NATIONAL TRANSPORTATION SAFETY BOARD

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

April 5, 2022

MATERIALS LABORATORY FACTUAL REPORT Report No. 22-007

A. ACCIDENT INFORMATION

Place	:	Lewiston, Idaho
Date	:	July 24, 2021
Vehicle	:	SIAI-Marchetti SM-1019B, N28U
NTSB No.	:	WPR21FA283
Investigator	:	Andrew Swick, ASI-WPR

B. COMPONENTS EXAMINED

Piece of flight control stick, stick-mounted locking arm, locking arm's saddle clamp end cap, and U-shaped flight control lock.

C. DETAILS OF THE EXAMINATION

A piece of a flight control stick, a stick-mounted locking arm, a saddle clamp end cap, and a U-shaped flight control lock were submitted to the NTSB Materials Laboratory for examination, as shown in figures 1a – 1c. By design, the control lock is used to lock the ailerons and the elevator in a neutral position and limit rudder travel while the aircraft is on the ground. The lock consists of a U-shaped tube with hinge pivots at both ends, as indicated in figure 1b, two rudder locking tabs, located on the long arms of the lock, and a locking hole, located on the underside of the transverse leg, as indicated in figure 1b and 1c. When not in use, the lock pivots down to a stowed position on the floor of the cockpit and is held in place by a retention clip. To engage the control lock, the transverse section of the tube is lifted, rotating the bar about the two end pivots. A locking arm is mounted to the forward side of the control stick by a saddle clamp. A pin, fillet welded to the forward end of the locking arm, engages with the locking hole on the underside of the control lock, as seen in figure 1c. With the pin inserted in the hole, movement of the control stick, and its associated control surfaces, is restricted. On-scene examination of the wreckage indicated that the locking arm was rotated approximately 90° to the right from its typical position and that the control lock was found in a raised position.

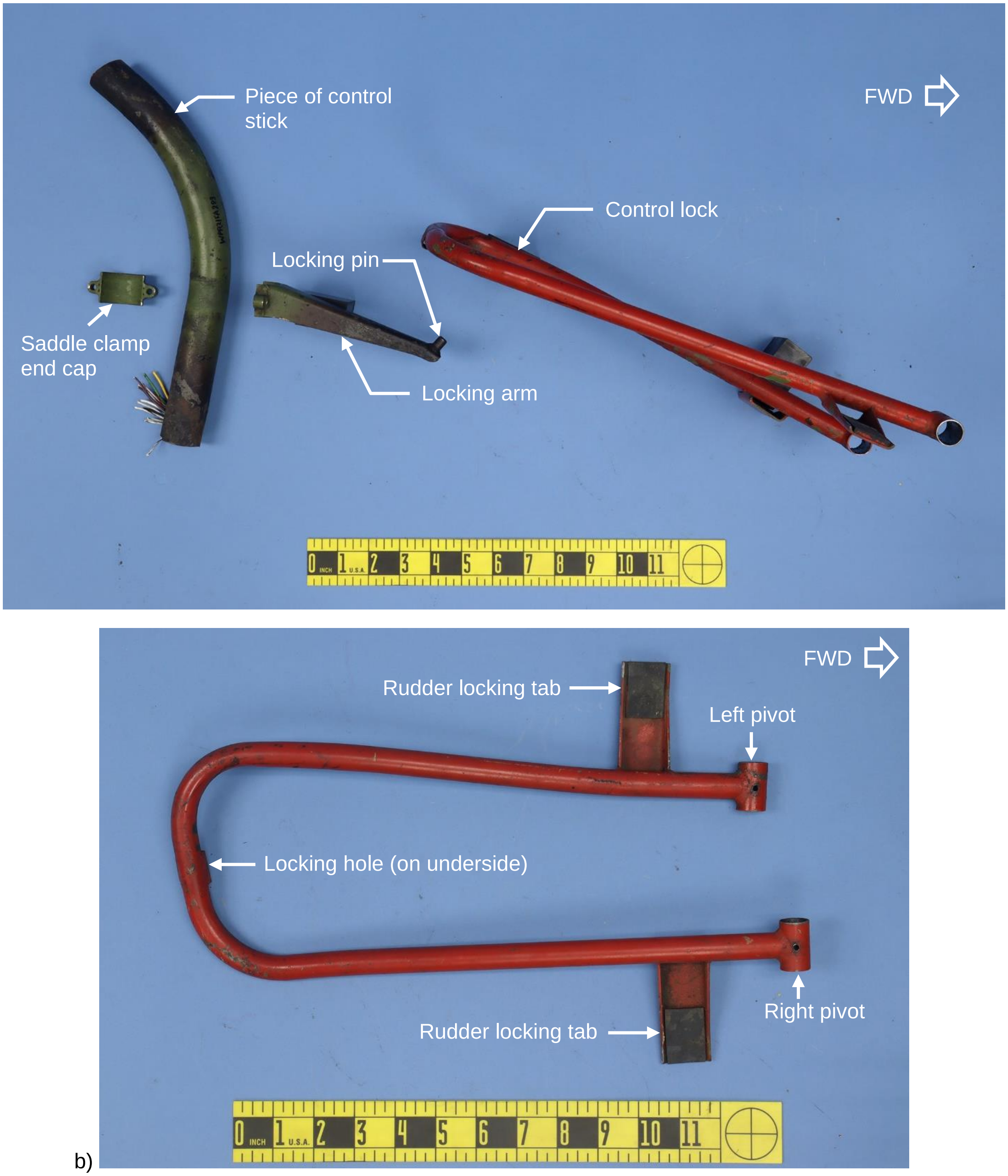
The control lock was deformed but there was no apparent deformation to the locking arm or the piece of control stick. The deformation had displaced the left pivot aft, inward, and downward relative to the right pivot, as seen in figures 1a and 1b. The paint on transverse arm of the lock exhibited wear at the spot that engaged with the retention clip as well as other sporadic chips and scratches, as shown in figures 2a – d. The locking arm, shown in figures 3a and 3b, was examined for any bending or buckling features, but none were observed. Similarly, there was no apparent deformation to the piece of the control stick. A stripe of red paint was observed along the edge where top and left sides of the locking arm met, as indicated in figure 3a and shown at higher magnification in figure 3c. Visual examination indicated that the red paint was conformal to the underlying surface, did not appear to have disturbed the underlying paint, exhibited a slightly raised lower stripe edge, and exhibited transverse scratch features that had removed the red paint in select areas. The features were consistent with wet application of the paint.

There were circumferential rub marks in the paint at the point where the locking arm was clamped to the control stick. Images of the control stick's forward-facing and aft-facing sides are shown in figures 4a and 4b, respectively, and images of the locking arm's saddle clamp are shown in figures 5a and 5b. Most of the paint on these two components exhibited a heat-damage, debris-covered, and/or glossy appearance, but on the control stick, at the locking arm's clamping point, there were circumferentially aligned bands of paint, free of dirt, that exhibited a matte appearance as indicated in the images. The control stick's saddle clamp exhibited a combination of banding and discreet patches where paint exhibited a rubbed appearance.

The forward portion of the locking arm and the fillet weld at the base of the pin were coated with paint that had chipped and flaked, as shown in figures 6a – d. The pin surface itself consisted of bare metal. The pin and much of the surrounding surface, painted or not, had a dark oxidized appearance that was consistent with exposure to fire. Some areas, where the paint had chipped and exposed the underlying metal, had a lighter gray appearance.

The locking arm's pin and control lock's pin hole exhibited features consistent with rubbing against one another. Two bands were observed at the base of the pin where it met the toe of the weld. Those two regions are shown in figures 7a and 7b for the forward-facing and aft-facing sides of the pin, respectively. The two bands also exhibited a heat tint that was consistent with exposure to fire. The pin was examined for similarly tinted gouges or impact marks, but none were found. The inner diameter surface of the locking hole was initially covered in debris and oily residue, as shown for the forward region in figure 8. The debris and residues were removed using standard laboratory cleaning protocols and the resulting inner surface is shown in figures 9a – d. The hole exhibited wear along the forward and aft edges, consistent with contact with the fillet weld at the base of the locking arm pin. Elsewhere the hole was either coated with paint, exhibited a smooth rubbed appearance, or exhibited machining / grinding marks.

Donald Kramer, Ph.D.
Sr. Materials Engineer



a) b)

Figure 1: a) Image of the flight control locking components, as received; b) top down view of the the control lock; and

c) 

Figure 1 (cont.): c) Image showing the pin on the top side of the locking arm and the hole that receives the pin, located on the underside of the control lock.

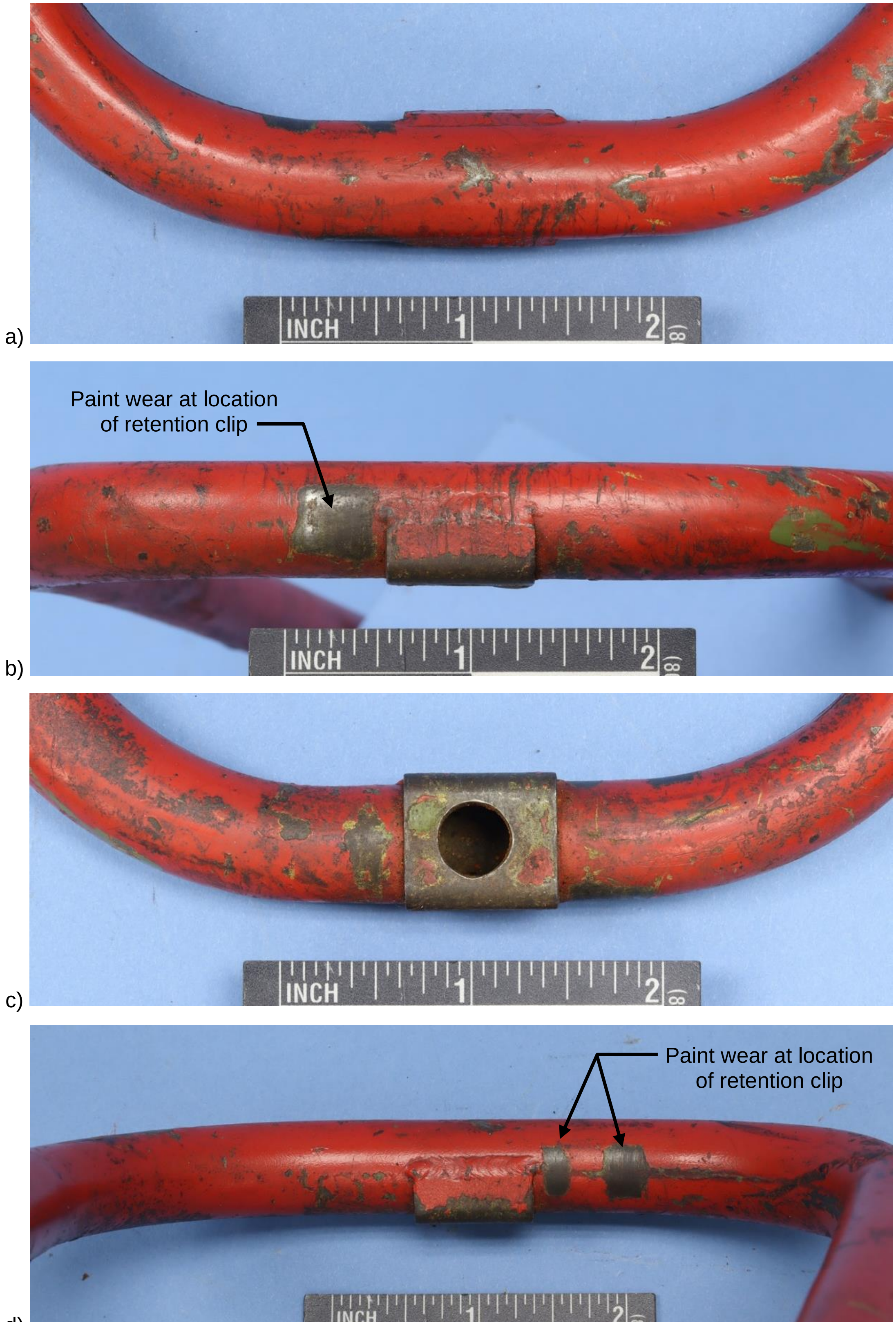
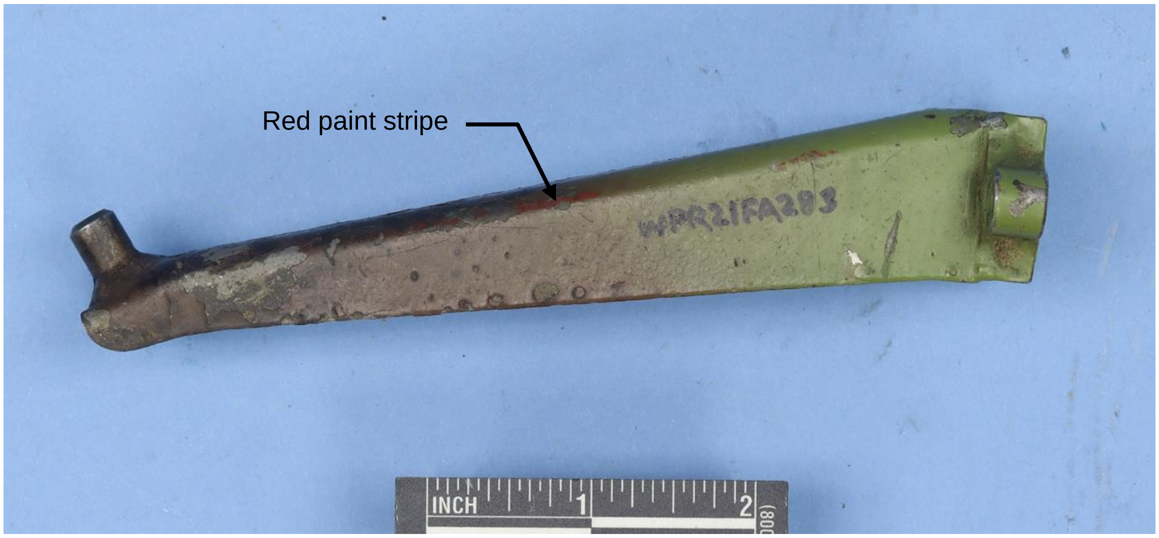


Figure 2: Images of the control lock's transverse arm; a) top side viewed top down; b) aft side viewed looking forward; c) bottom side viewed looking up; and d) forward side viewed aft.

a) 

b) 

Figure 3: Images of the locking arm; a) view of the left side; b) view from underneath looking up; and

c) 

Figure 3 (cont.): c) image of a paint stripe located along the top left edge.

a) b)

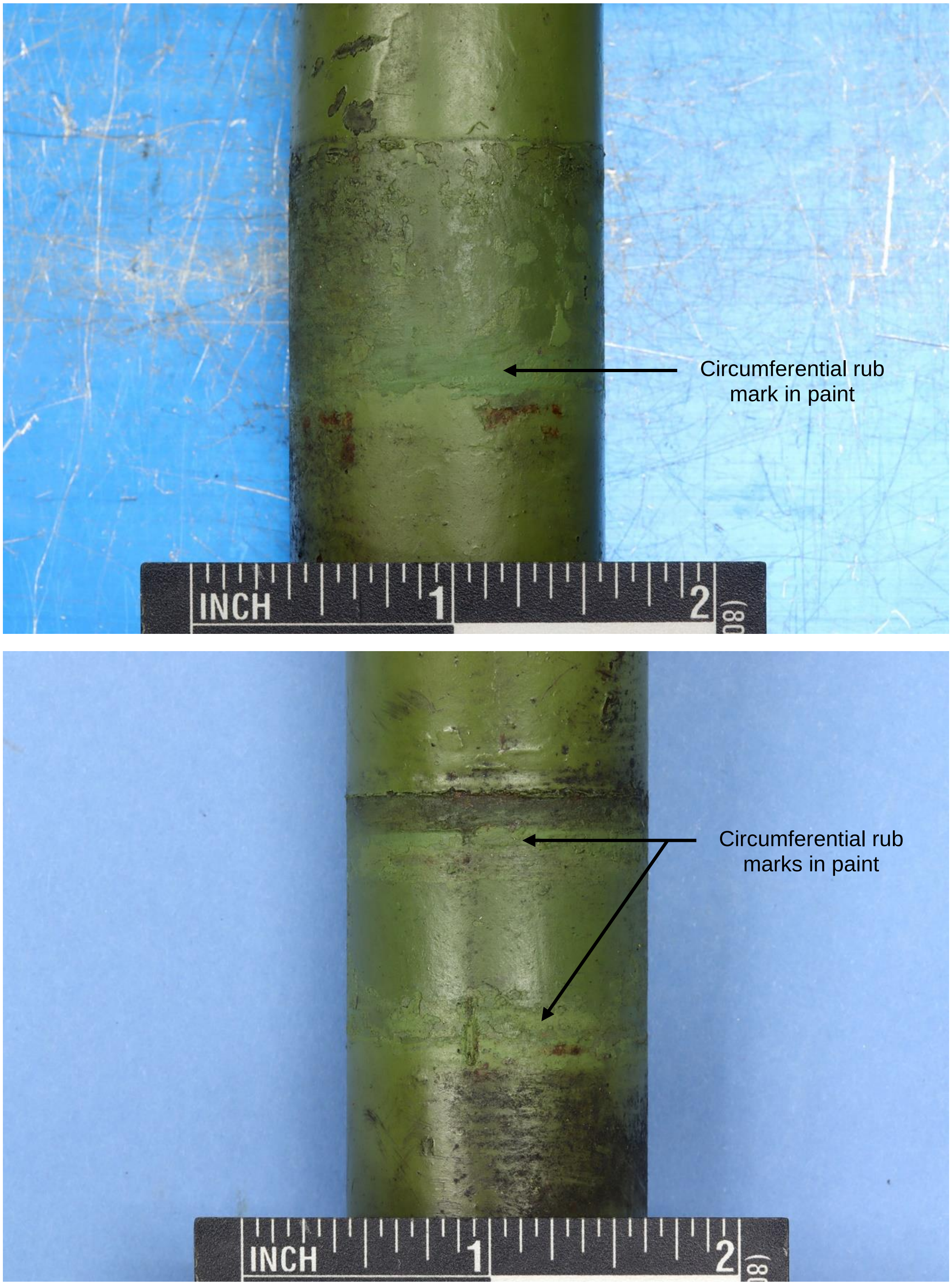


Figure 4: Images of the control stick at the spot where the locking arm was clamped to the stick. Circumferential rub marks were observed in the paint; a) forward side of the stick and b) aft side of the stick.

a)

b)

Figure 5: Images of the locking arm's control stick clamping surfaces; a) clamping surface on the aft end of the locking arm and b) the locking arm's saddle clamp end cap.

a) b)

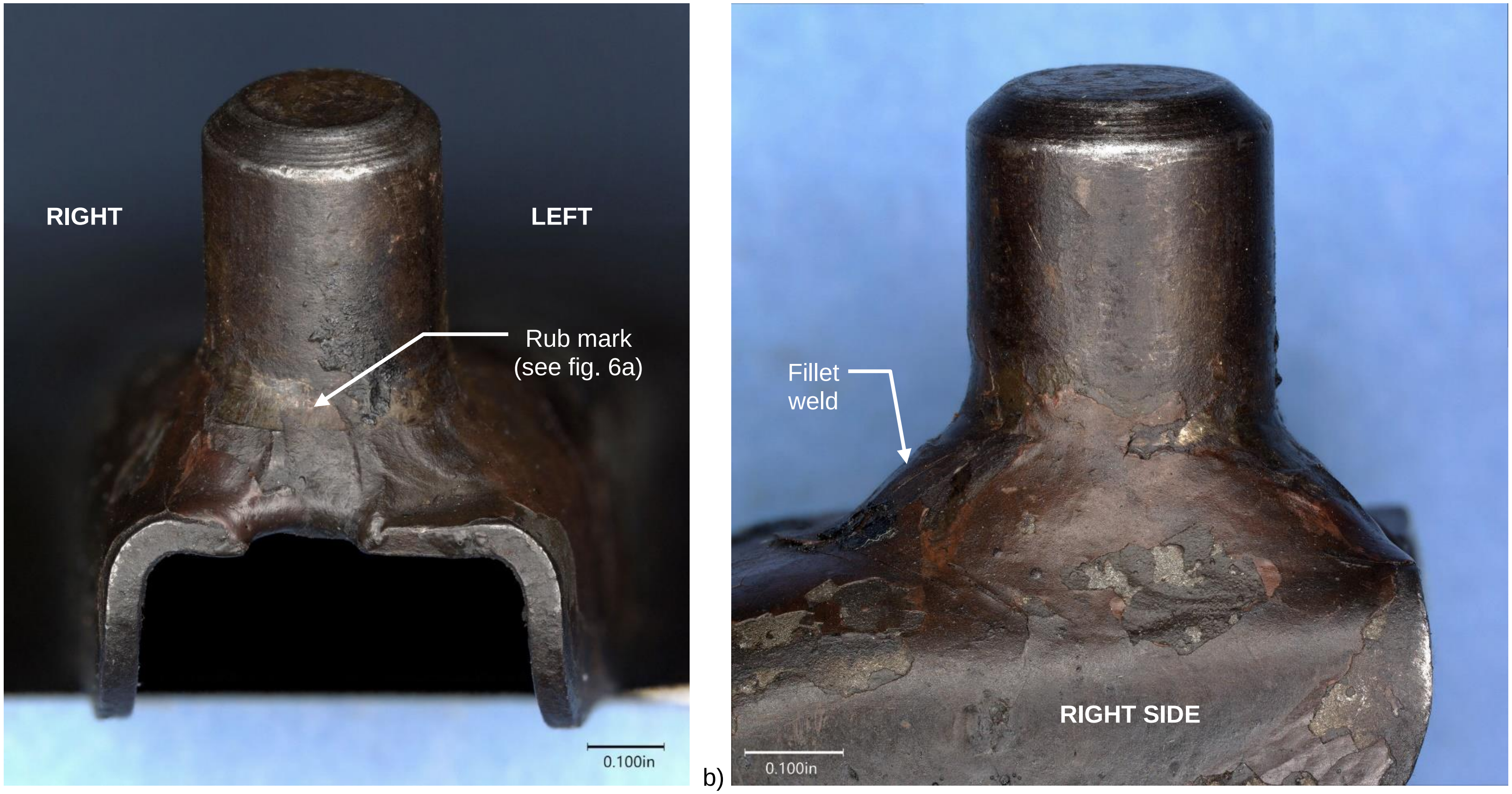


Figure 6: Images of the pin at the forward end of the locking arm; a) forward view; b) right side view;

c) d)

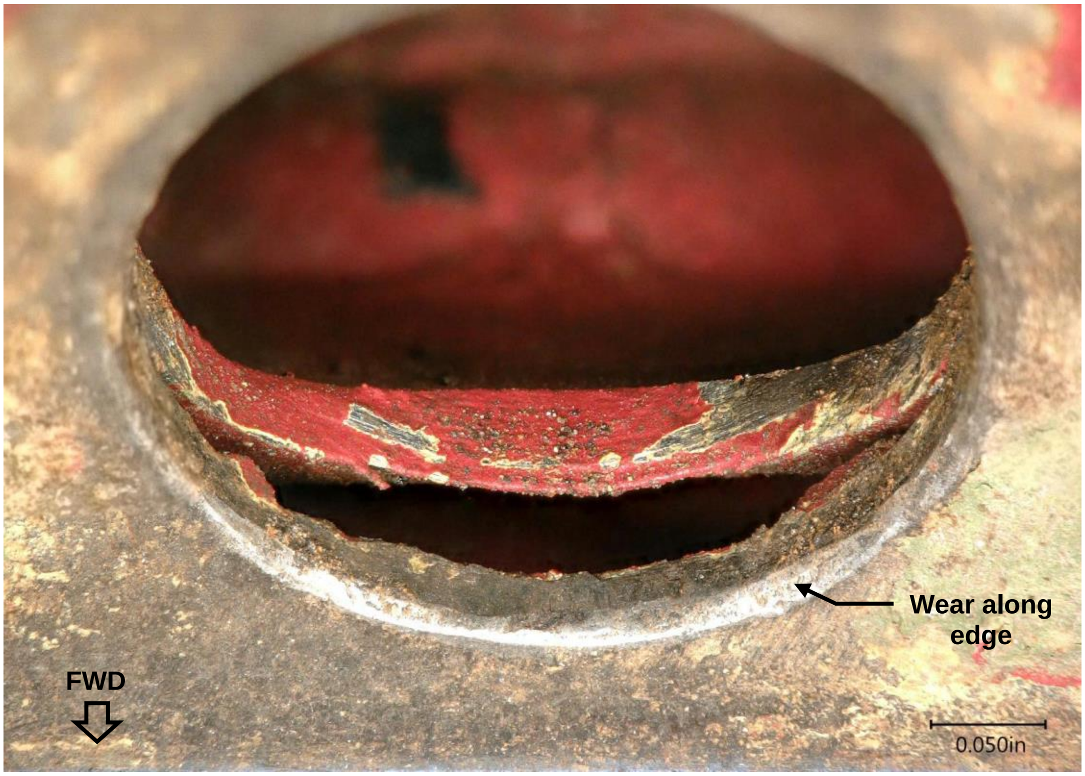
Figure 6 (cont.): c) aft side view; and d) left side view.

a)

b)

Figure 7: Higher magnification images of rub marks at the toe of the weld located at the base of the pin; a) Rub mark on the forward-facing portion of the pin and b) rub mark on the aft-facing portion of the pin.

Figure 8: Image of the locking hole's inner diameter surface showing accumulated debris and oily residues. The edge of the hole was rounded/chamfered, consistent with rubbing against the locking pin's weld toe.



a)

b)

Figure 9: Images of the locking hole's inner diameter surface after cleaning; a) forward; b) right side;

c)

d)

Figure 9 (cont.): c) aft; and d) left side.