 inch long.

The remaining portions of the fracture and crack exhibited a rougher texture and a general 45° slant. These features were consistent with overstress failure.

The fractures were examined using a scanning electron microscope. Figure 7 illustrates the progressive region of the fracture surface, displaying fatigue striations consistent with fatigue cracking. The remainder of the fracture surface exhibited dimple rupture, consistent with failure from overstress (see Figure 8). The thumbnail portion of the opened crack also exhibited fatigue striations, as shown in Figure 9.

The chemical compositions of the part sections were inspected using energy dispersive x-ray spectroscopy (EDS) and x-ray fluorescence (XRF). The chemical compositions were consistent with AA 2024 aluminum alloy.

Erik Mueller
Materials Research Engineer

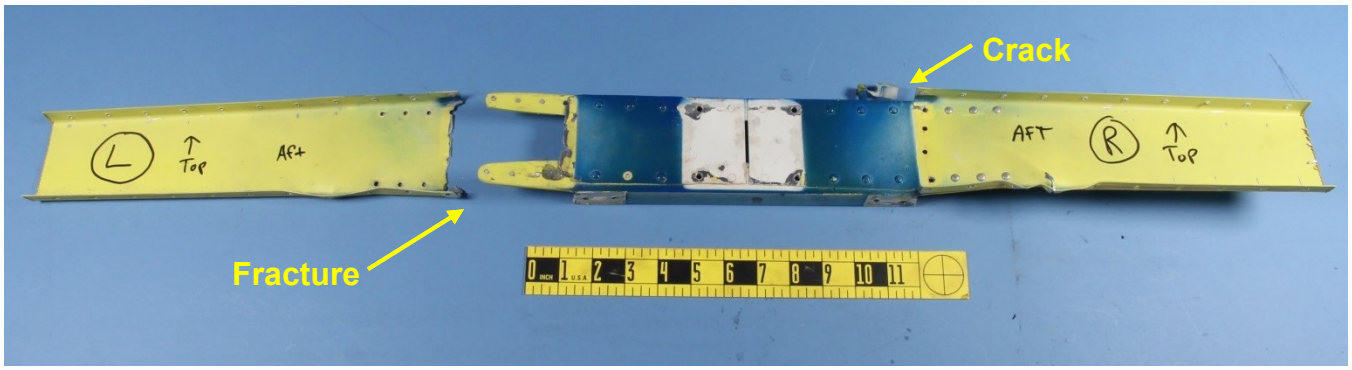

Figure 1 – The section of the horizontal stabilizer spar, as received (aft looking forward). The fractured section is annotated on the left.

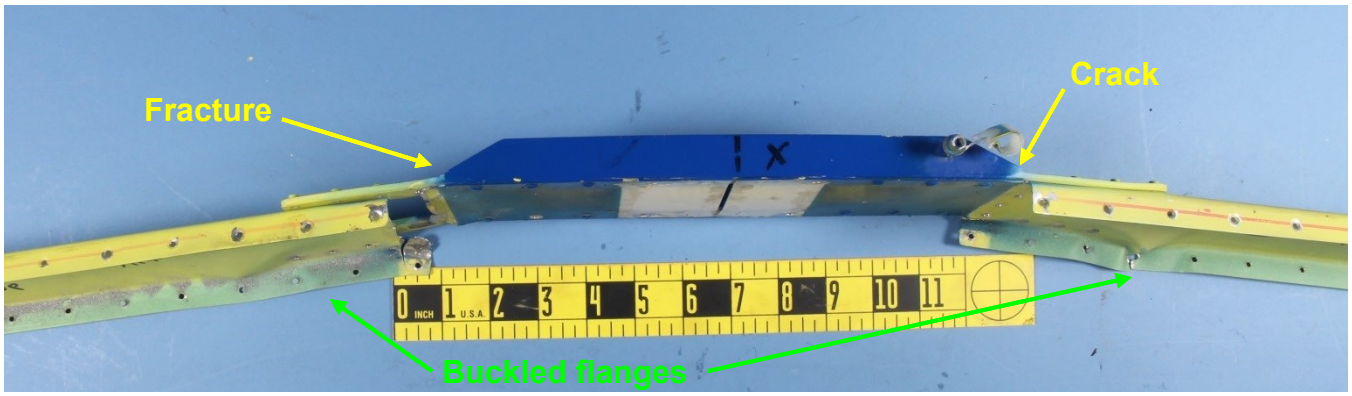

Figure 2 – The spar section halves, as view from above. Areas of buckling are denoted on both sides.

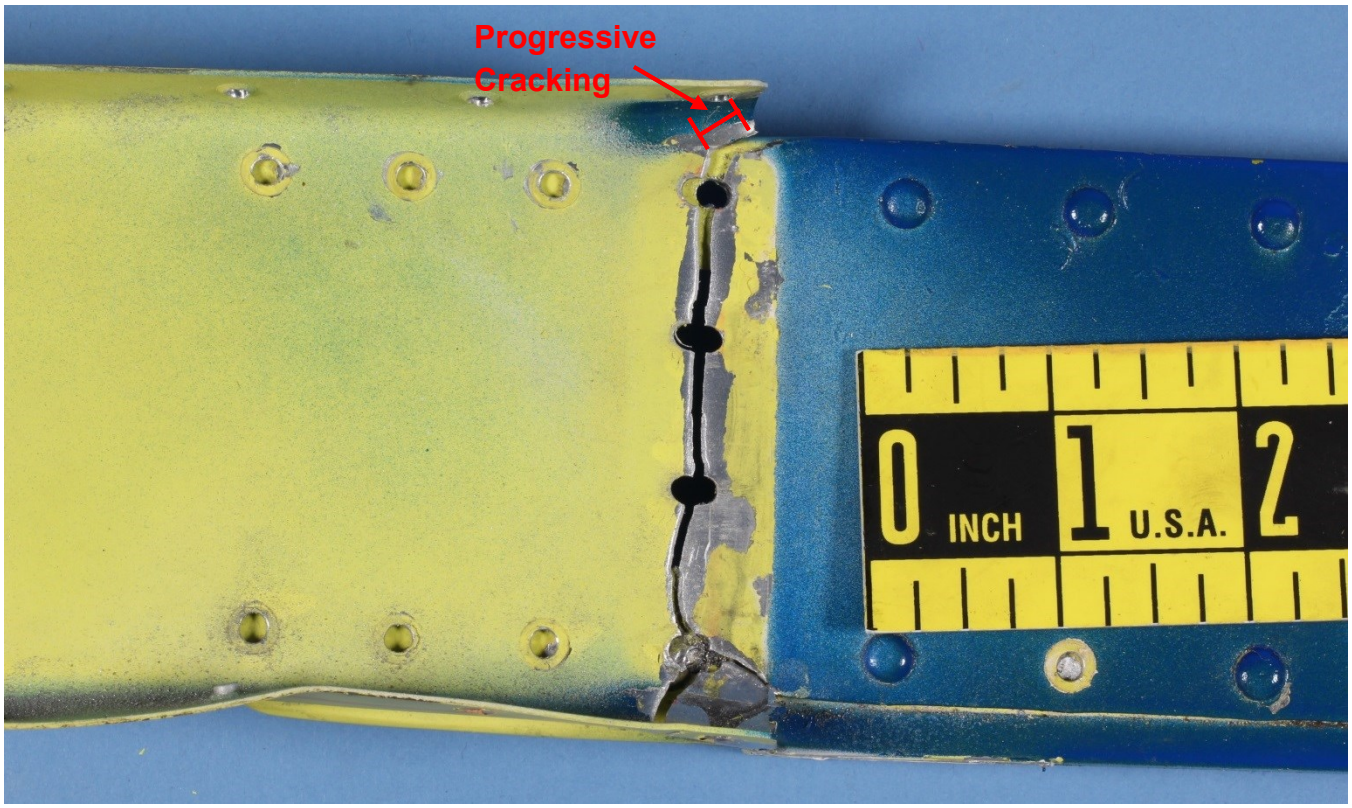

Figure 3 – The fractured halves of the spar, positioned to show their relative positions at fracture (aft looking forward). The small area of progressive fracture is labeled on the top of the figure.

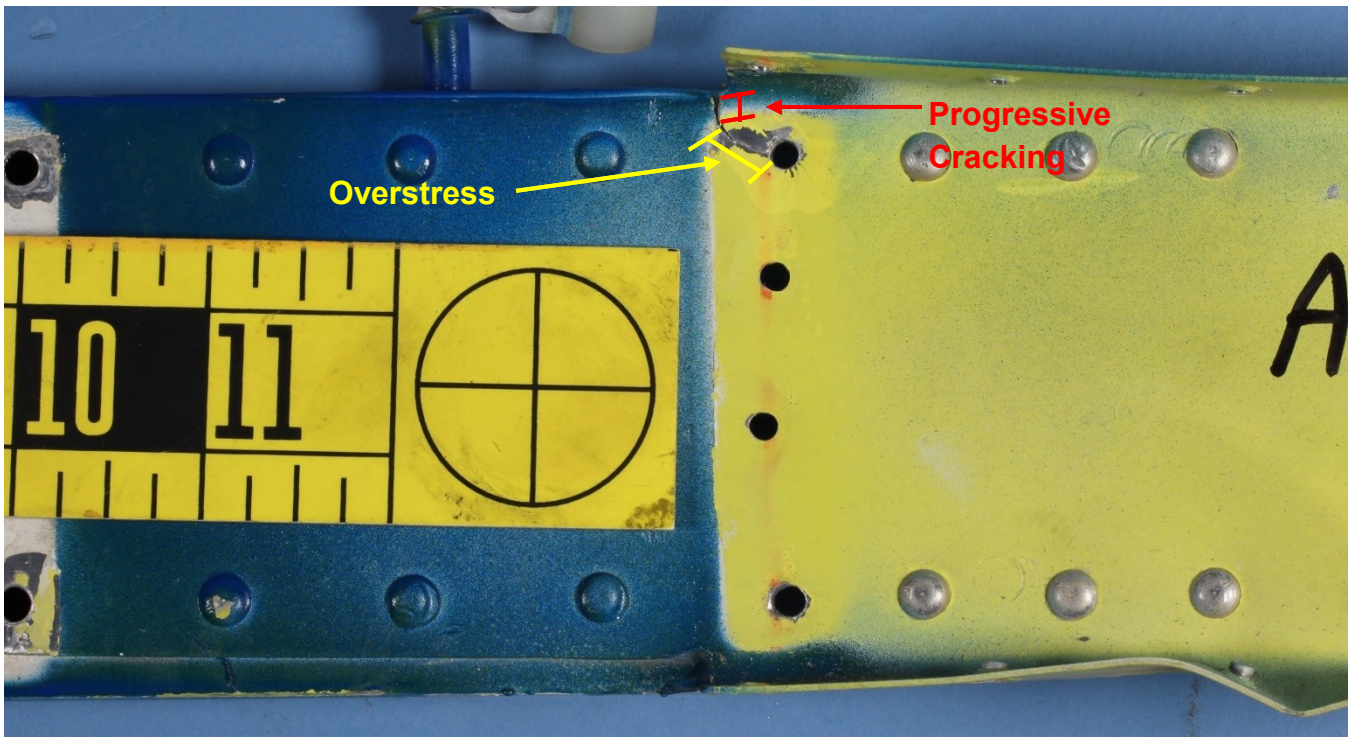

Figure 4 – The small upper crack on the right side of the spar section, as received (aft looking forward). The area of progressive fracture is labeled on the top of the figure.

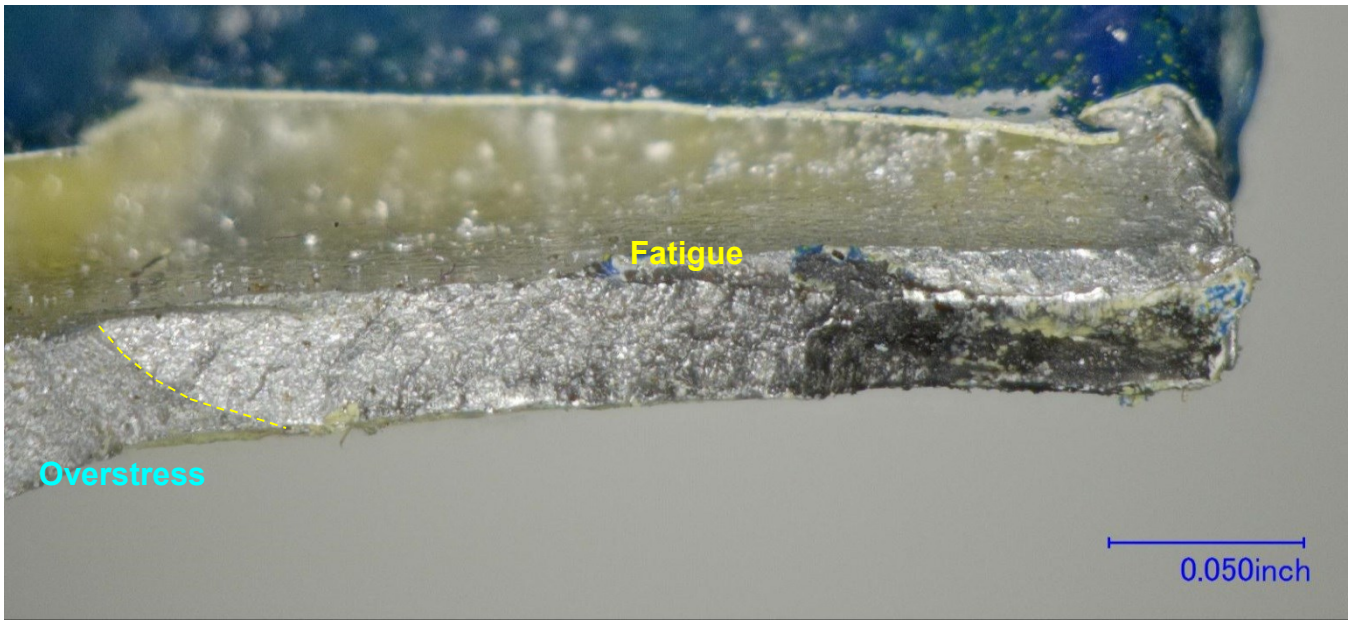

Figure 5 – The progressive portion of the fracture surface on the left side of the spar section.

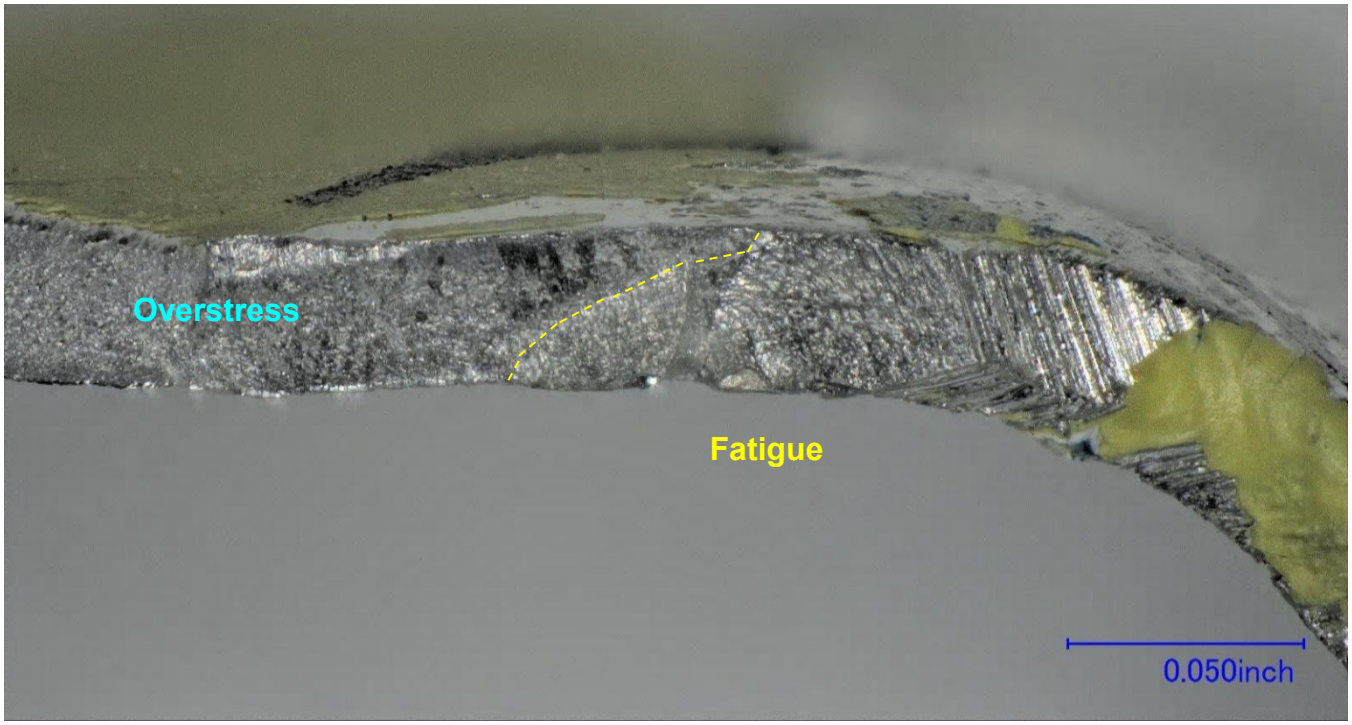

Figure 6 – The progressive portion of the crack on the right side of the spar section, after intentional crack opening.

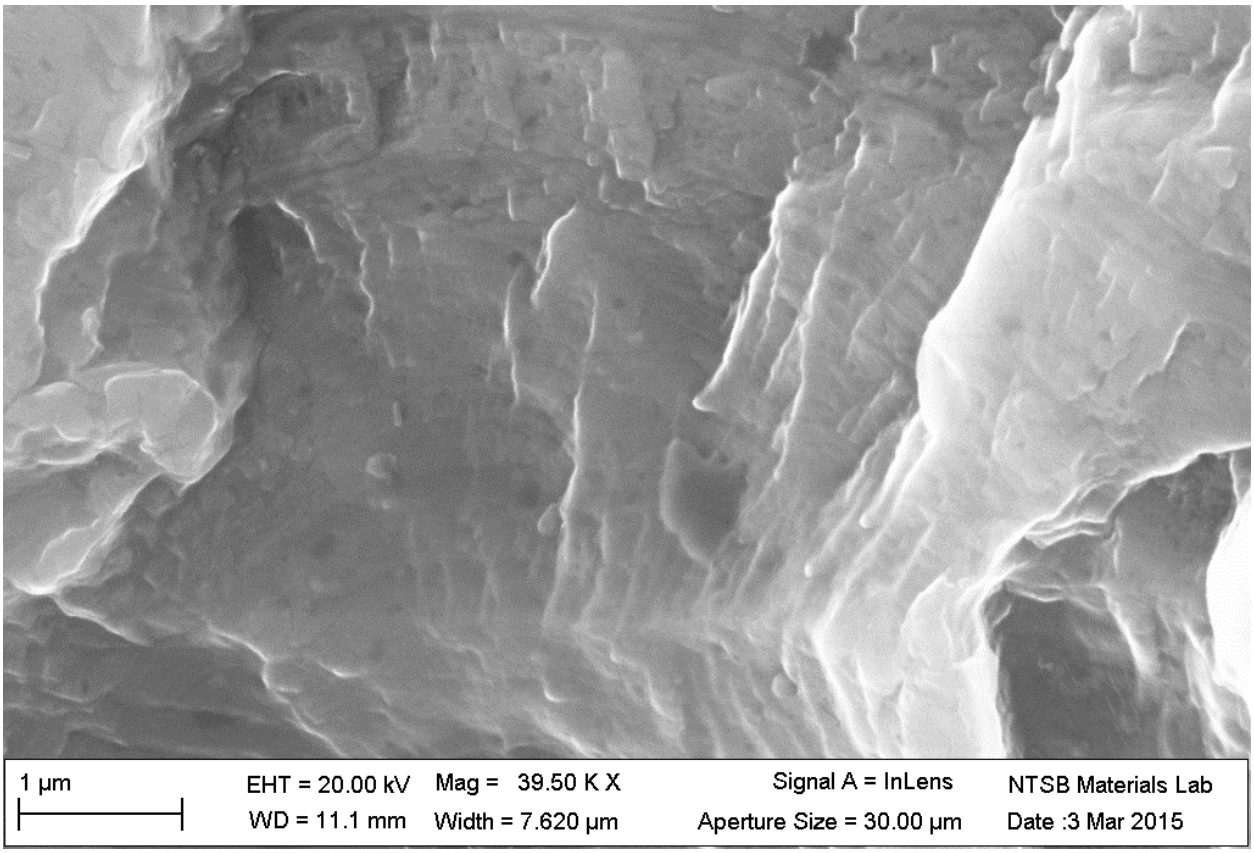

Figure 7 – Secondary electron (SE) micrograph of fatigue striations on the spar section fracture surface.

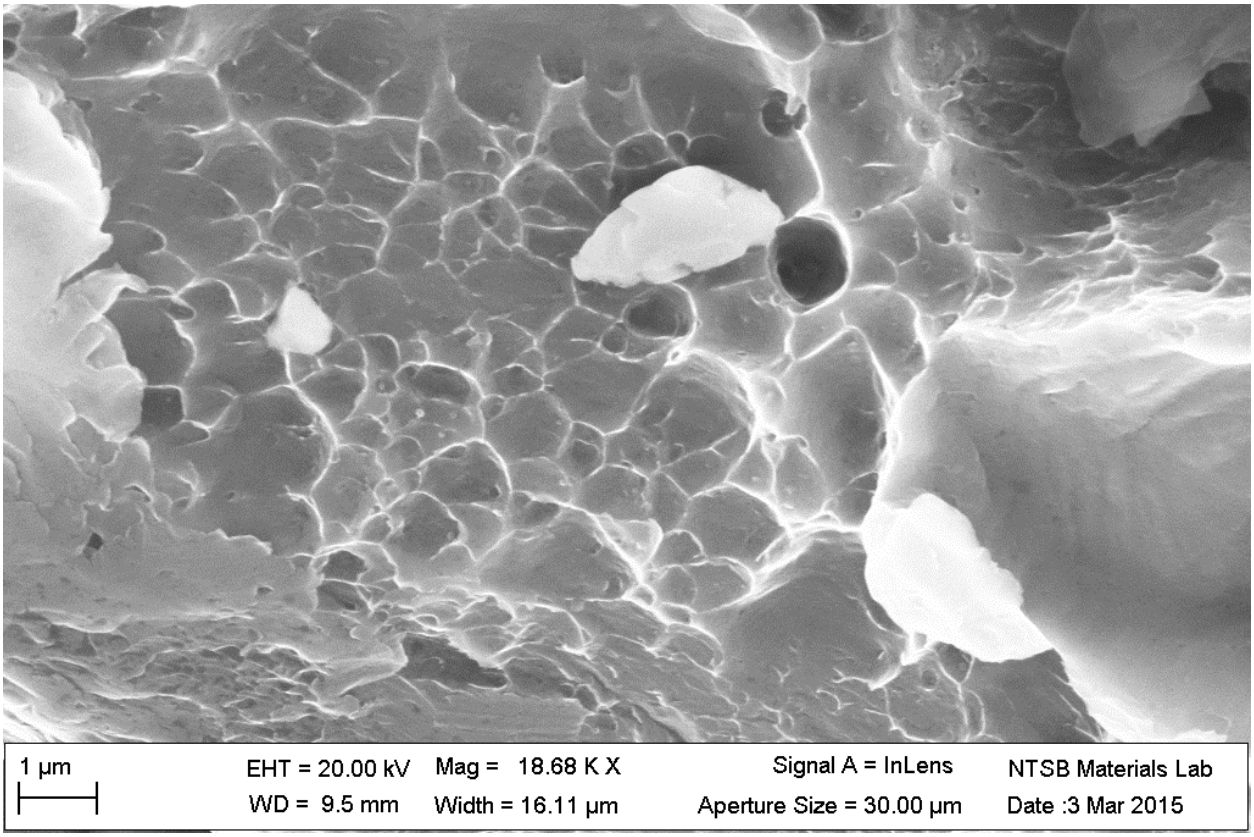

Figure 8 – SE micrograph of dimple rupture on the spar section fracture surface.

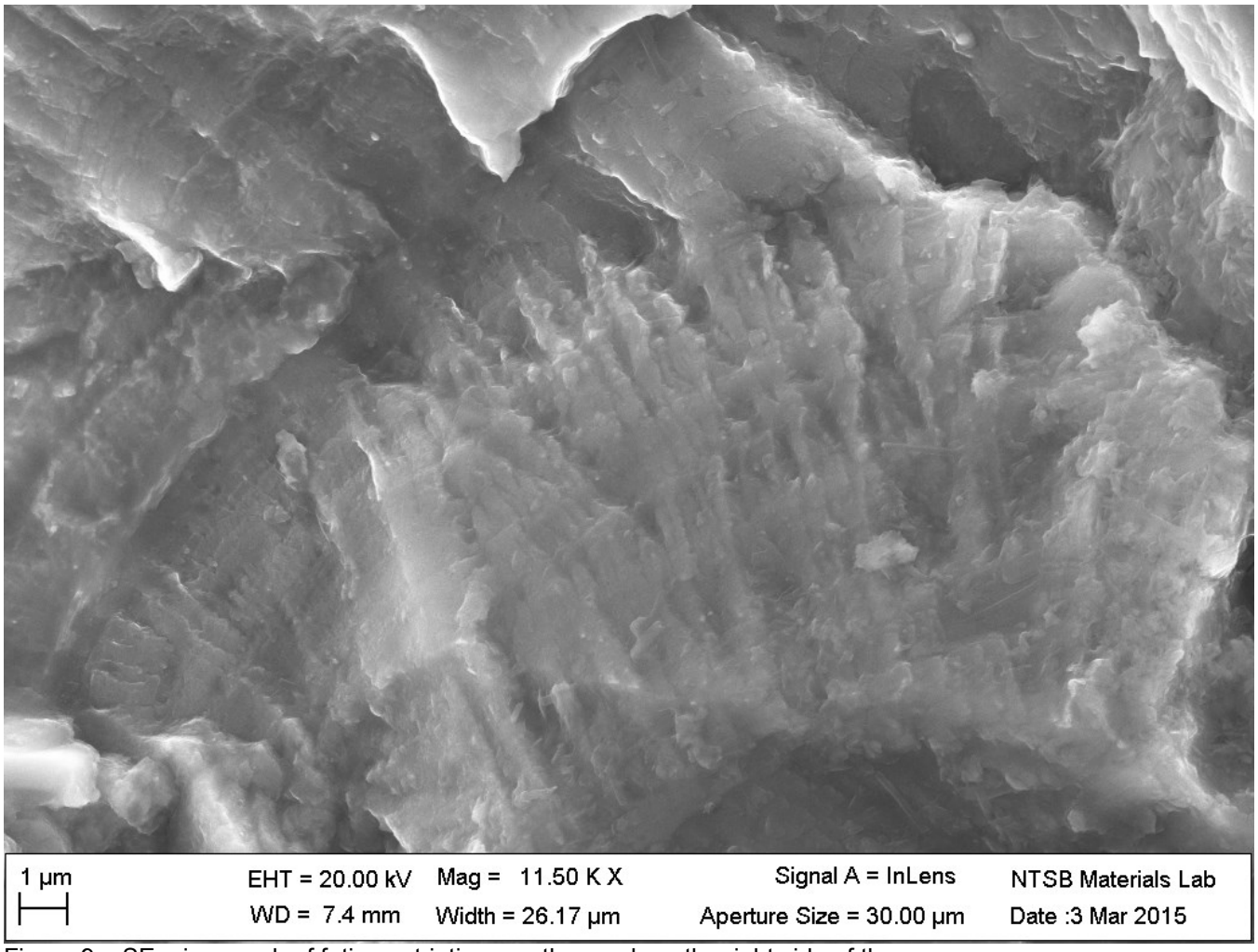

Figure 9 – SE micrograph of fatigue striations on the crack on the right side of the spar.