

NATIONAL TRANSPORTATION SAFETY BOARD

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



April 21, 2021

MATERIALS LABORATORY FACTUAL REPORT

Report No. 21-035

A. ACCIDENT INFORMATION

Place : Oshkosh, Wisconsin
Date : February 27, 2021
Vehicle : Piper Pa-23, N1460P
NTSB No. : CEN21LA147
Investigator : Timothy Sorensen, ASI-CEN

B. COMPONENTS EXAMINED

Nose landing gear lower drag link, fractured into three pieces.

C. DETAILS OF THE EXAMINATION

A nose landing gear lower drag link, fractured into three pieces was submitted to the NTSB Materials Laboratory for examination, as shown in figure 1. The drag link consisted of a bracket at the aft end with two tubes that extended forward, one on each side of the bracket. A strap was welded onto the forward end of each tube. Bushings were press-fit into each strap and into the left and right sides of the bracket, allowing the assembly to be connected to the landing gear strut tube at its forward end and to the upper drag link at its aft end.

The tubes were joined to the bracket by arc welds. To facilitate this, each tube had been sectioned in the longitudinal direction at its aft end, removing approximately half of the tube circumference over an approximately 1.75-inch length. The tubes were positioned against the bracket, with the longitudinal cuts on the left or right side of the bracket and the circumferential cuts butted against the forward face of the bracket. The tubes were then welded to the bracket along the entire perimeter of the cuts. Both tubes had fractured in the transverse plane in-line with the forward end of the bracket and at the transition from split tube to unsplit tube, as shown in figures 2 and 3. The fracture surfaces were examined and exhibited 45 degree slant fractures through most of the wrought tube material. Along the welded region, the weld metal had not completely fused to the bracket, resulting in a lack-of-fusion region, as indicated in figures 2 and 3. Toward the toe of the weld, the metal had apparently fused to the bracket and the weld metal failed in shear at this point, as indicated in figures 2b and 3b.

Multiple crack origins were observed near the bottom of each tube in the wrought material and tearing was observed at the top of each tube, consistent with crack initiation along the lower portions of each tube. Digital microscope images of the origin areas of

the left and right tubes are shown in figures 4a and 4b, respectively. The tube ends were sectioned from the rest of the tube, cleaned with an alkaline detergent, and sonicated in acetone, in accordance with standard laboratory procedures. The origin areas were then examined using a scanning electron microscope. The fracture surfaces had a predominantly rubbed appearance and there were no apparent oxidation, corrosion, or environmental products on the fracture surface. Examination by electron microscope revealed isolated areas that were not damaged. Such images from the right-side tube are shown in figures 5 and 6. Figure 5 shows striated features that were observed in the wrought material starting along the outer diameter, consistent with fatigue crack propagation. Figure 6 shows striated features that were observed starting near the boundary with the lack-of-fusion region and progressing radially outward. Similar features were observed on the left-side tube (not shown) but with crack initiation in the wrought material starting near the inner diameter. Much of the 45° slant fracture region was rubbed and well-defined transition to final overstress could not be determined.

Donald Kramer, Ph.D.
Sr. Materials Engineer

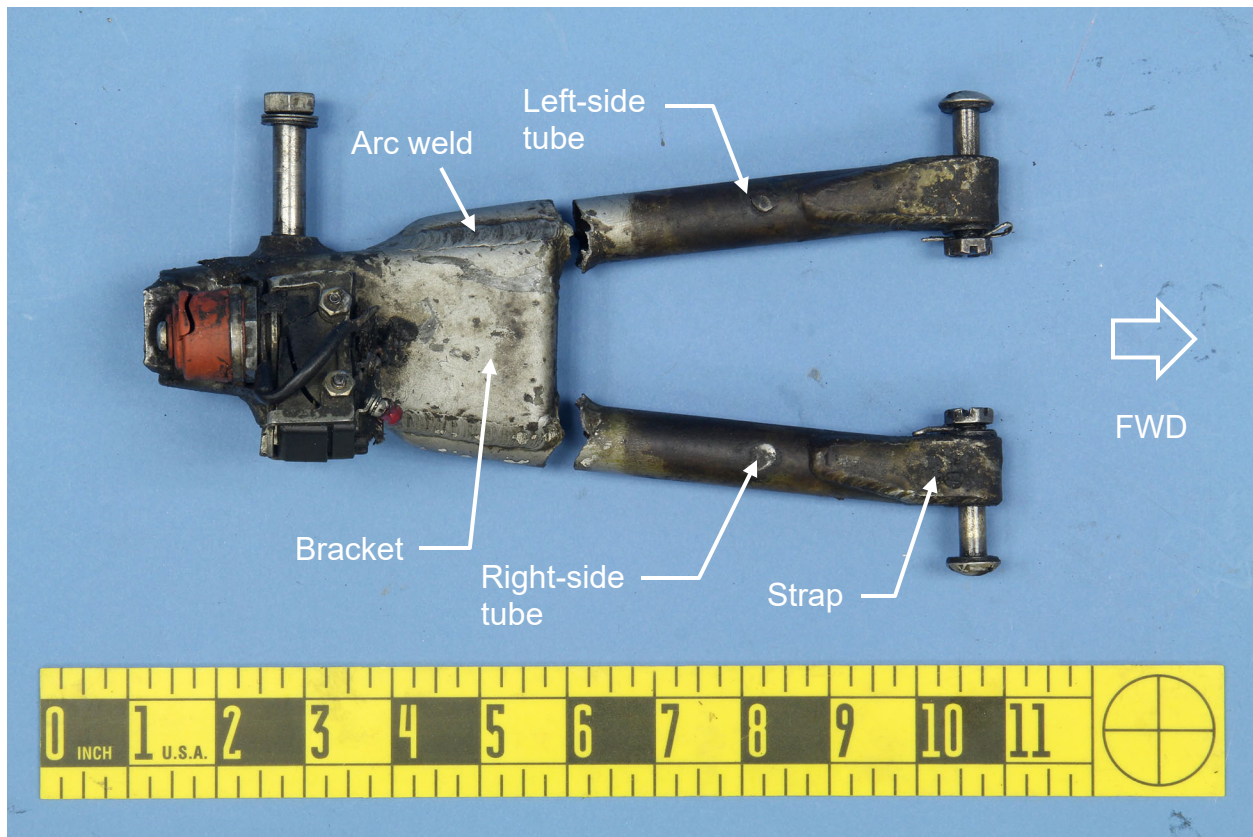


Figure 1: Fractured lower drag ling as received.

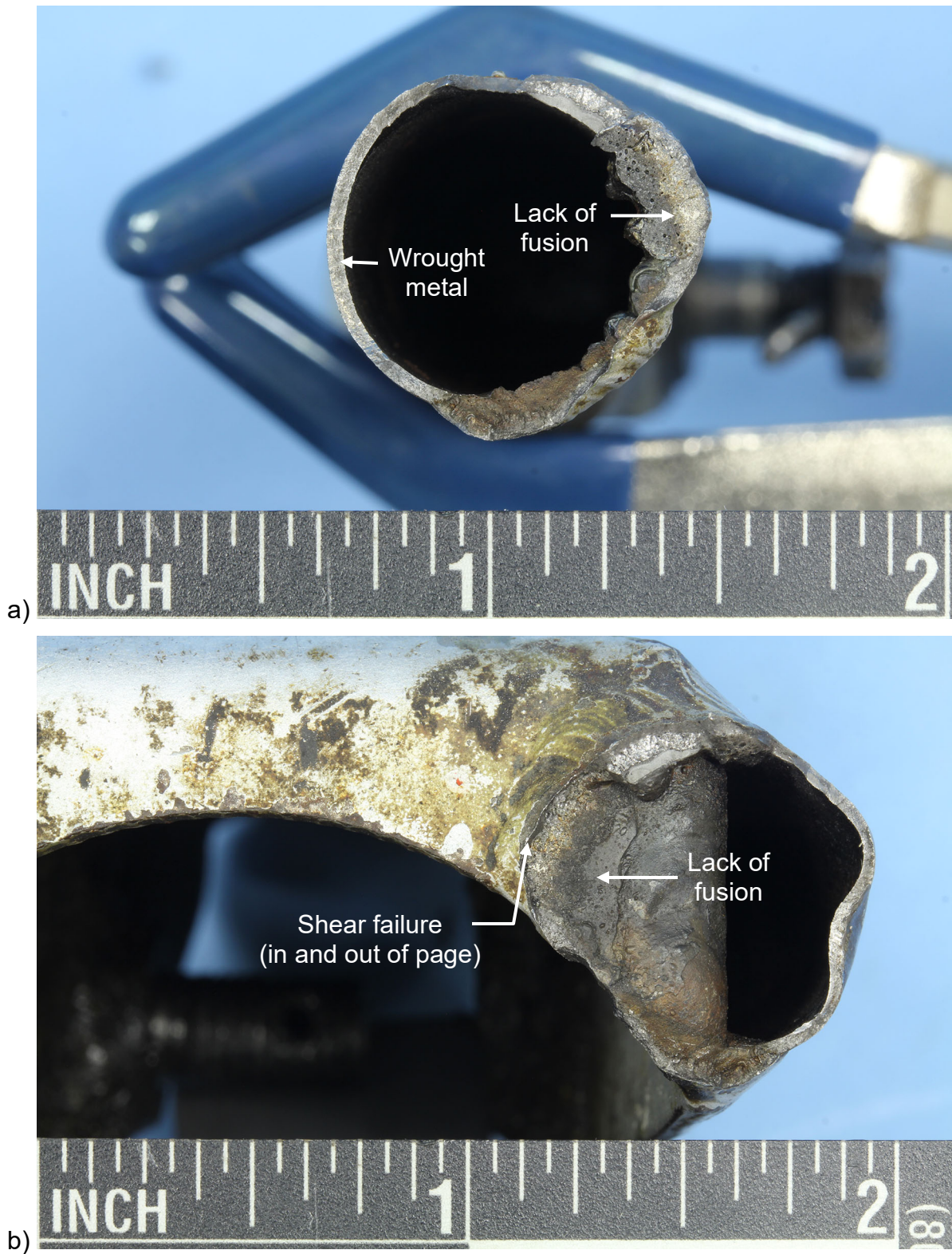


Figure 2: Fractured left-side tube: a) forward fracture and b) aft fracture.

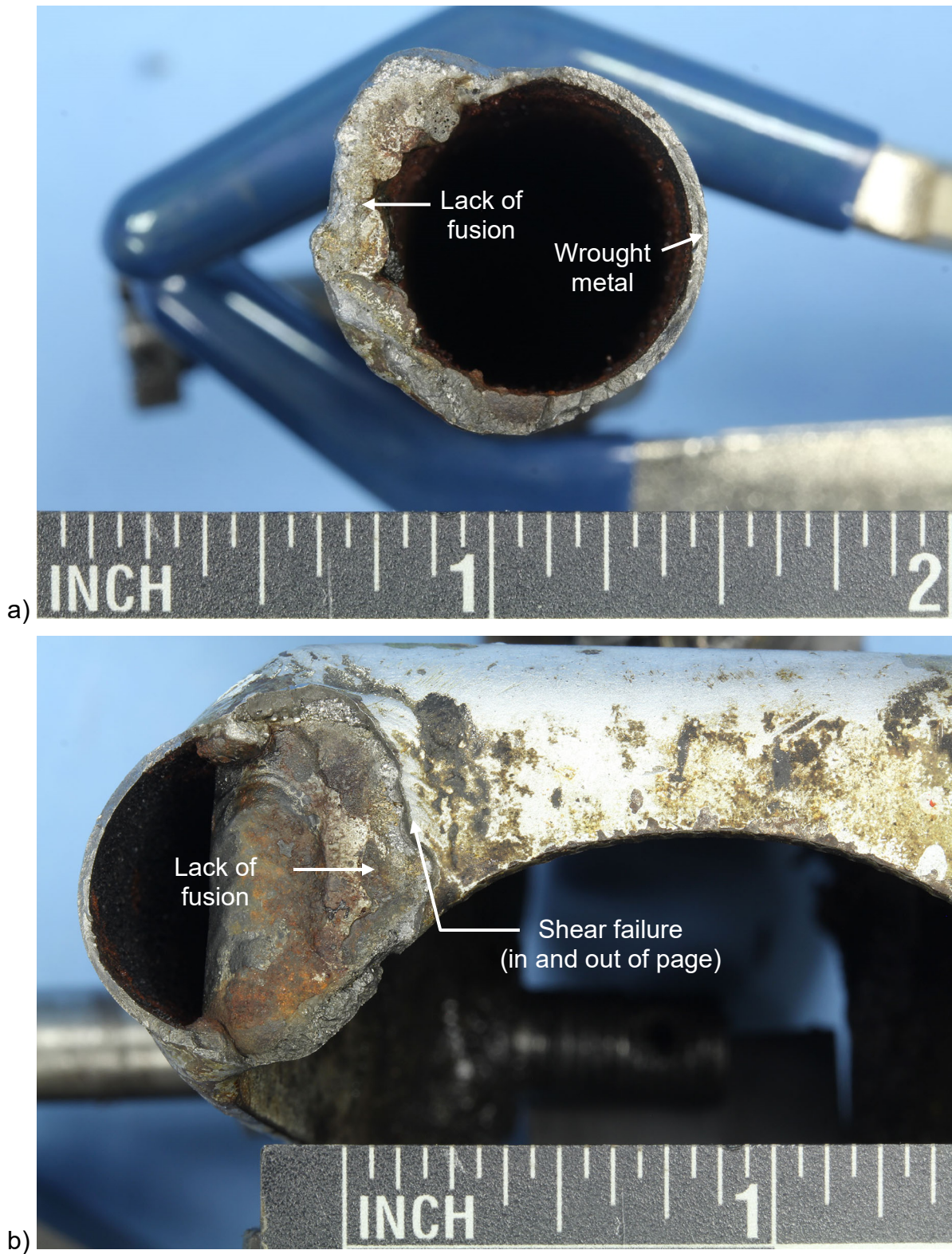


Figure 3: Fractured right-side tube: a) forward fracture and b) aft fracture.

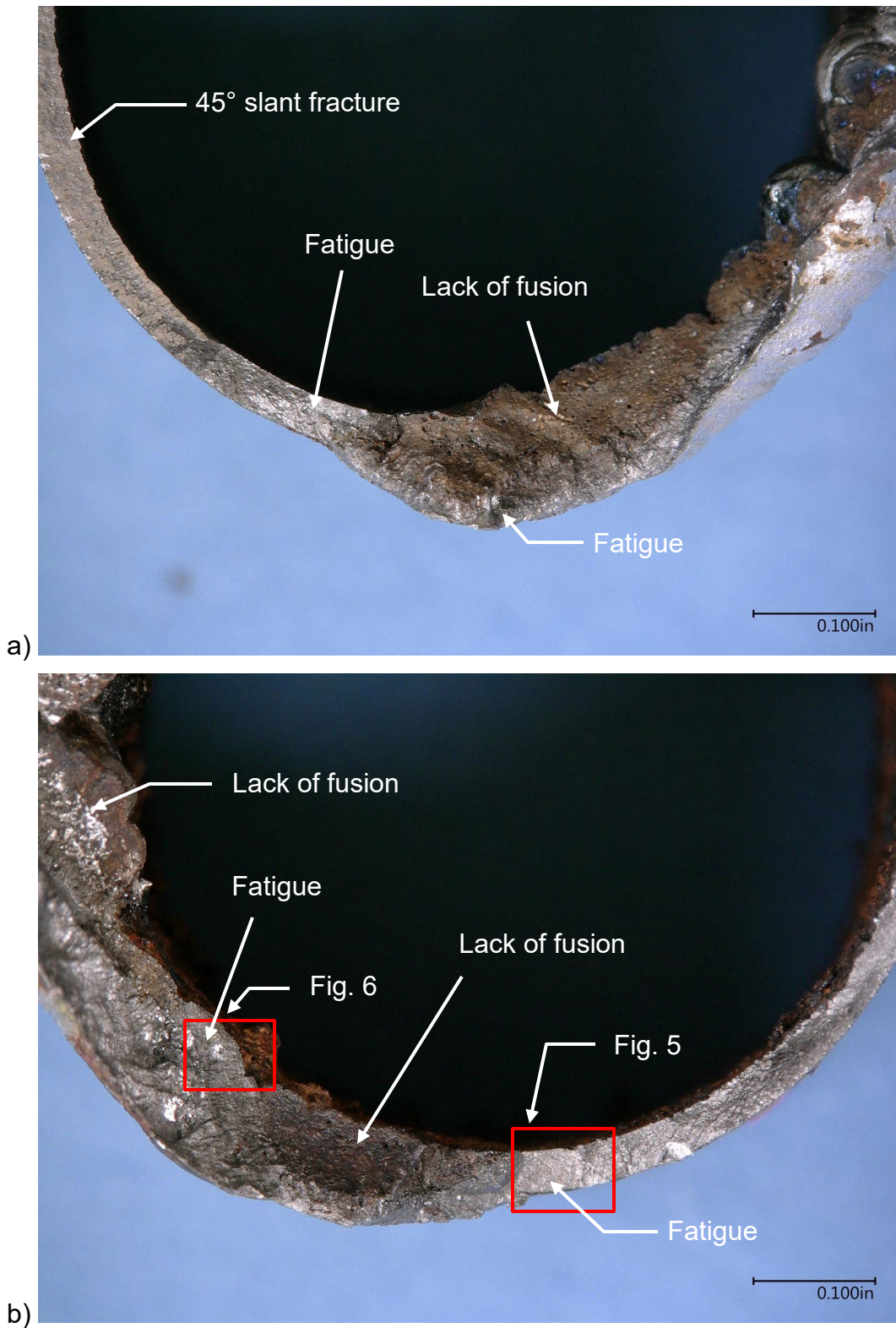


Figure 4: Image of the fracture origin areas for the a) left-side tube and b) right-side tube.

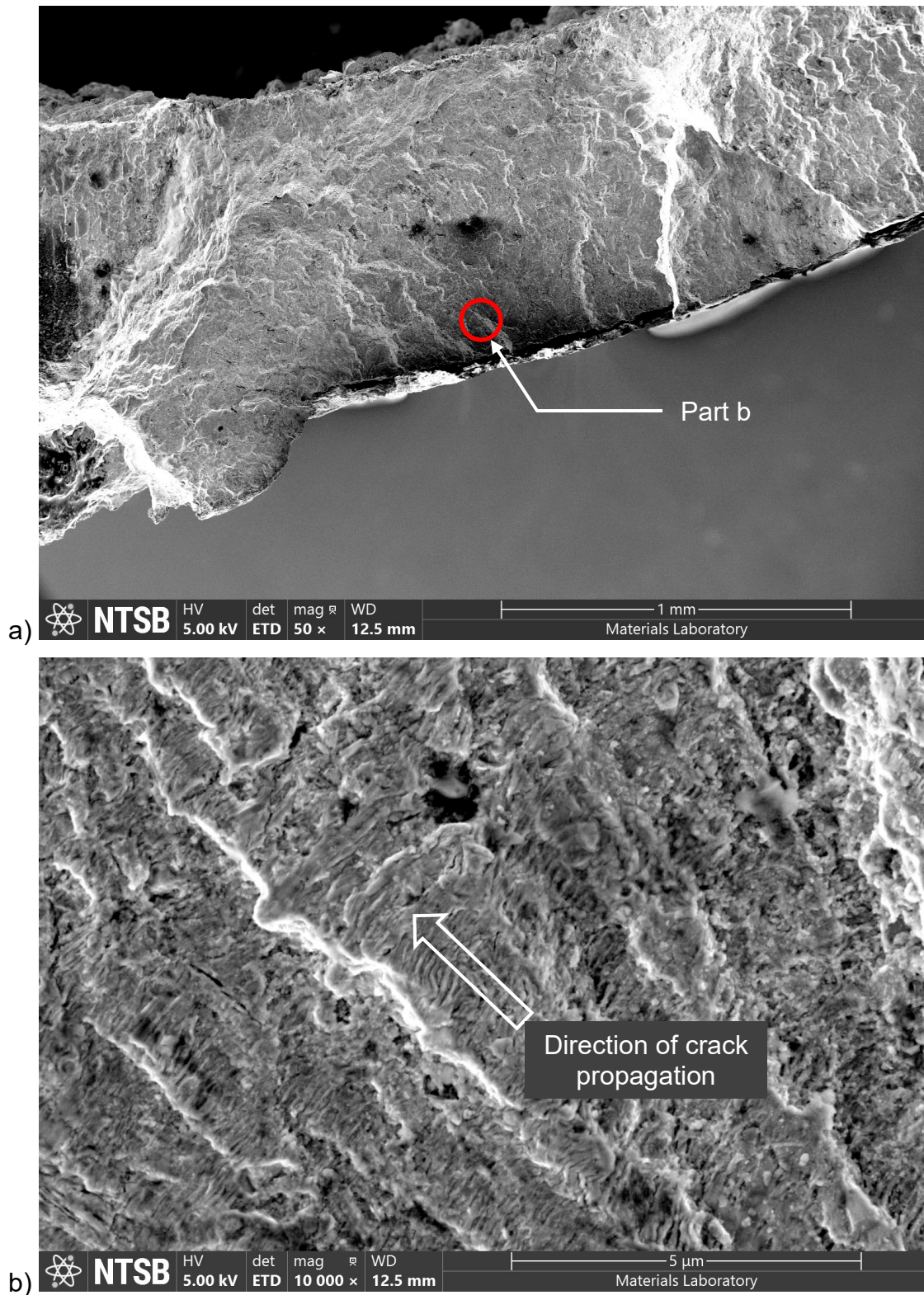


Figure 5: Scanning electron microscope images at the location indicated in figure 4b (right-side tube): a) overview image and b) higher magnification image showing striations consistent with fatigue crack propagation.

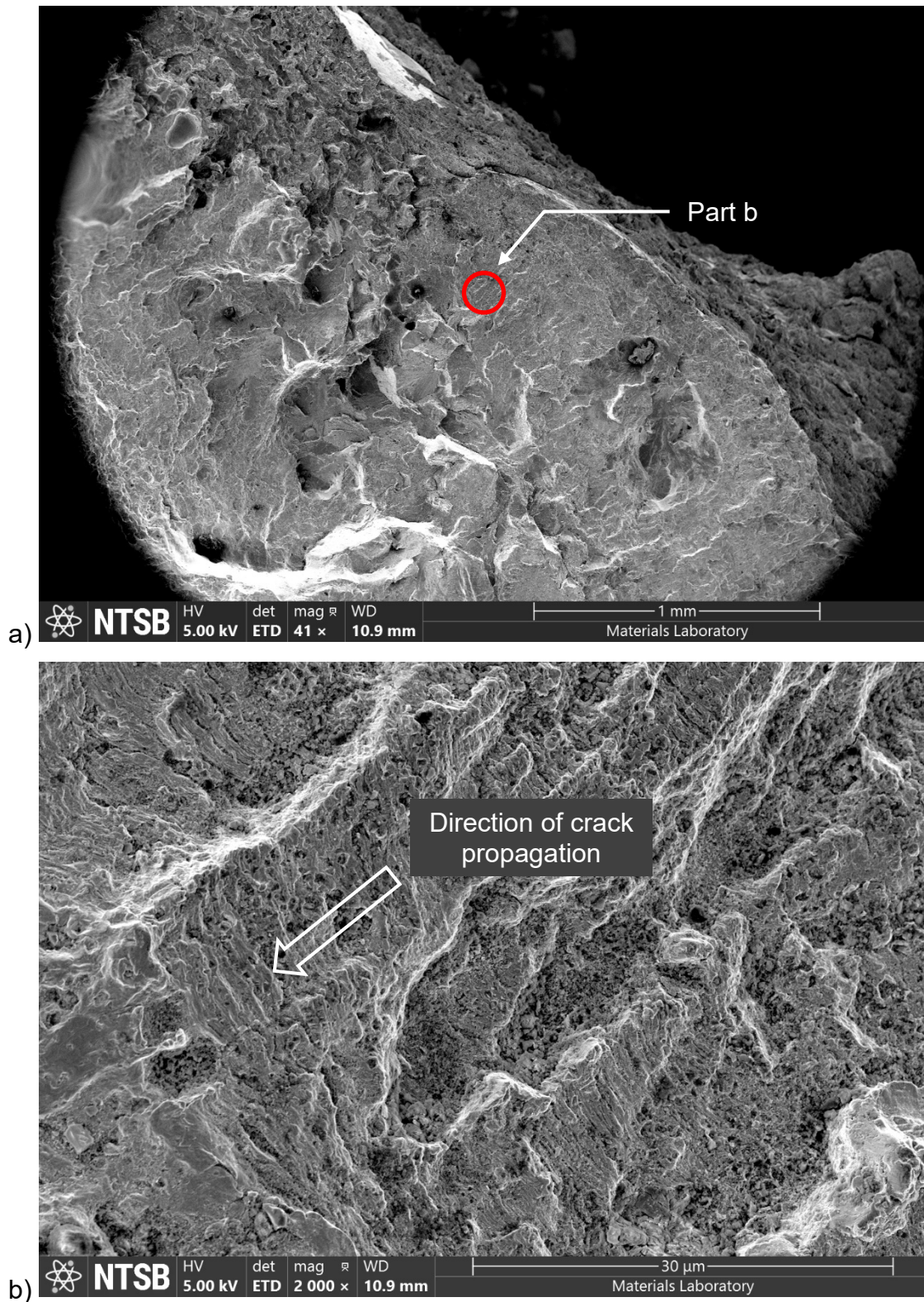


Figure 6: Scanning electron microscope images at the location indicated in figure 4b (right-side tube): a) overview image and b) higher magnification image showing striations consistent with fatigue crack propagation.