

NATIONAL TRANSPORTATION SAFETY BOARD

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



October 30, 2020

MATERIALS LABORATORY FACTUAL REPORT

Report No. 20-048

A. ACCIDENT INFORMATION

Place : Newborn, Georgia
Date : 1/6/2020
Vehicle : Cessna 172 H Skyhawk, N1612F
NTSB No. : ERA20FA068
Investigator : Aaron Mccarter

B. COMPONENTS EXAMINED

Items removed from a CMI O-300 engine:

1. Portions of the left-hand smooth muffler and separated shroud (identified as "A").
2. Portion of the right-hand smooth muffler and shroud (identified as "B").

C. DETAILS OF THE EXAMINATION

The as-received portions of the left-hand smooth muffler and separated shroud (identified as "A") are shown in Figure 1. The as-received portion of the right-hand smooth muffler and shroud (identified as "B") is shown in Figure 2. According to the IIC, the mufflers were separated from the airplane during the accident sequence and were found partially buried in mud, protected from the post-crash fire. The right-hand muffler (B) had some organic debris entrained within the folds, consistent with the absence of post-crash fire exposure.

Left-hand smooth muffler and separated shroud pieces

Using visual inspection methods, the left-hand smooth muffler exterior surface was sound with no evidence of cracks, or through-thickness metal wastage. Using a hand-held x-ray fluorescence spectrometer, the left-hand smooth-muffler main-tube is fabricated from type 321 stainless steel. No serial number or manufacturer identification marks were noted on the exterior surfaces of the smooth muffler. According to the airplane maintenance records, the left-hand muffler was replaced with a Nicrocraft¹ 568-110 (S/N 55-0005) on 4/1/2010.

¹ Nicrocraft, Oklahoma City, OK

Right-hand smooth muffler and shroud piece

The right-hand muffler and shroud exhibited substantial mechanical damage during the accident sequence. The aft face of the muffler with inlet tube was separated from the assembly and was not recovered as depicted in Figure 3. Using visual inspection methods (5X to 50X stereo-zoom microscope), the right-hand smooth muffler surface exhibited cracks, and through-thickness metal wastage. The fractures associated with the separation of the aft face with inlet tube exhibited largely oxidized fracture surfaces and thinned walls (See Figures 3 through 6). The center inlet tube was separated from the rest of the muffler due to loss of mechanical integrity from metal wastage (see Figures 2 and 3). Holes and wall thickness loss was also noted around the muffler body at the aft face as shown in Figure 3 and 6.

As shown in Figure 5, a metallurgical cross-section was taken through an exemplar area of metal wastage as revealed in Figure 7. The micrograph of the cross-section shows evidence of general thermal oxidative loss of material wall thickness as well as through-thickness holes and cracks

Figure 8 shows metal wastage and wall-thickness through-holes adjacent to the crimp seal between the muffler tube and the forward end plate. A metallurgical cross section was taken in the region as shown in Figures 8a and 9.

No serial number of manufacturer identification was noted on the exterior surfaces of the right-hand smooth muffler. Using a hand-held x-ray fluorescence spectrometer, the right-hand smooth-muffler main-tube is fabricated from type 321 stainless steel.

Michael Budinski
Chief, Materials Laboratory Division

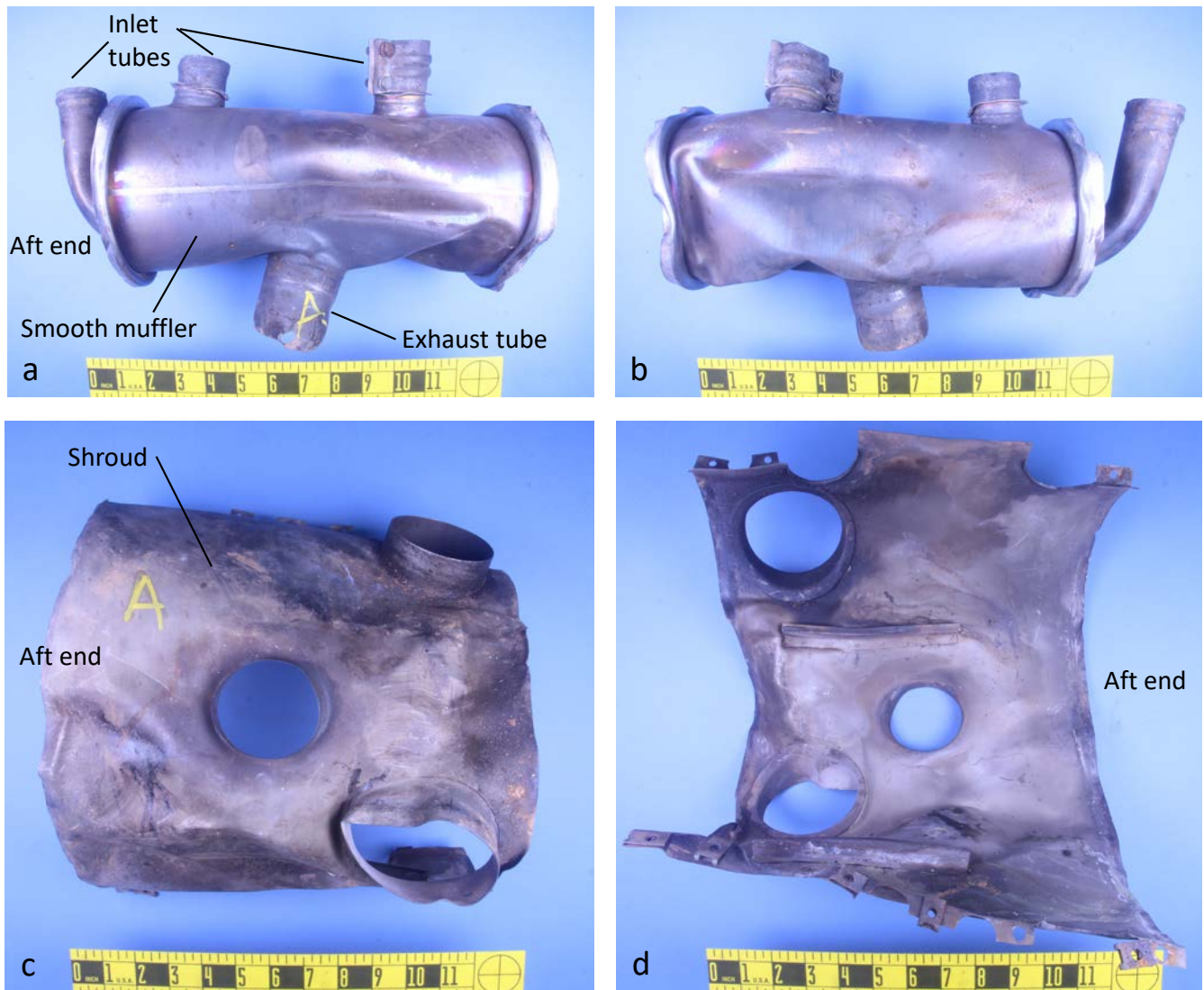


Figure 1 Images of portions of the left-hand smooth muffler (views a, b) and separated shroud (views c, d) (identified as "A")

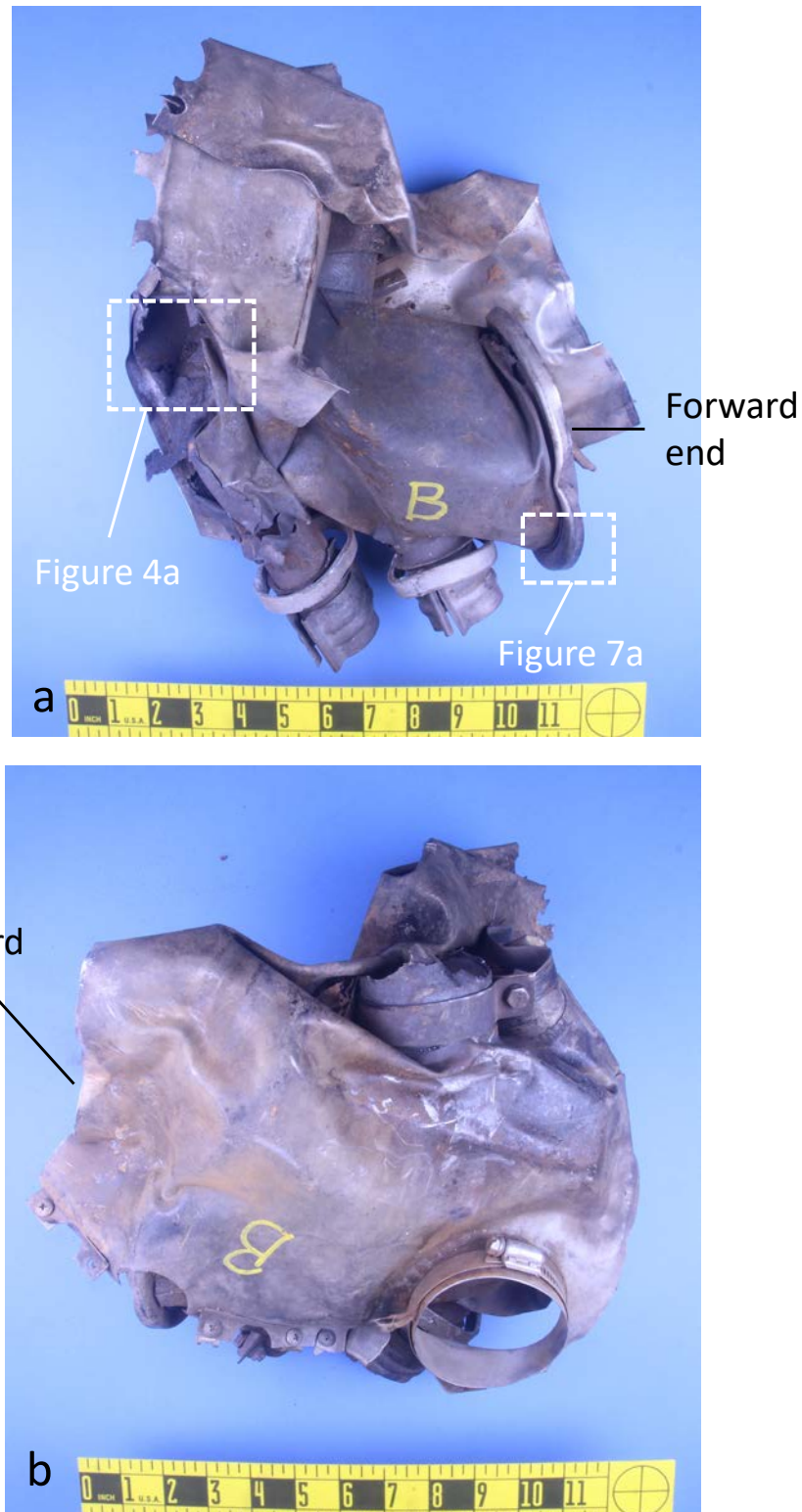


Figure 2 Images of portions of the right-hand smooth muffler and shroud (identified as "B").

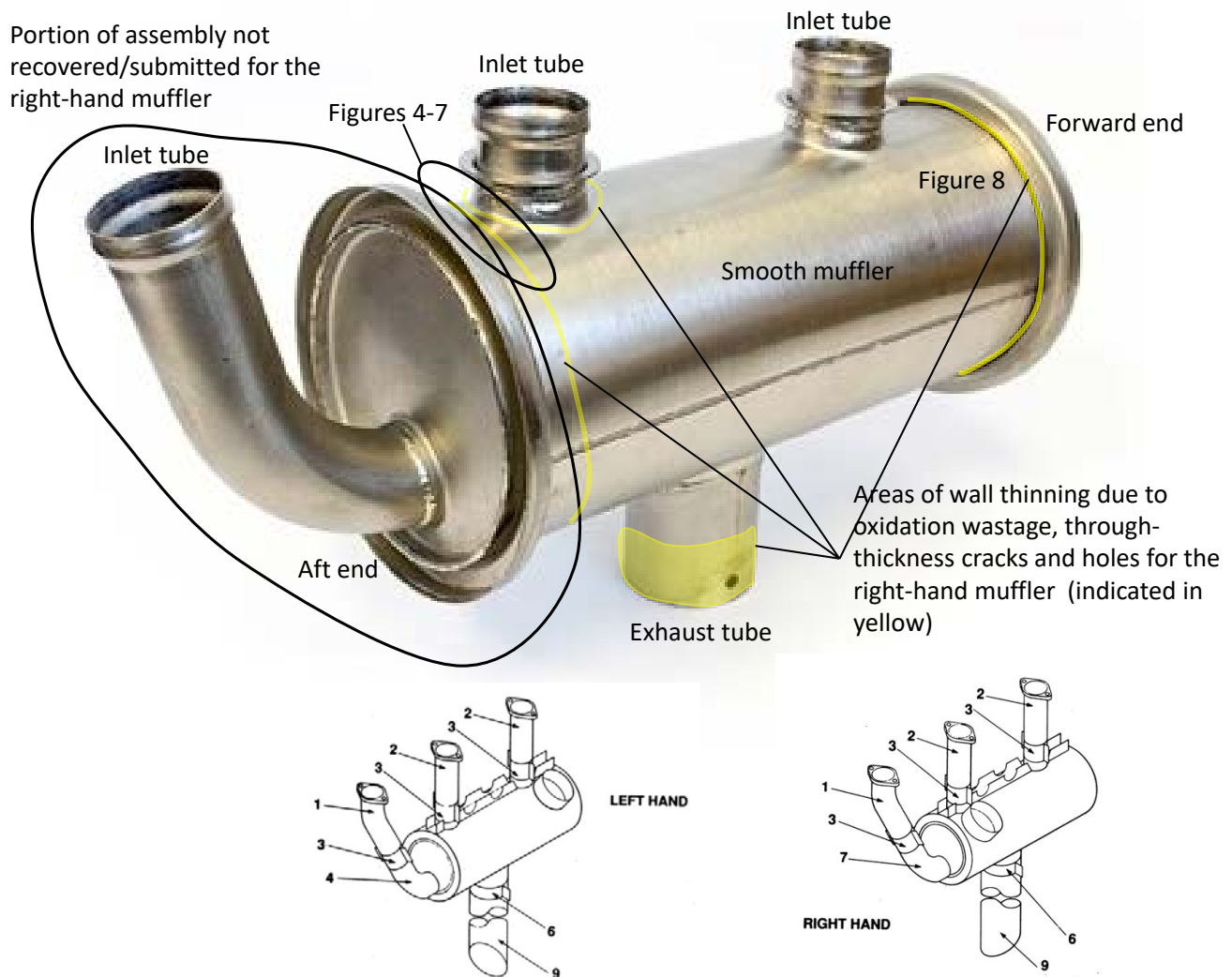


Figure 3 Image of an exemplar smooth muffler showing annotations related to the right-hand accident muffler. For reference, the lower drawings are IPC images of the left and right-hand mufflers with shrouds and risers. All images are taken from the Nicrocraft catalog.

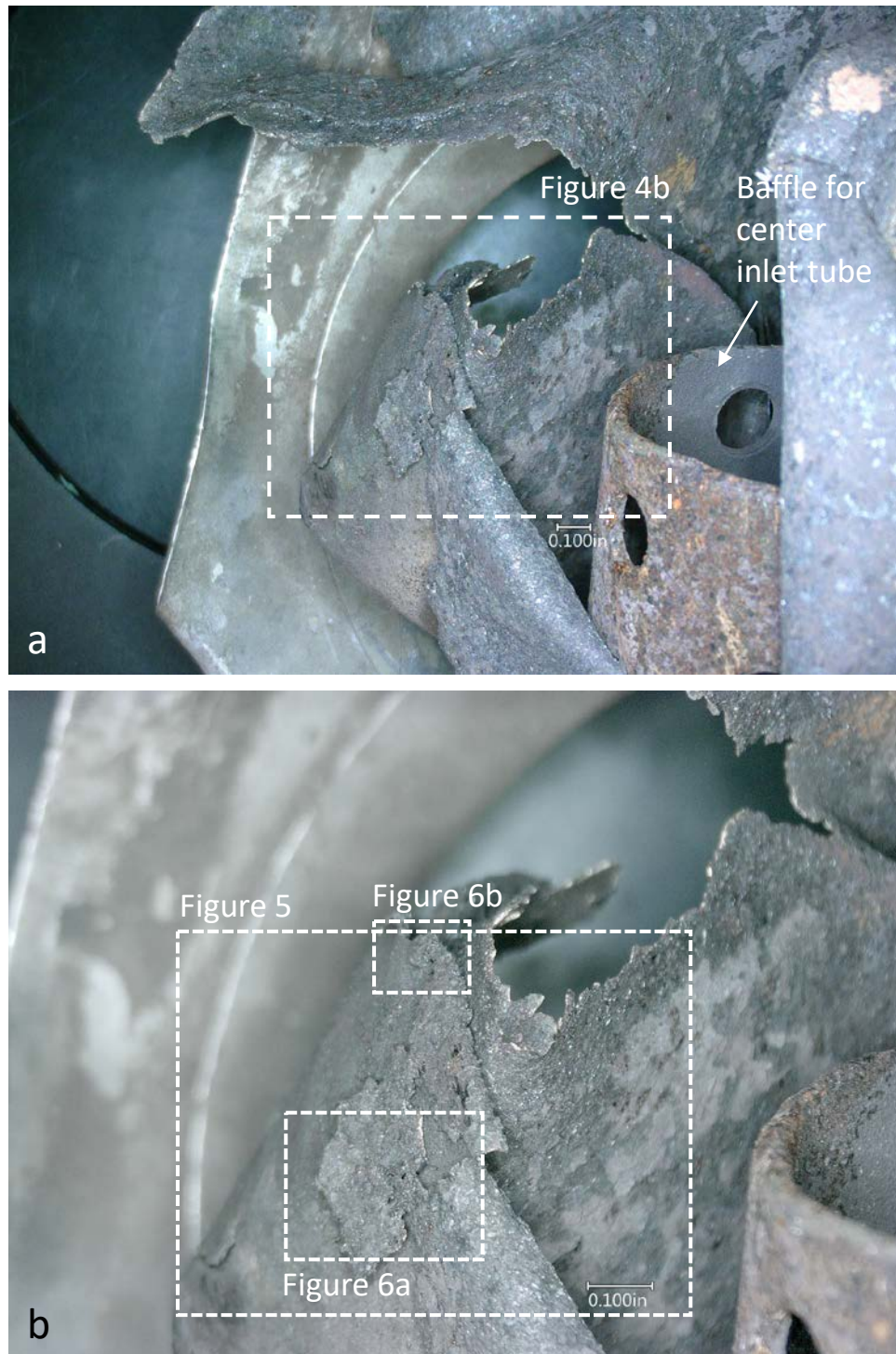


Figure 4 Digital microscope images of the fracture surfaces at the aft end of the right-hand muffler (See Figure 3 for orientation). Views a and b show the fractured edge of the muffler wall at progressively higher magnifications.

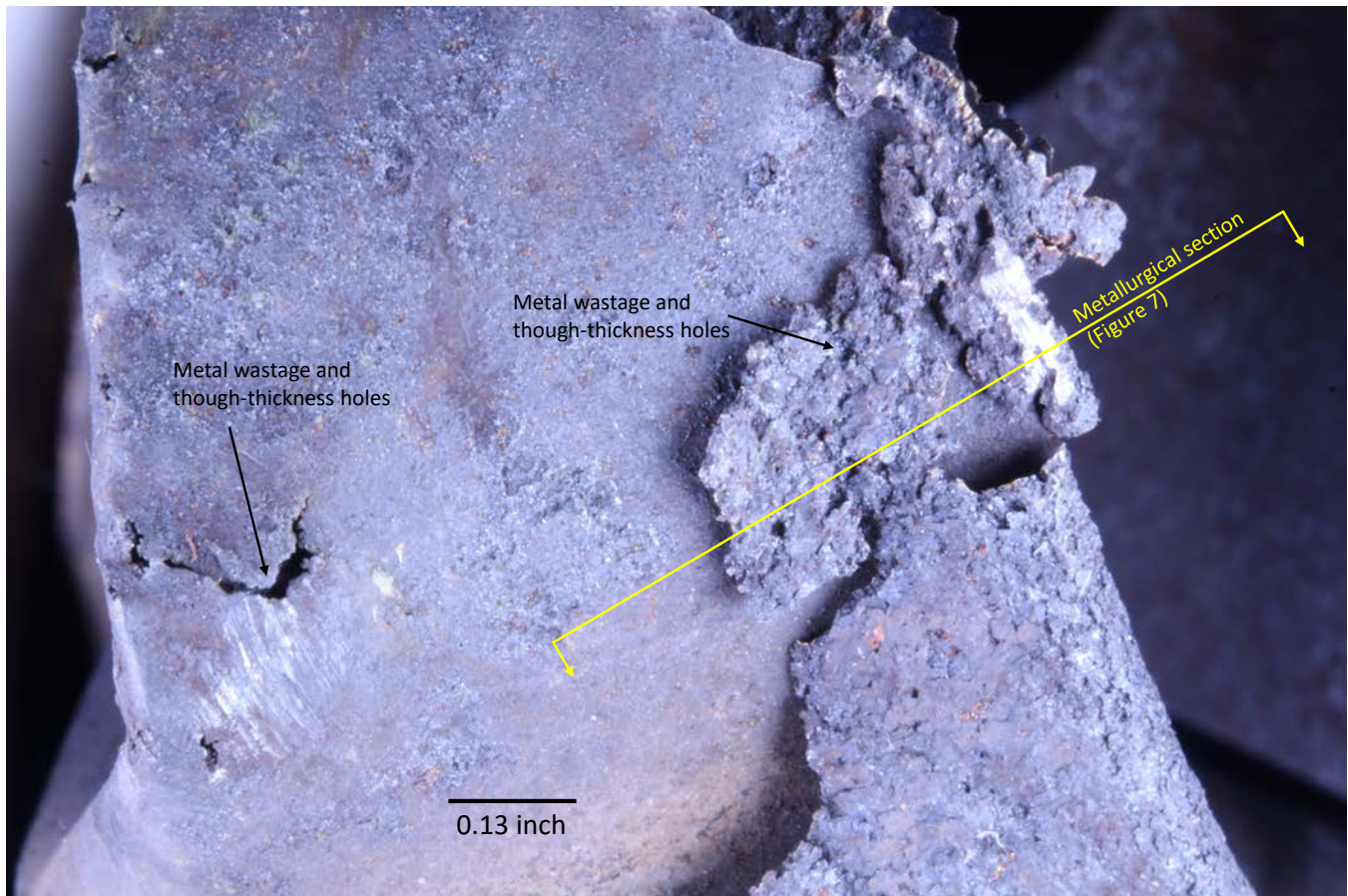


Figure 5 Close image of the fracture surfaces at the aft end of the right-hand muffler (see Figure 3 for orientation). Areas exhibiting metal wastage and holes are annotated. A reference line for a metallurgical cross-section through a representative area of metal wastage is identified. An image of the cross-section is shown in Figure 7.

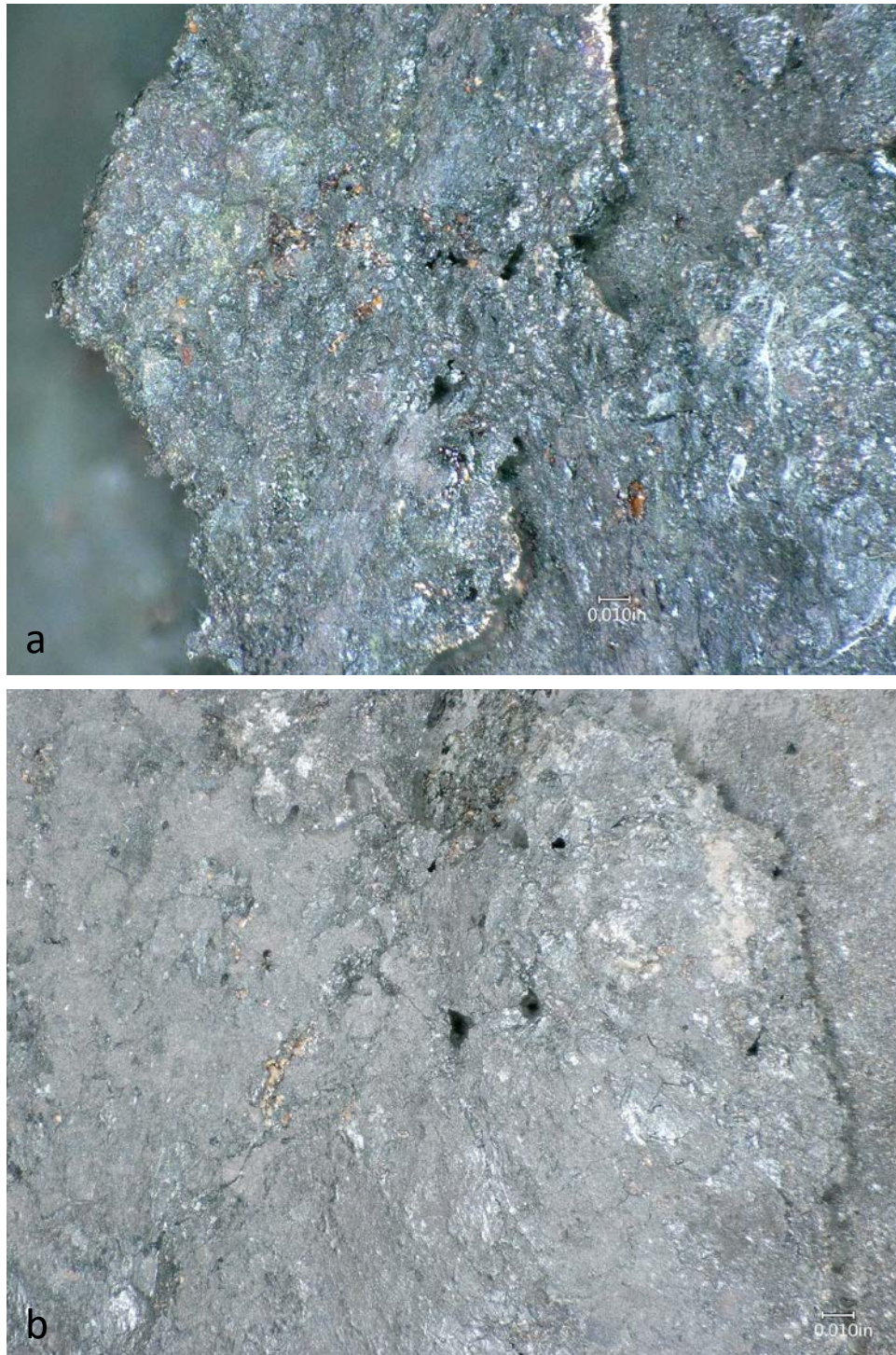


Figure 6 Close view digital microscope images of areas highlighted in Figure 4b revealing oxidized fracture surfaces and signatures of general metal wastage and holes .

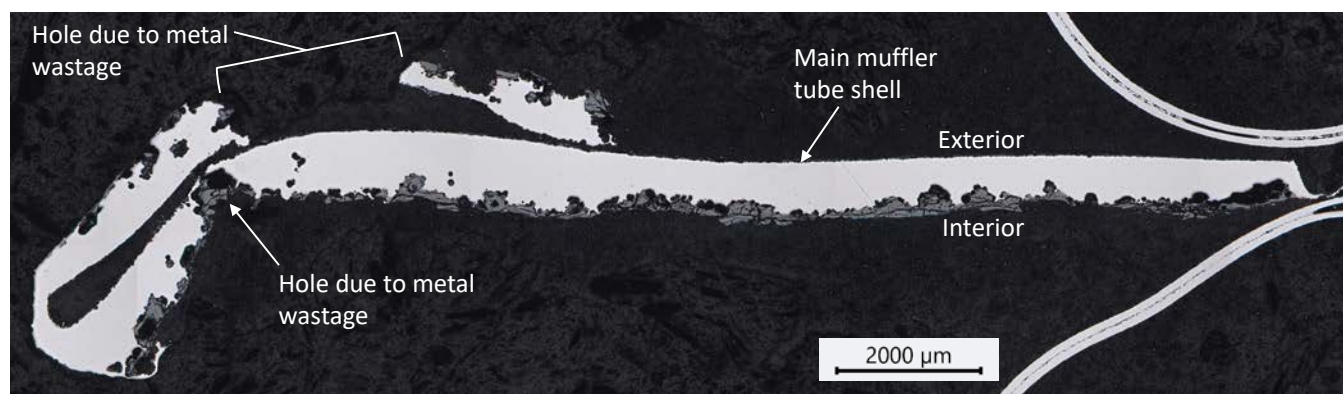


Figure 7 Brightfield optical micrograph montage of a metallurgical cross-section through an area of metal wastage indicated in Figure 5. The micrograph shows evidence of general thermal oxidative loss of the internal material wall thickness as well as through-thickness holes and cracks.

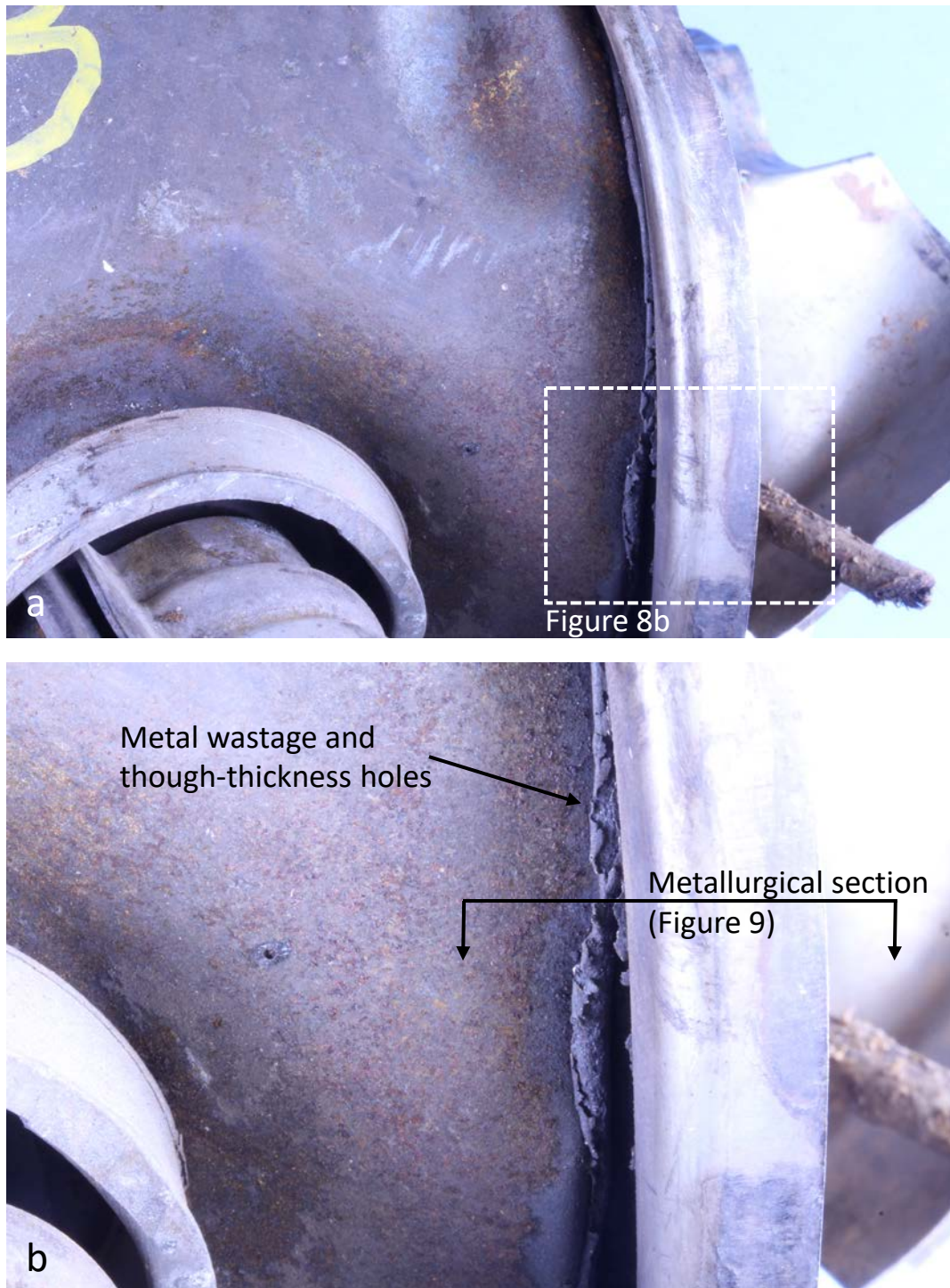


Figure 8 Images of the fracture surfaces at the forward end of the right-hand muffler (see Figures 3 for orientation) showing holes due to metal wastage. View b is a higher magnification image and is annotated to show the location of a metallurgical cross section (see Figure 9).

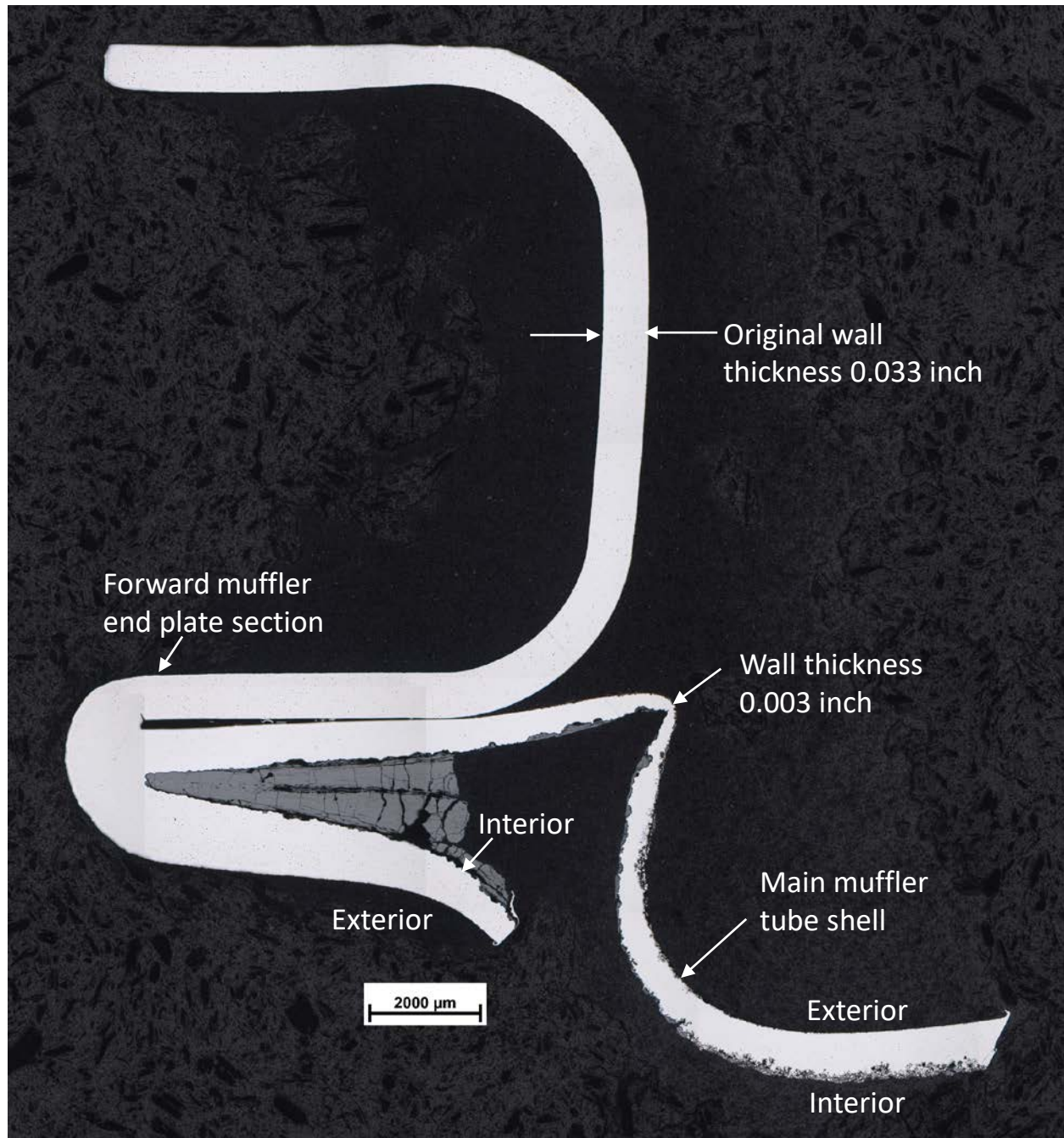


Figure 9 Brightfield optical micrograph montage of a metallurgical cross-section through an area of metal wastage indicated in Figure 8a. The micrograph shows evidence of general thermal oxidative loss of material wall thickness as well as through-thickness holes and cracks. Within the crimped joint, the original wall thickness was measured.