

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA22LA171

MATERIALS LABORATORY

Factual Report 22-104

December 23, 2022

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A. ACCIDENT INFORMATION

Location: Sparta, Tennessee
Date: March 27, 2022
Vehicle: Cessna 172F, N8431U
Investigator: Millicent Hill

B. COMPONENTS EXAMINED

Items from the left main landing gear

1. Upper and lower fractured pieces of the left main landing gear spring strut
2. Separated step and attachment bracket assembly

C. EXAMINATION PARTICIPANTS

Specialist Michael Budinski
NTSB
Washington, DC

Technician Edward Komarnicki
NTSB
Washington, DC

D. DETAILS OF THE EXAMINATION

The submitted left main landing gear items are shown in in Figure 1 with key pieces identified. For reference, an image of the landing gear spring strut with step and bracket from the Cessna Model 172 Service Manual is shown in Figure 2¹.

The left main landing gear spring strut fractured where the step is affixed to the spring strut. The step bracket was tack welded to the spring strut as indicated in Figures 3-6. Detailed images in Figures 5 and 6 reveal that a thumbnail-shaped semi-elliptical fatigue crack initiated at a tack weld between the step bracket and the spring strut and propagated to a length of about 0.2 inch; a size sufficient for overstress fracture during the accident flight². The pre-existing fatigue crack exhibited dark coloration consistent with tight and adherent corrosion product.

Digital microscope images of both halves of the spring strut fracture surfaces are shown in Figure 7. Higher magnification oblique views in Figure 8 reveal that a

¹ Service Manual 1969 thru 1976 Model 172 Skyhawk Series, Cessna Textron Company, 01Jul1972, Rev 4. See also, Service Manual 100 - Series 1963 thru 1968 Section 5-4 D637-1-13 Revision 7, Cessna Textron Company, 01Jul2007.

² A thumbnail-shaped crack is an industry-specific term to describe a semi-elliptical crack or pre-crack in a solid.

semi-elliptical fatigue crack initiated and propagated at a step bracket tack weld deposit on the underside of the spring strut.

Close views using a digital microscope in Figures 9 and 10 document fine fractographic features of the semi-elliptical fatigue crack as well as the subsequent overstress crack that occurred during the accident flight.

Figure 11 shows the top side surfaces of the spring strut pieces at the location of the fracture (under the step bracket). In this area, the surfaces exhibit corrosion product deposits and loose scale. The sides and bottom side surfaces also exhibit such corrosion product and scale. As shown in Figure 4b, the underside of the step bracket also exhibited corrosion product and loose scale. Based on visual inspection, there is no evidence of an epoxy adhesive present on the faying surfaces of the step bracket or spring strut. In accordance with the Service Manual, step brackets may only be affixed to the spring strut using an approved epoxy adhesive on abrasively blasted surfaces; welding on the spring strut is not permitted.

Submitted by:

Michael K. Budinski
Chief, Materials Laboratory

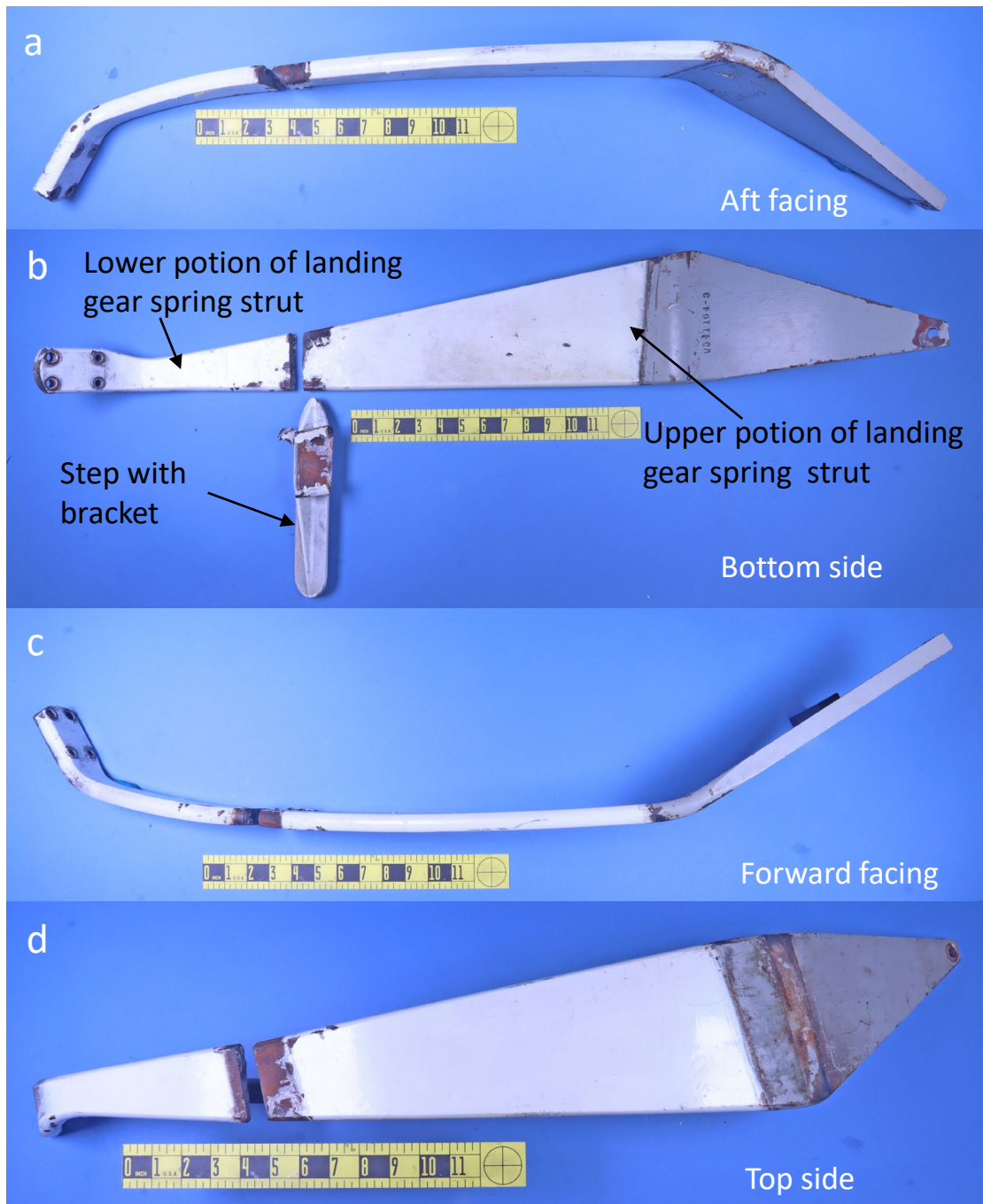


Figure 1. Image of the submitted items.

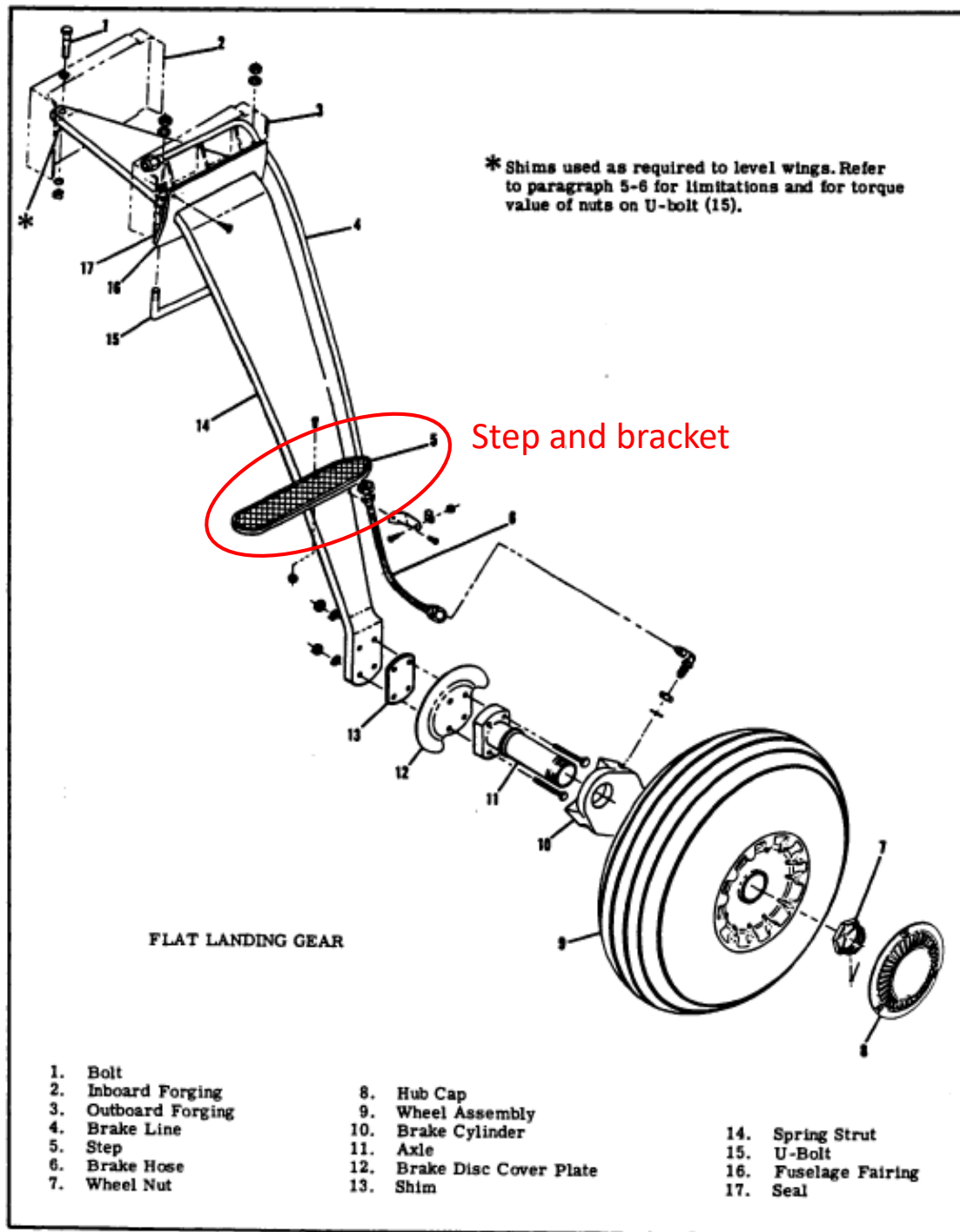


Figure 5-1. Main Gear Installation (Sheet 1 of 2)

Figure 2. Image of the main landing gear spring strut and step assembly from the Service Manual—1969 thru 1976 Model 172 Skyhawk Series.

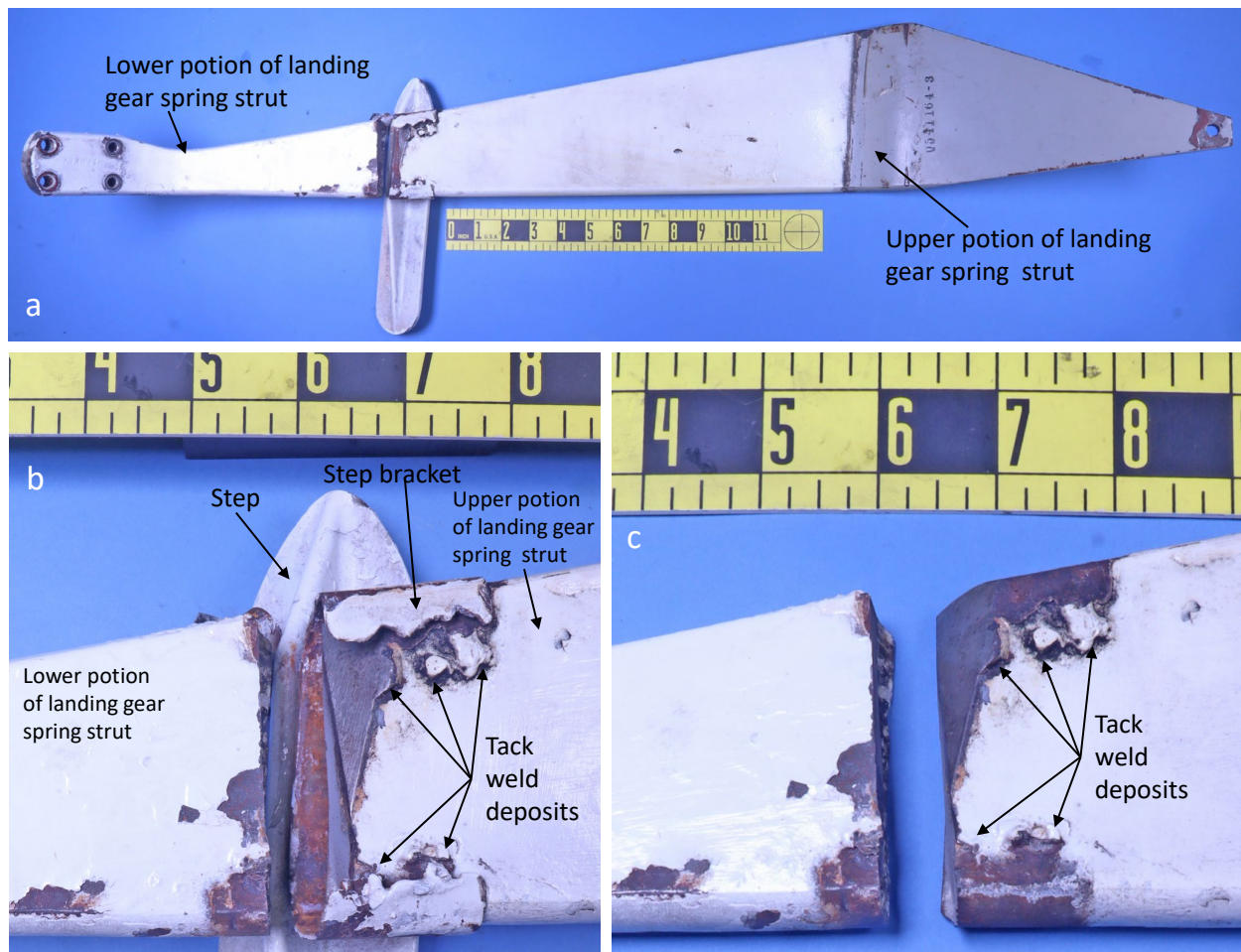


Figure 3. Images of the upper and lower portions of the fractured spring strut pieces with the step and bracket positioned in its approximate pre-accident location. A tack weld between the step bracket and the bottom face of the spring strut is noted.



Figure 4. View a shows an image of the upper and lower portions of the fractured spring strut with the step and bracket positioned in its approximate pre-accident location. Tack welds between the step bracket and the bottom face of the spring strut are noted. In view b, the underside of the bracket exhibits corrosion product, loose scale, and paint stains from wicking paint

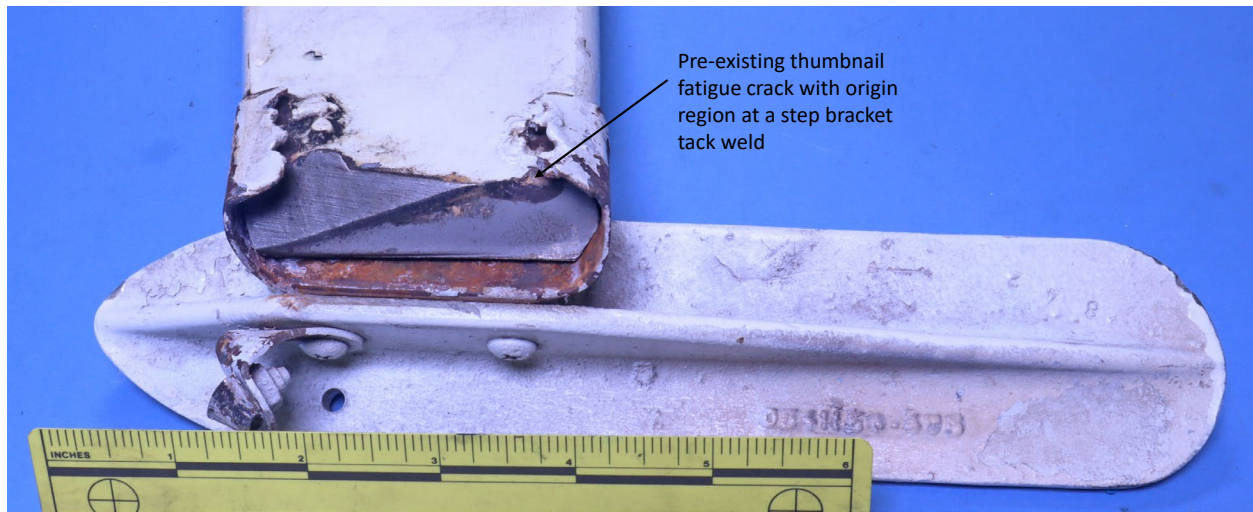


Figure 5. Image of the upper portion of the fractured spring strut piece with the step and bracket positioned in its approximate pre-accident location. A fractured tack weld between the step bracket and the bottom face of the spring strut is noted. A closer image is shown in Figure 6.

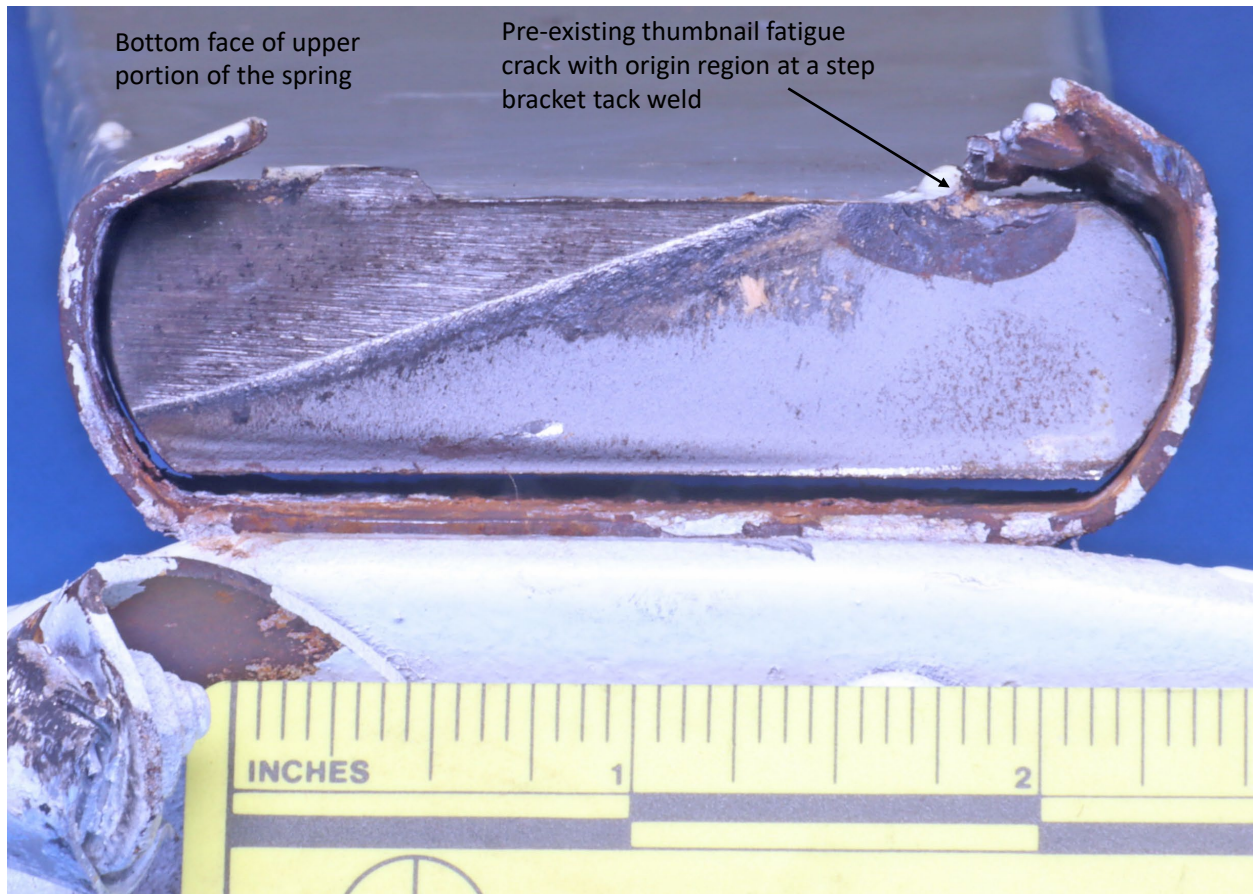


Figure 6. Closer image of the upper portion of the fractured spring strut piece with the step and bracket positioned in its approximate pre-accident location. A fractured tack weld between the step bracket and the bottom face of the spring strut is noted.

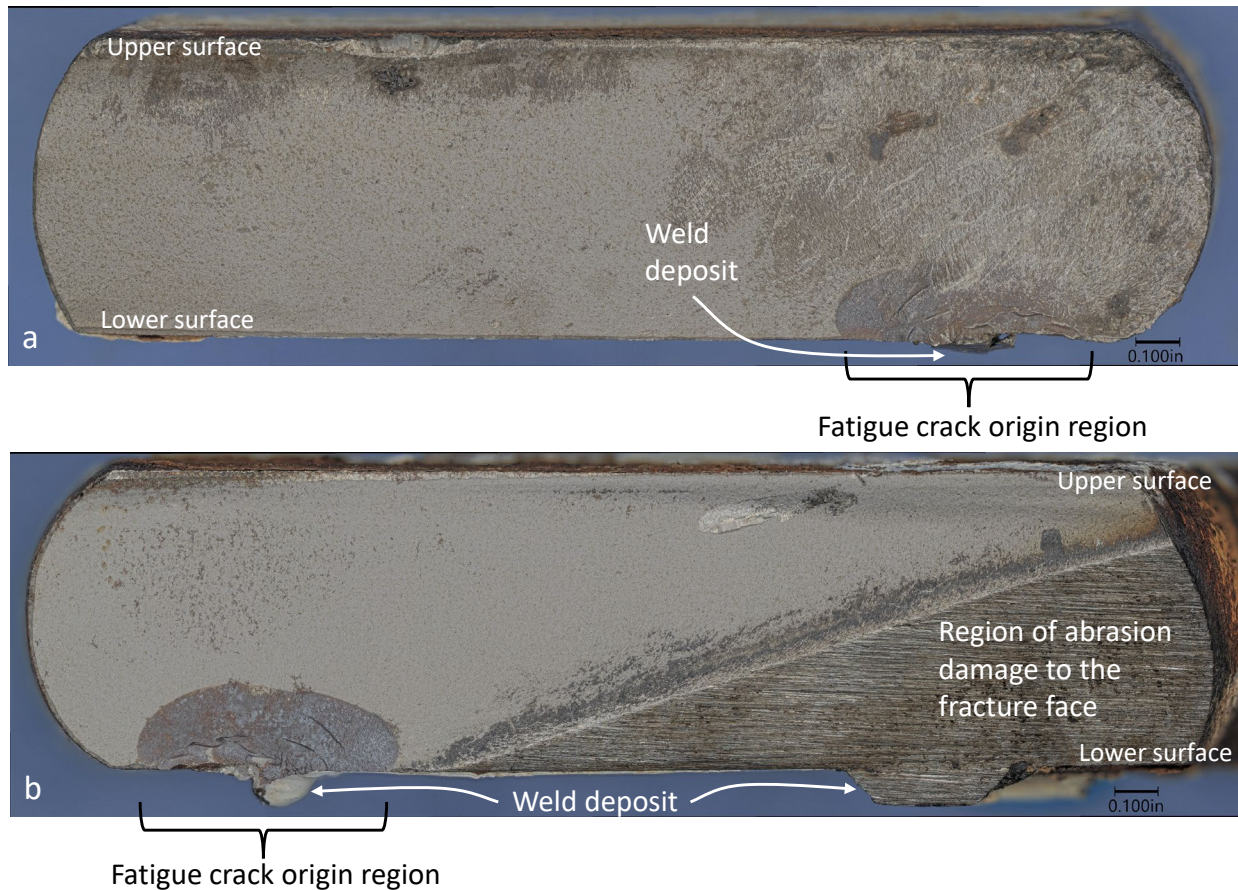


Figure 7. Digital microscope images of the fracture faces of the upper and lower spring strut pieces. A semi-elliptical fatigue crack is noted at the fracture origin region.

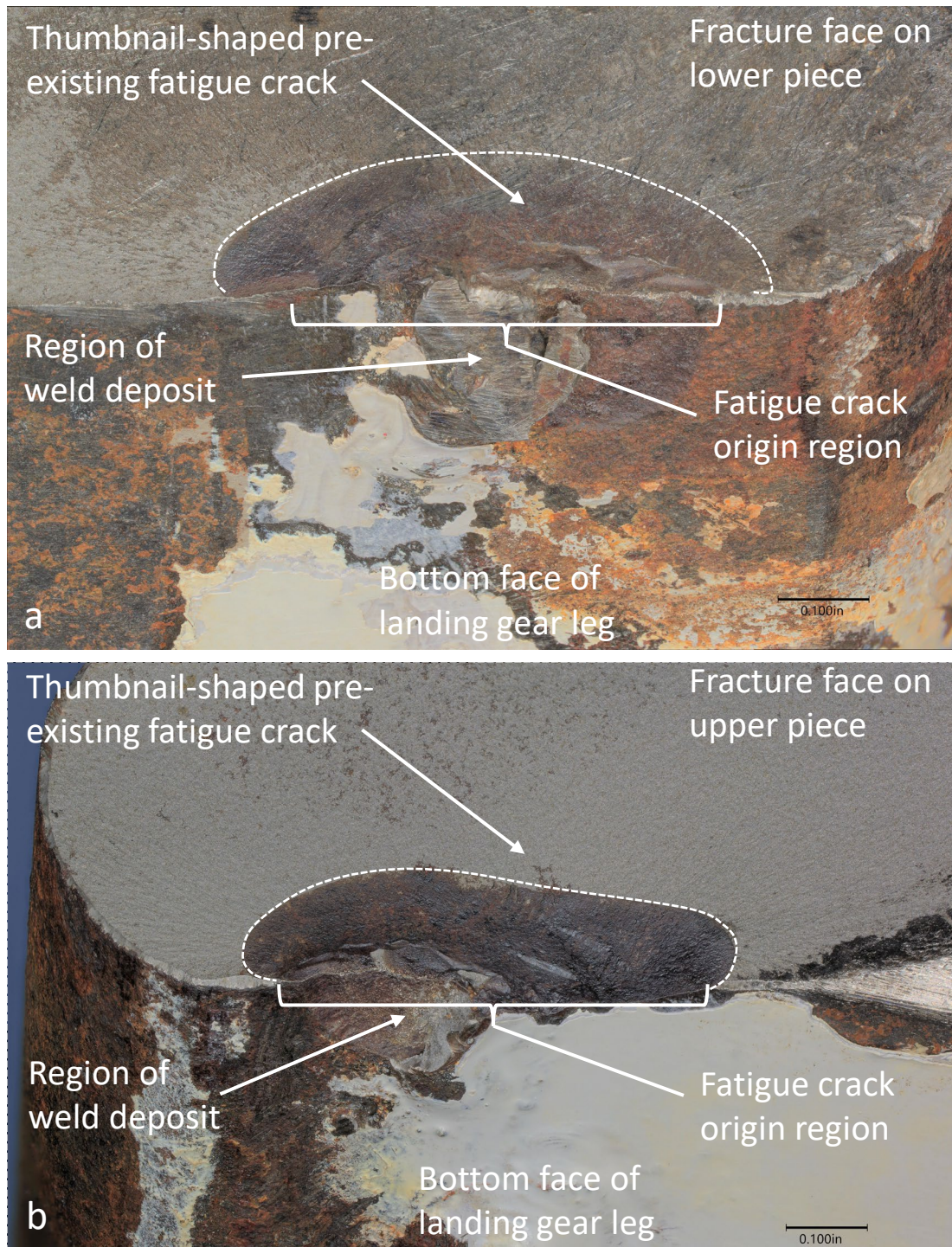


Figure 8. Oblique digital microscope images of the fracture origin region on the upper and lower spring strut pieces. The fatigue crack origin region is located at a weld deposit between the step bracket and the underside of the spring strut.

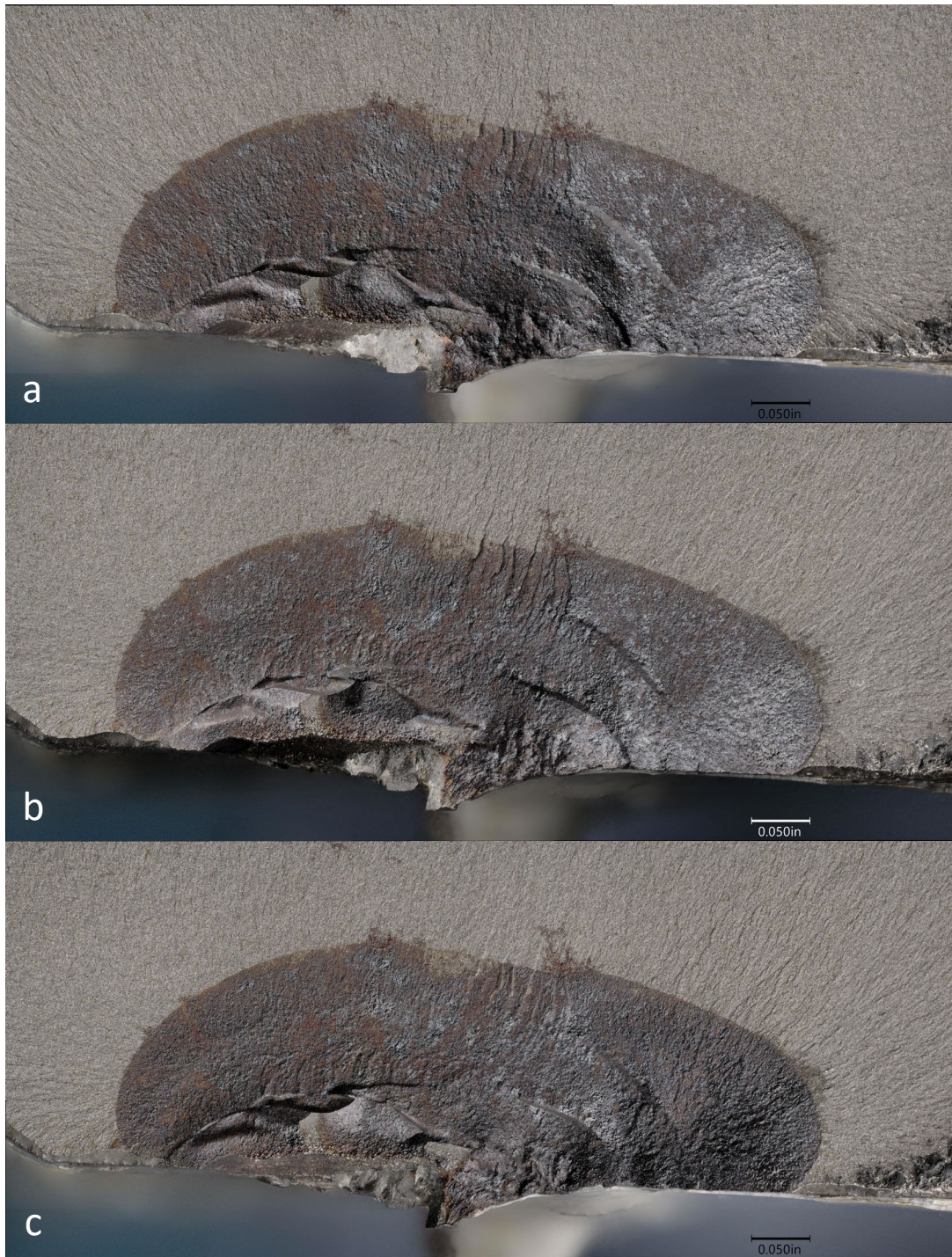


Figure 9. Digital microscope images of a semi-elliptical fatigue crack (darker region) at the fracture origin region viewed under different oblique lighting conditions and high dynamic range color.

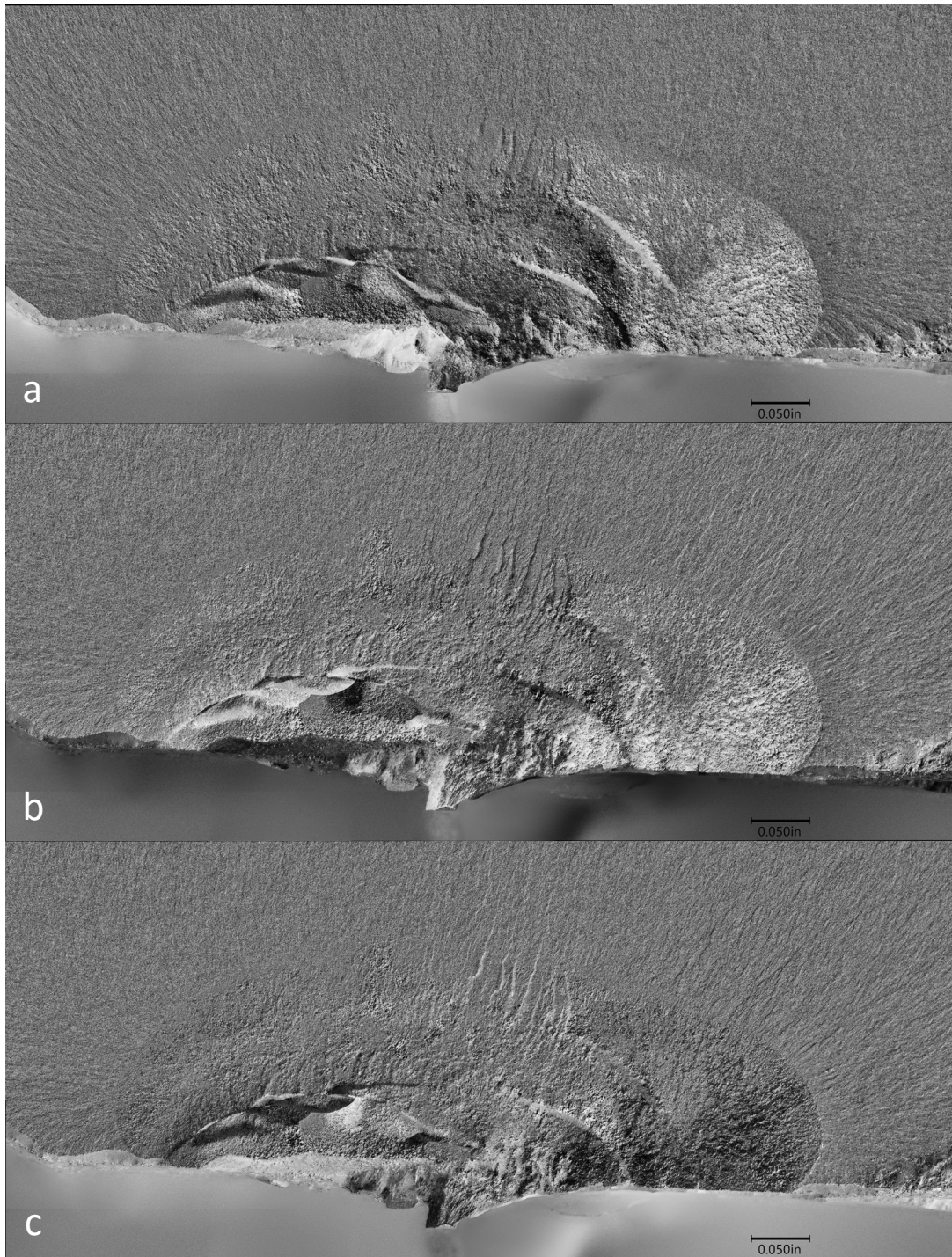


Figure 10. Monochromatic digital microscope images of a semi-elliptical fatigue crack at the fracture origin region viewed under different oblique lighting conditions (Same images as Figure 9, but monochromatic).

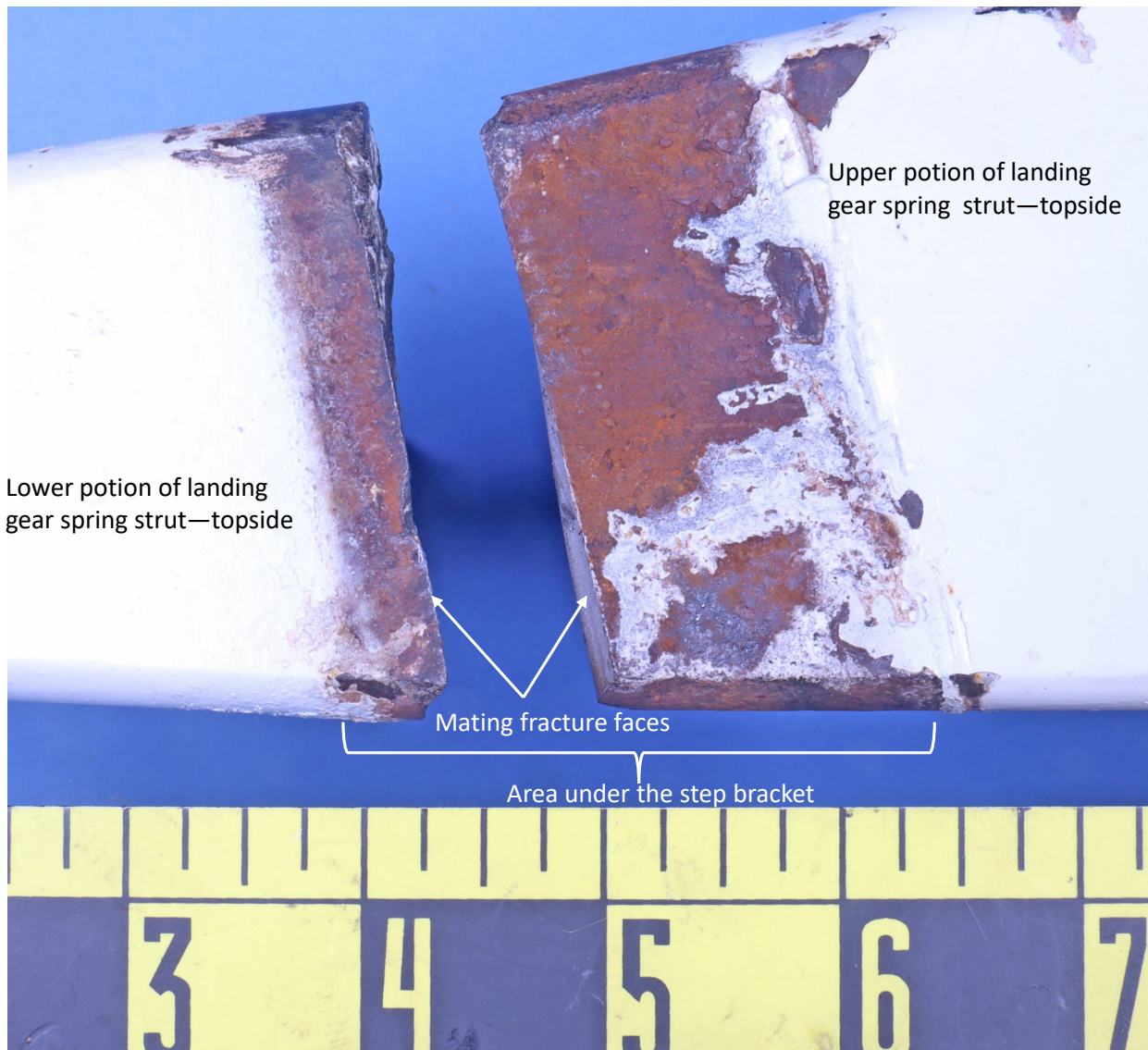


Figure 11. Portions of the upper and lower spring strut pieces showing the topsides in the vicinity of the fracture. The spring strut surfaces exhibit corrosion product and loose scale under the step bracket. Paint stains under the step bracket are consistent with paint wicking under the step bracket when the spring strut was painted (see Figure 4b for the faying surface of bracket). No evidence of an epoxy adhesive was noted.