

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

January 29, 2021

Computed Tomography Specialist's Factual Report

CEN20LA425

A. ACCIDENT

Location: Spring, Texas
Date: September 29, 2020
Time: 1400 central daylight time
Airplane: Cessna 172N airplane, N75634

B. GROUP

Computed
Tomography
Specialist: Scott Warren
National Transportation Safety Board
Washington, D.C.

C. SUMMARY

On September 29, 2020, about 1400 central daylight time, a Cessna 172N, N75634, was substantially damaged when it was involved in an accident near Spring, Texas. The student pilot sustained minor injuries. The airplane was operated as a Title 14 Code of Federal Regulations (CFR) Part 91 instructional flight.

The internal configuration of the left and right steering tubes from the accident aircraft were documented using radiographic images that were collected from November 18-20, 2020 in Chicago, Illinois. A total of 5,777 computed tomography (CT) slice images were examined, processed, and analyzed by the NTSB to evaluate the components.

Review of the images determined that, when the scans were conducted, the following indications were noted:

1. In the left steering tube, the internal washer was not captured between the spring and the flared rod end. It was located on the internal rod, but it was on the opposite side of the tube crimp area than the spring.
2. In the left steering tube, the tube crimp depth varied throughout the circumference of the tube. The minimum tube crimp depth was approximately at the outer bend radius of the tube, and the maximum tube crimp depth was approximately at the inner bend radius.
3. In the left steering tube, there were indications of a possible worn area at the minimum tube crimp location.
4. In the left steering tube, there were several indications of unknown material located in and around the washer area and inner tube wall.
5. In the left steering tube, the washer appeared to be deformed with raised lips around portions of the inner and outer edges.
6. In the right steering tube, the washer appeared to be captured between the spring and flared rod end.

D. DETAILS OF THE INVESTIGATION

1.0 General

The left and right steering tubes from the accident aircraft were subjected to x-ray radiograph and computed tomography (CT) scanning to document their internal conditions. The scanning was conducted from November 18-20, 2020 by Varex, Inc under the direction of the NTSB using the Actis 250/500 microfocus CT system.

For the CT scans, the components were individually loaded into the imaging unit and placed on a turntable. The components were then rotated in front of the x-ray source, and the x-rays were captured by a detector after they went through the part. The x-ray source produced a cone shaped beam of x-rays, and the portion of the part imaged was adjusted slightly after each scan was completed until the entire assembly (or region of interest of the part) was scanned. The x-ray energy levels measured by the detector were recorded at several thousand different points during each rotation, and this information was converted into slice images using reconstruction algorithms.

The components were scanned using a total of 5,777 slices, and the total size of the combined data sets was approximately 11.3 GB. The complete scan protocols are given in table 1. The digital radiograph and CT axial slice images were provided by Varex to the NTSB where they were examined, processed, and analyzed to evaluate the components.

Table 1
Scan Protocols

Component	Steering tube – left	Steering tube - right
Number of slices	2,476	3,301
Voxel ¹ Size - X Direction (millimeter(mm))	0.044	0.044
Voxel Size - Y Direction (mm)	0.044	0.044
Voxel Size - Z Direction (mm)	0.04	0.04
Image Projections per Revolution	1800	1800
Exposure time (milliseconds)	285.6	285.6
Frames to Avg (frames per projection)	2	2
X-ray Source Voltage (kilovolts)	222	222
X-ray Source Current (milliamps)	0.520	0.520
Source Filter Thickness (mm)	1	1
Source Filter Material	brass	brass
Image Matrix Size (pixels)	1024 x 1024	1024 x 1024

The data sets of slice images were examined, processed, and analyzed by the NTSB using the VGStudioMax software package to convert the axial slice data into orthogonal slice images and a three-dimensional reconstructed image of the component. As part of the evaluation, some sections of the components were digitally removed or rendered transparent to allow closer observation of interior parts. In the images, the higher density areas were shown as brighter shades of gray and lower density areas were shown as darker shades of gray. The pointers shown in some of the images denote specific areas of interest within that image.

¹ A voxel is a three-dimensional picture element (pixel).

The images of the components were examined for any signs of missing or damaged parts, contamination, or any other anomalies. Specific results (including example images) are presented in subsequent sections of this report.

2.0 Computed Tomography Results

The computed tomography (CT) results for the components are shown in figures 1 through 16. Review of the images determined that, when the scans were conducted, the following indications were noted:

1. In the left steering tube, the internal washer was not captured between the spring and the flared rod end. It was located on the internal rod, but it was on the opposite side of the tube crimp area than the spring.
2. In the left steering tube, the tube crimp depth varied throughout the circumference of the tube. The minimum tube crimp depth was approximately at the outer bend radius of the tube, and the maximum tube crimp depth was approximately at the inner bend radius.
3. In the left steering tube, there were indications of a possible worn area at the minimum tube crimp location.
4. In the left steering tube, there were several indications of unknown material located in and around the washer area and inner tube wall.
5. In the left steering tube, the washer appeared to be deformed with raised lips around portions of the inner and outer edges.
6. In the right steering tube, the washer appeared to be captured between the spring and flared rod end.

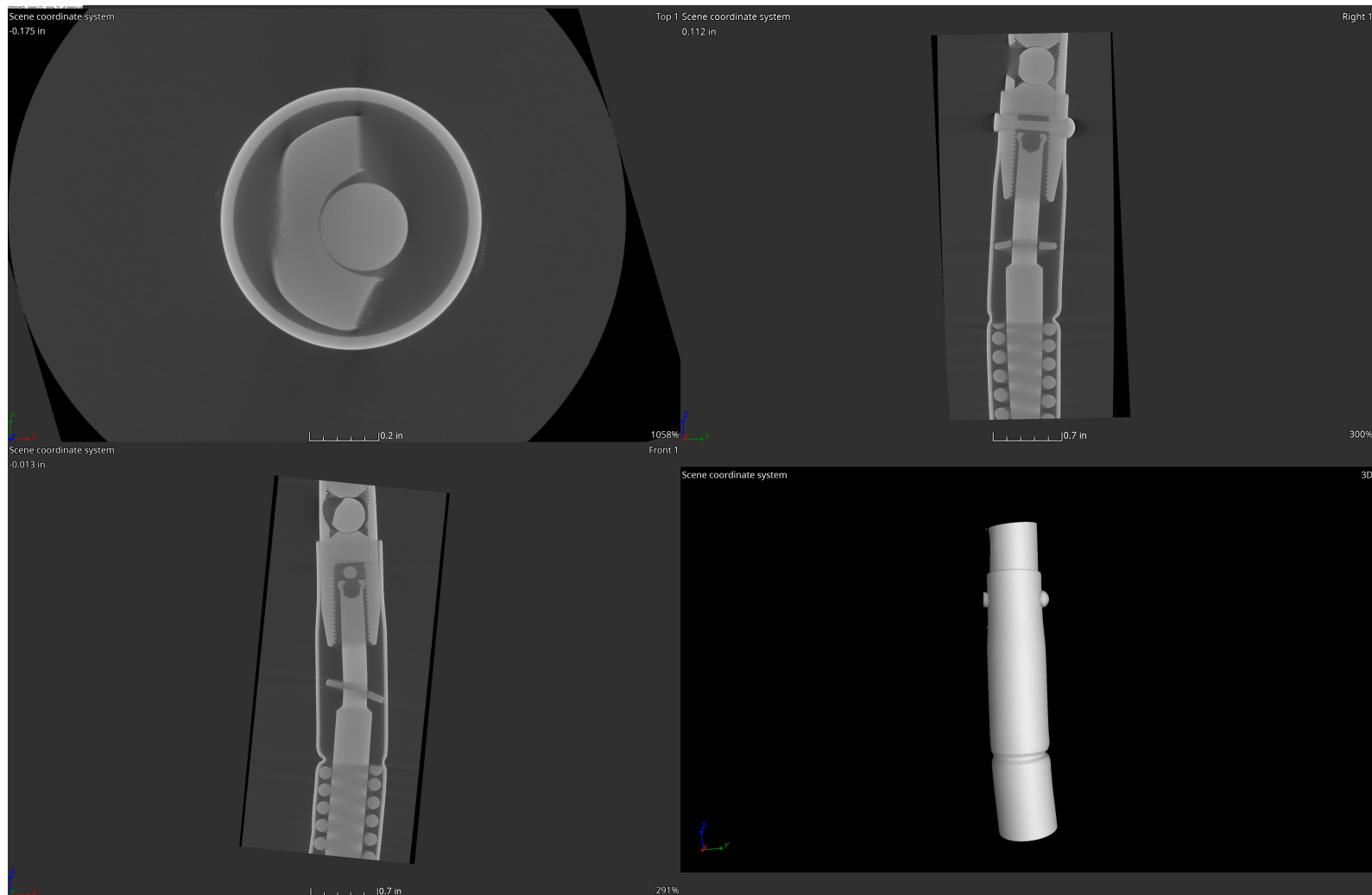


Figure 1
Left steering tube - overview

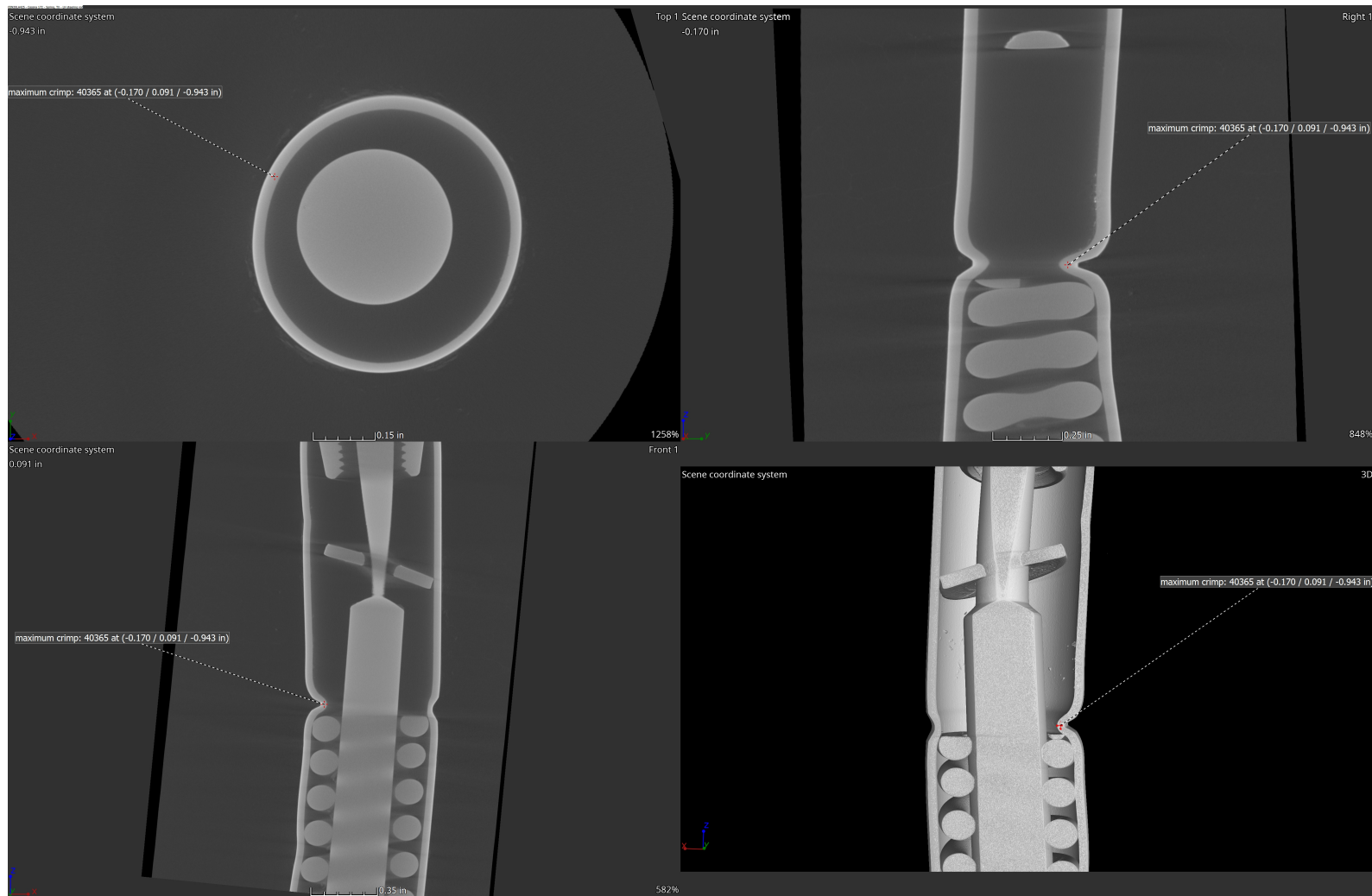


Figure 2
Left steering tube – maximum crimp location

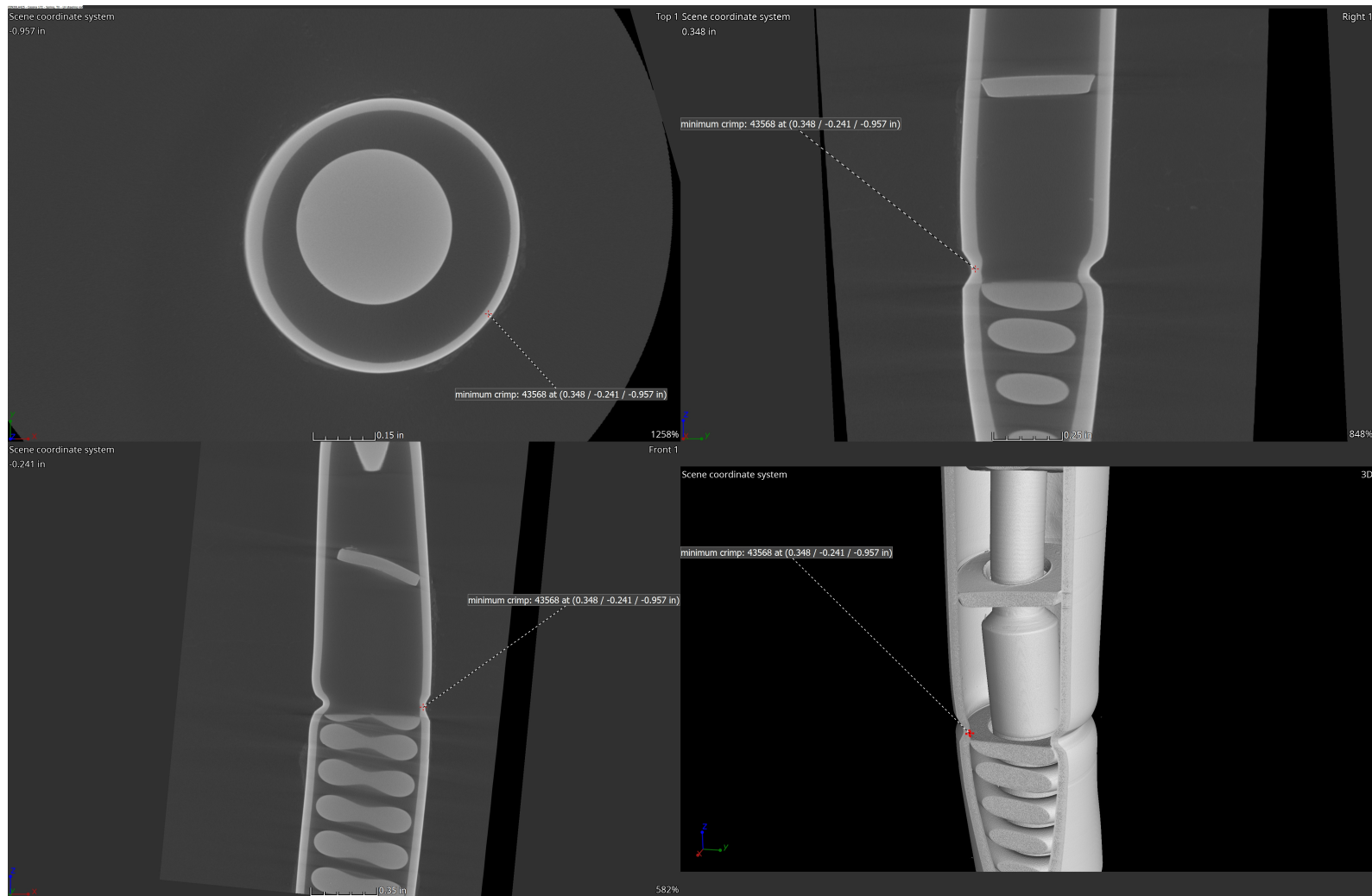


Figure 3
Left steering tube – minimum crimp location

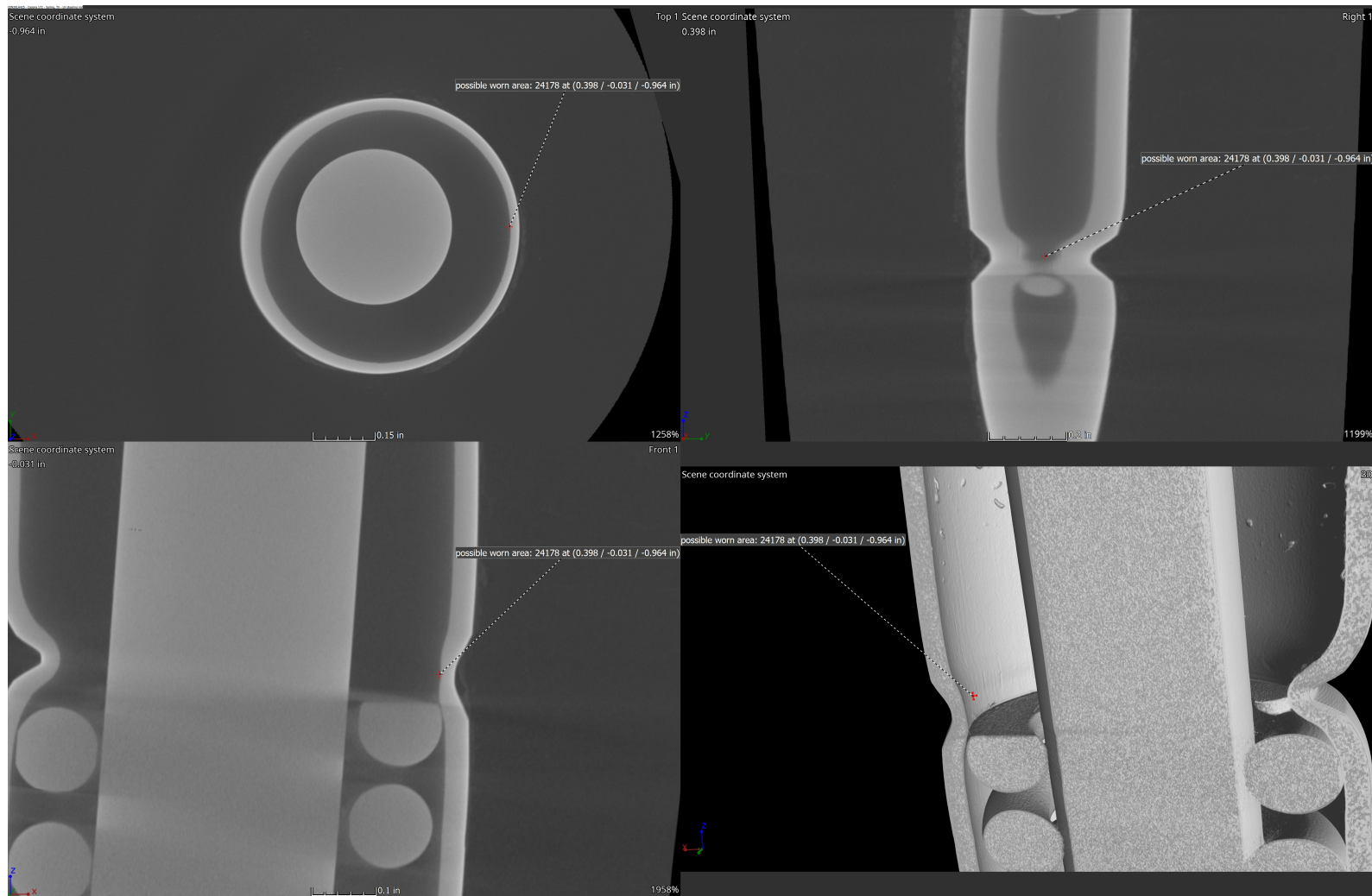


Figure 4
Left steering tube – possible worn area

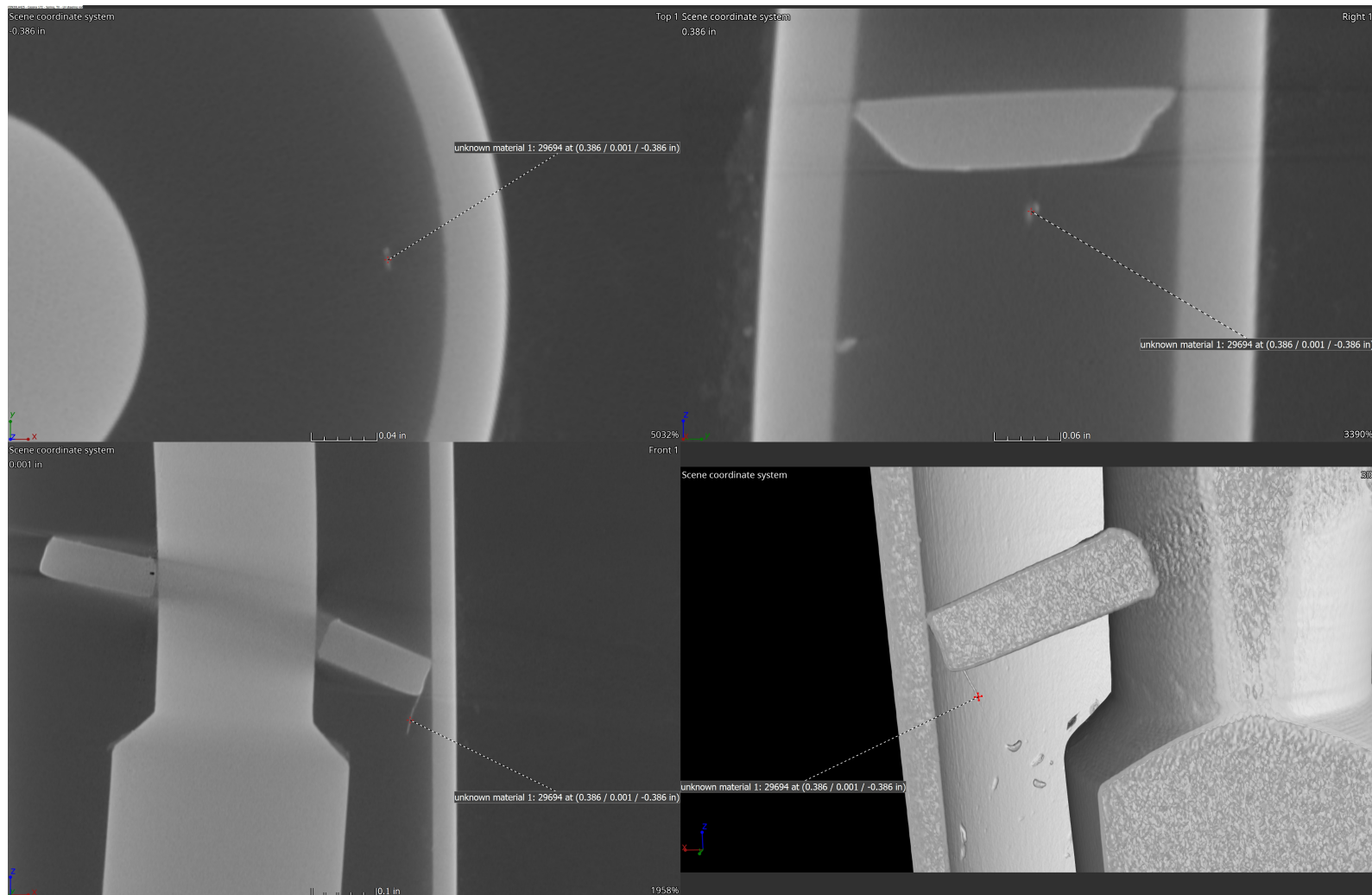


Figure 5
Left steering tube – unknown material 1

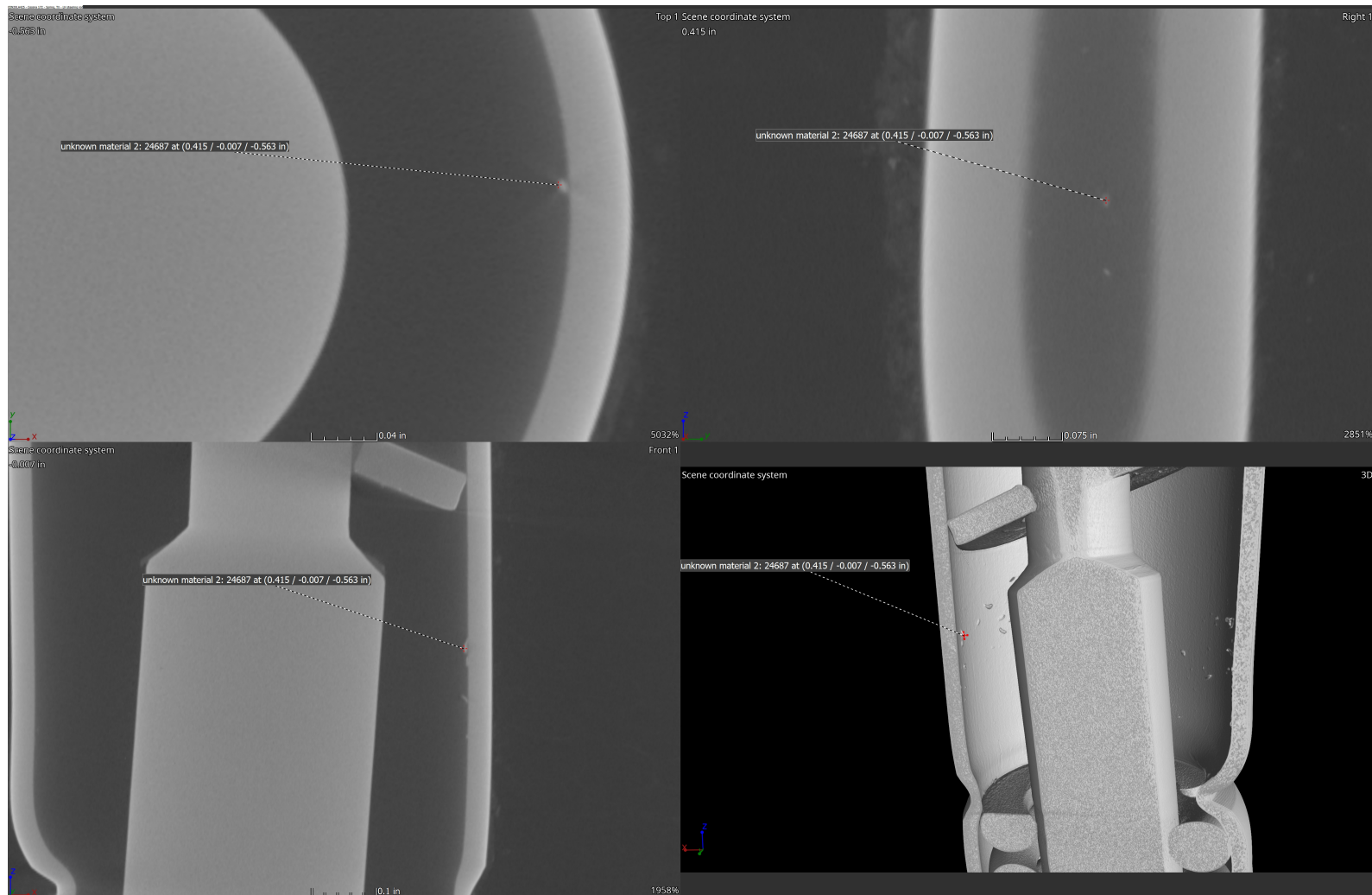


Figure 6
Left steering tube – unknown material 2

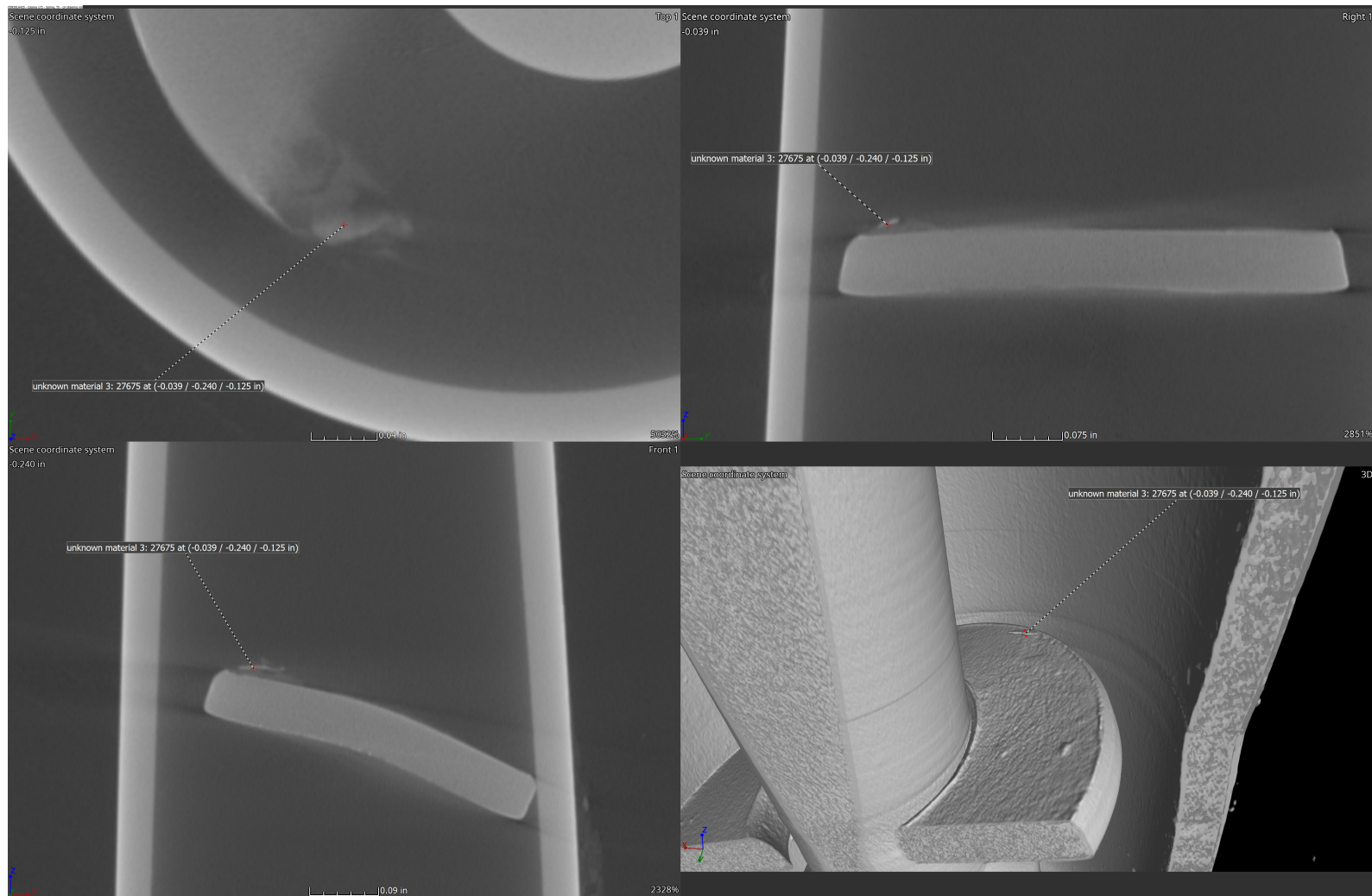


Figure 7
Left steering tube – unknown material 3

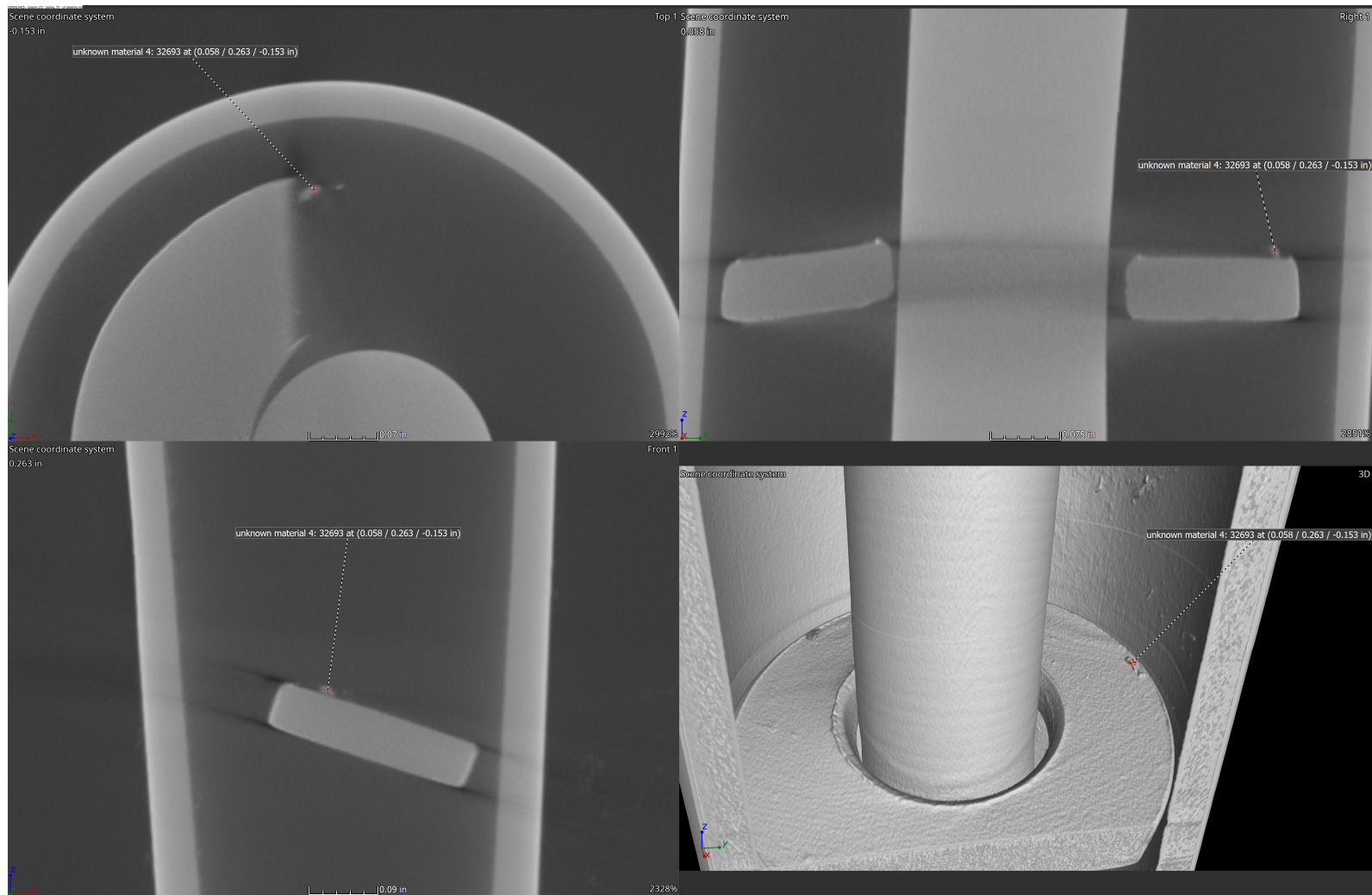


Figure 8
Left steering tube – unknown material 4

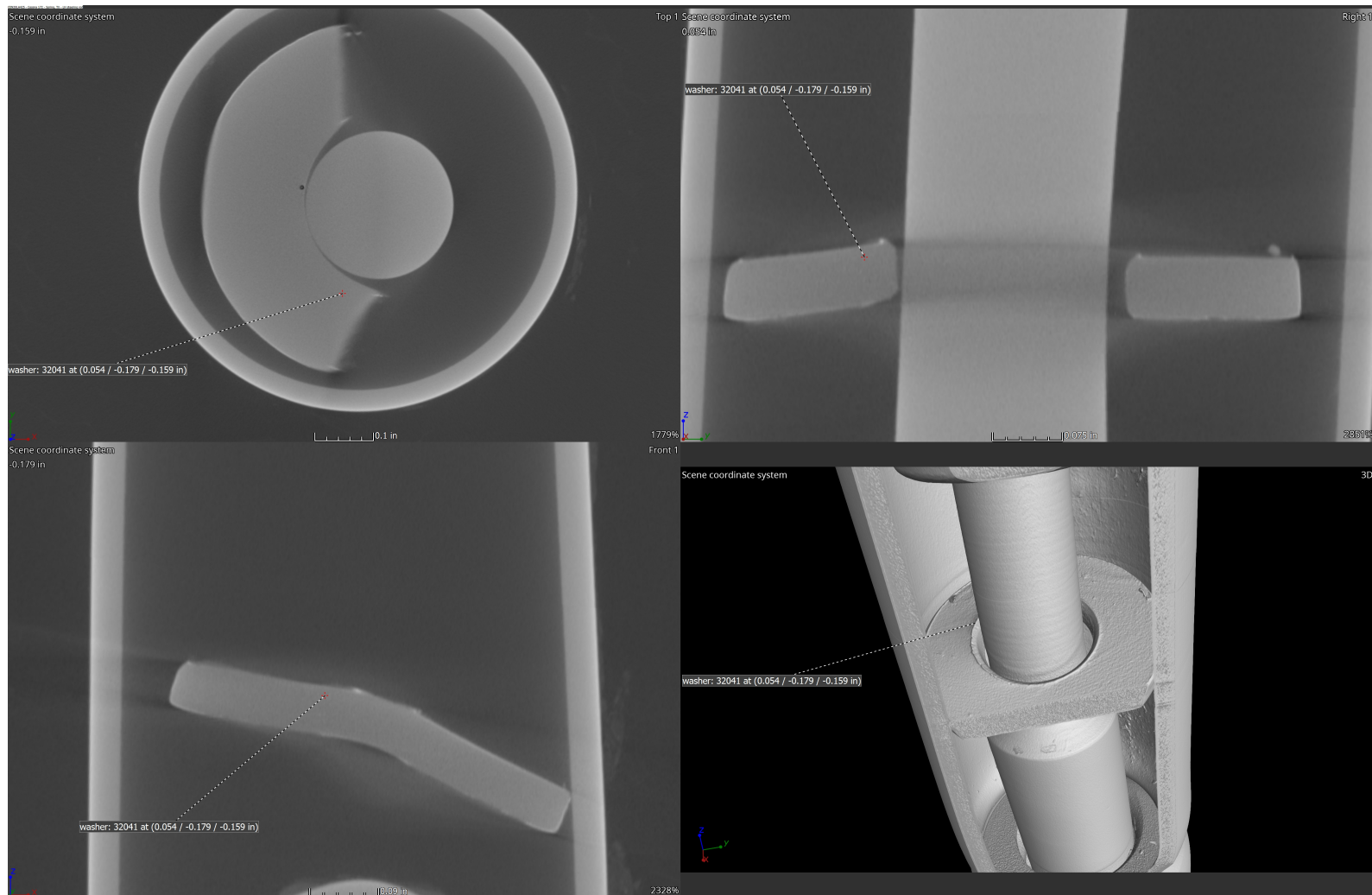


Figure 9
Left steering tube – washer

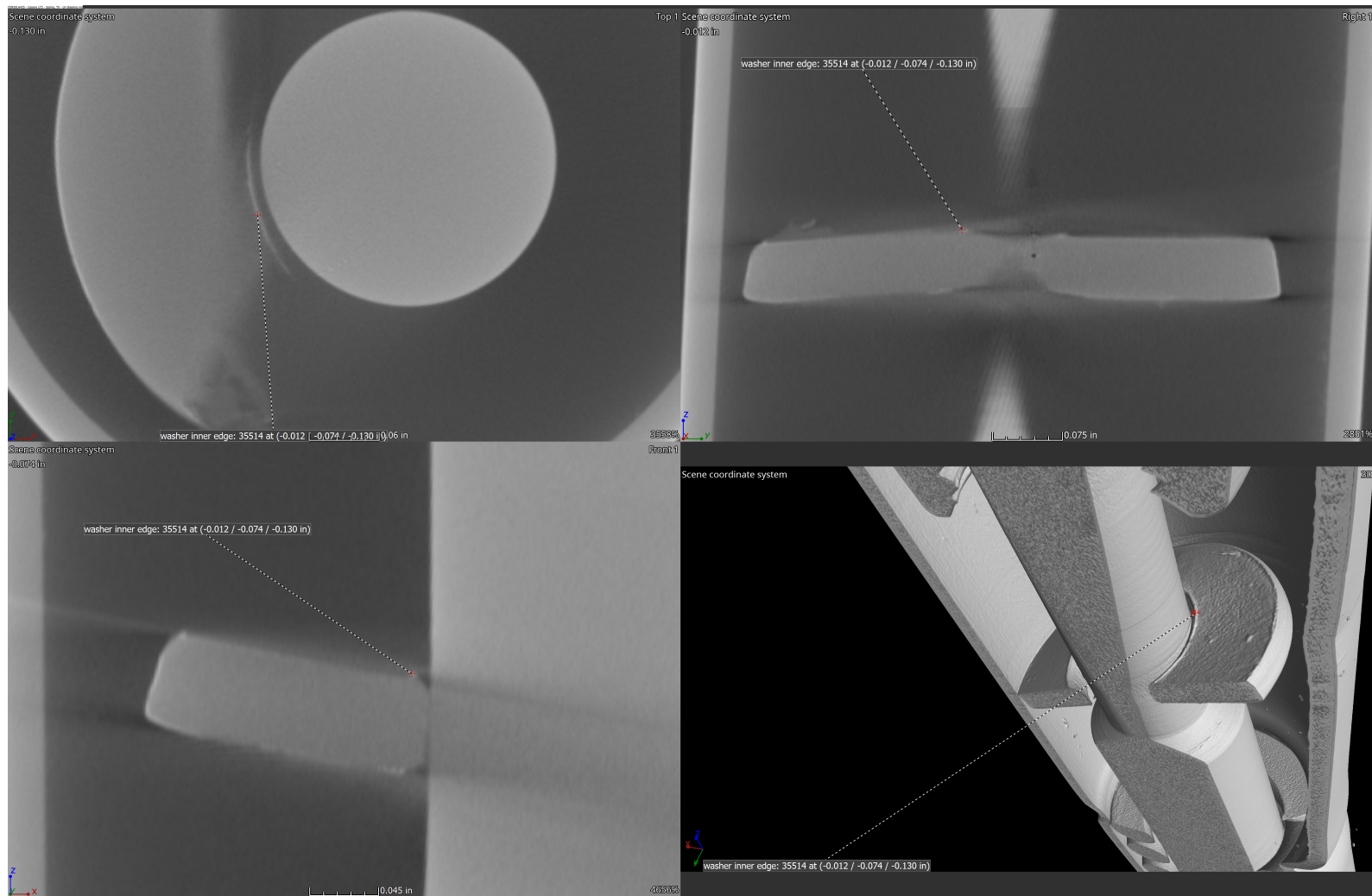


Figure 10
Left steering tube – washer inner edge

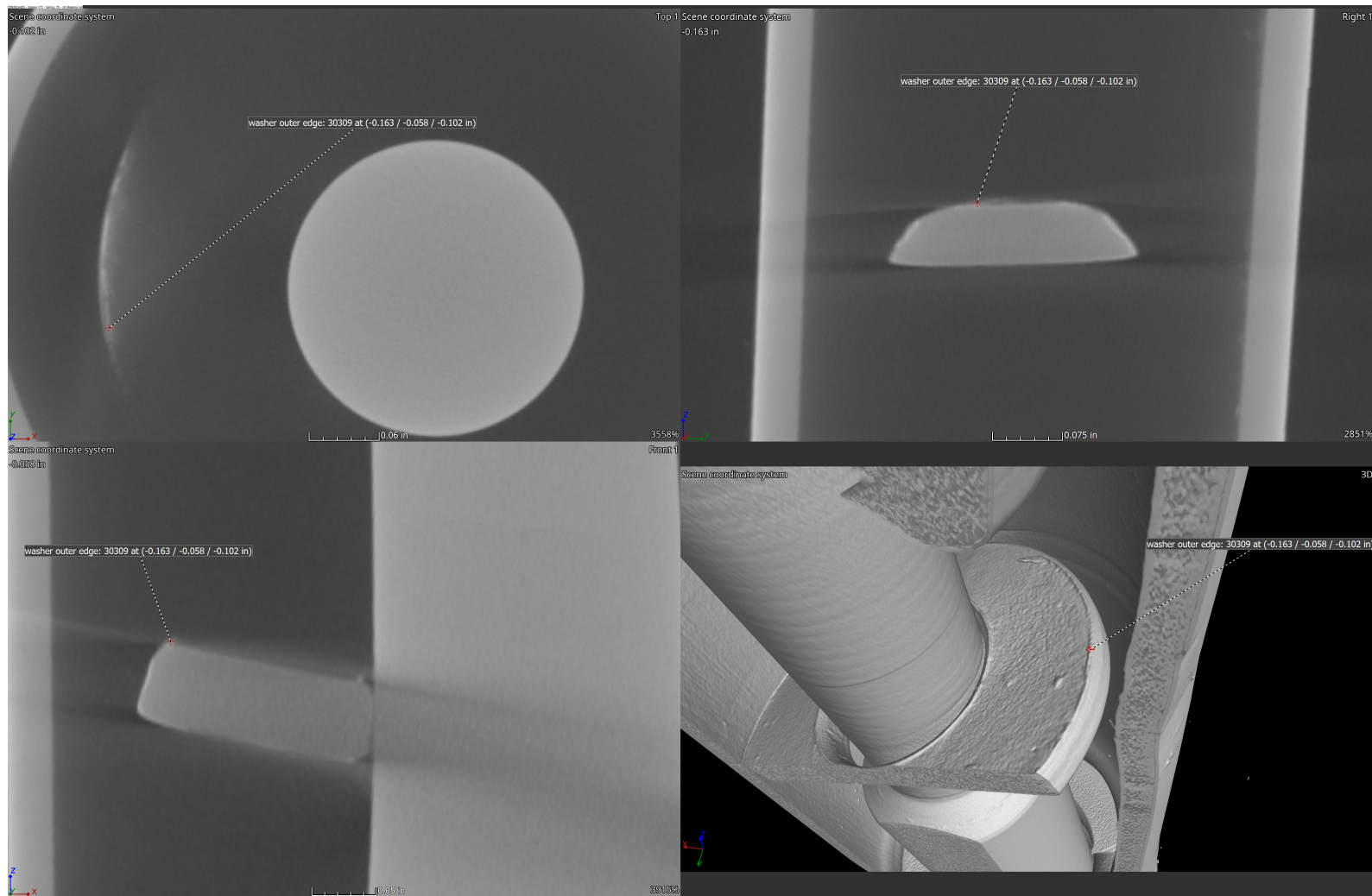


Figure 11
Left steering tube – washer outer edge

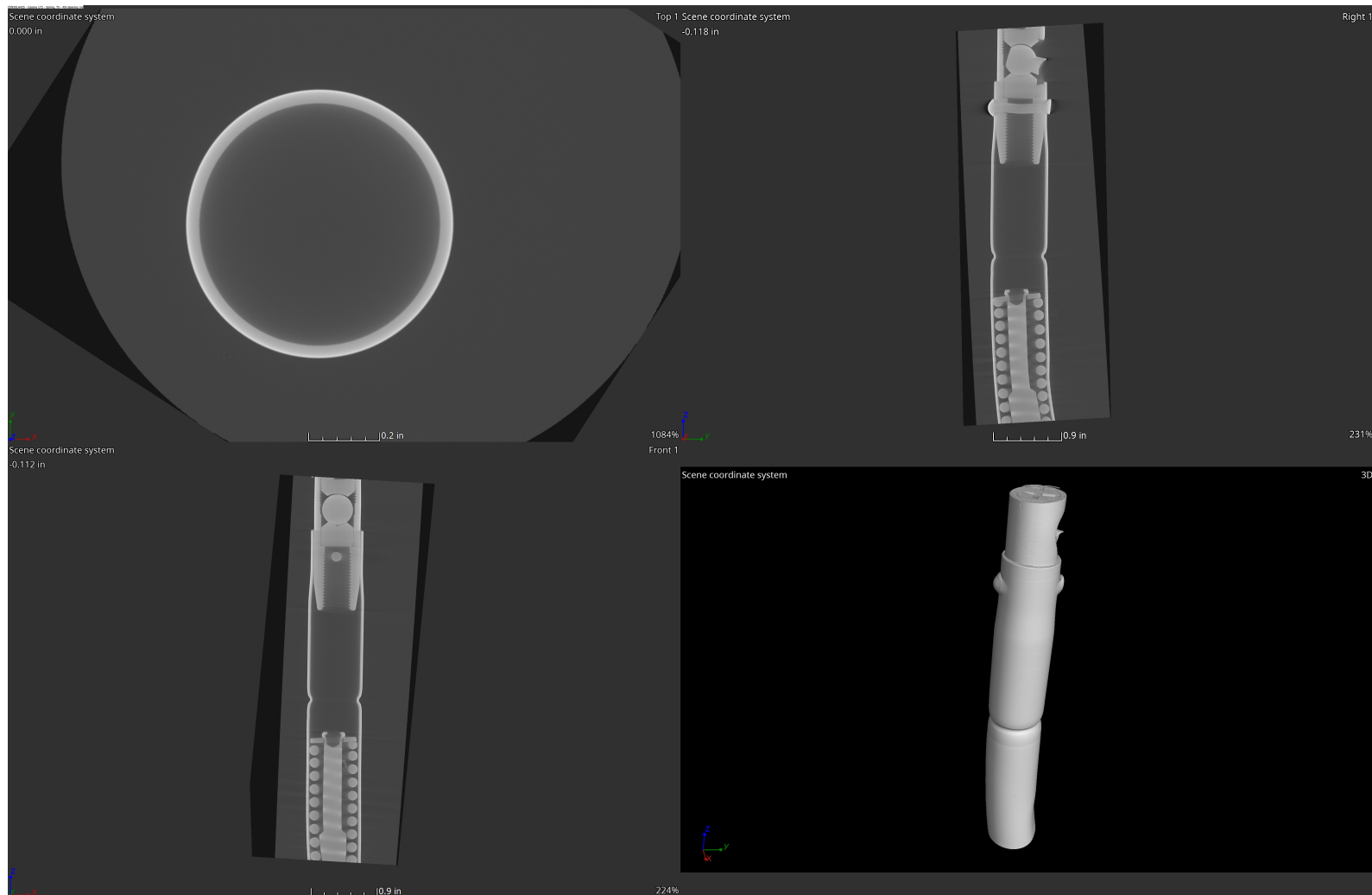


Figure 12
Right steering tube – overview

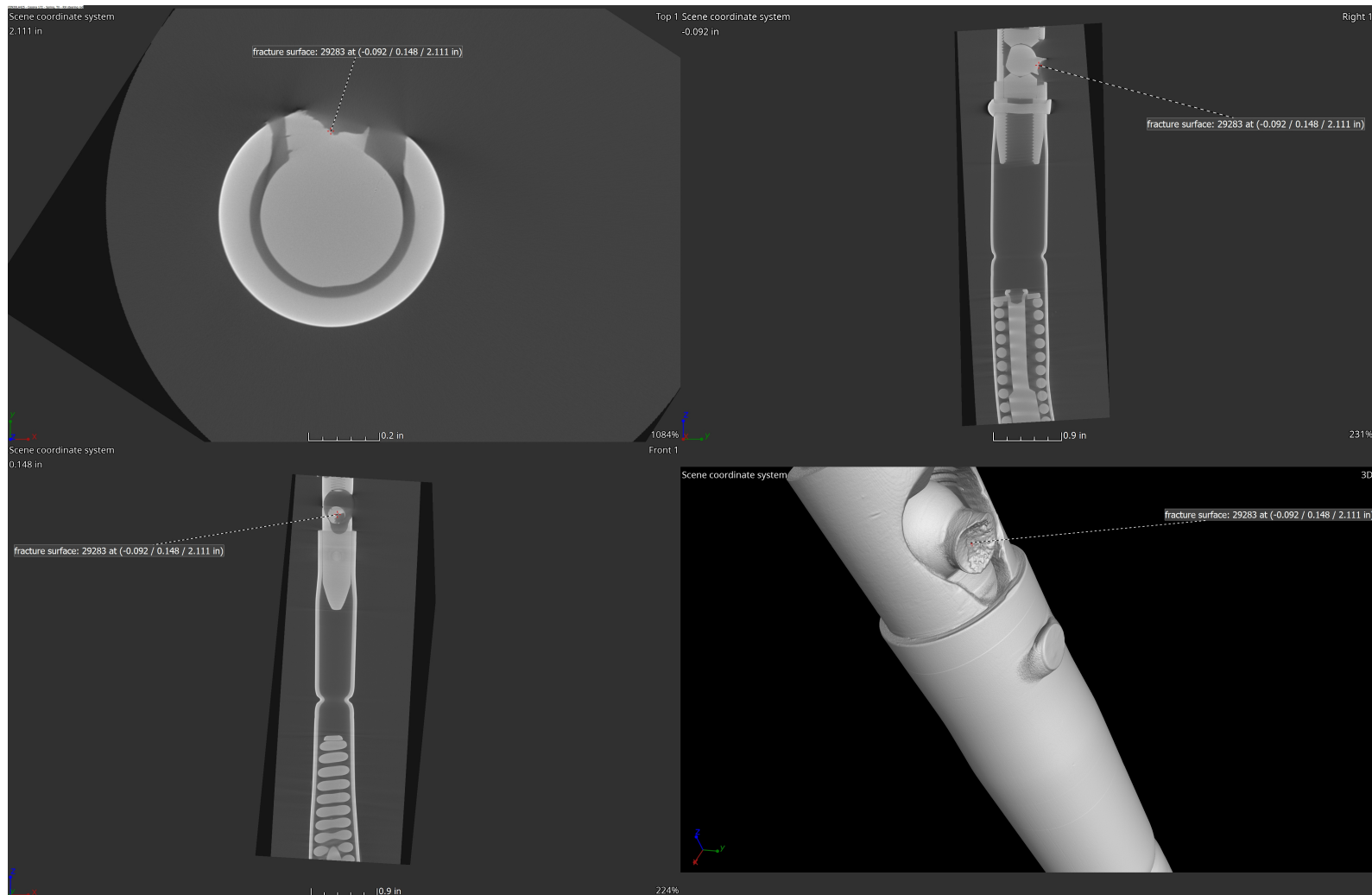


Figure 13
Right steering tube – fracture surface

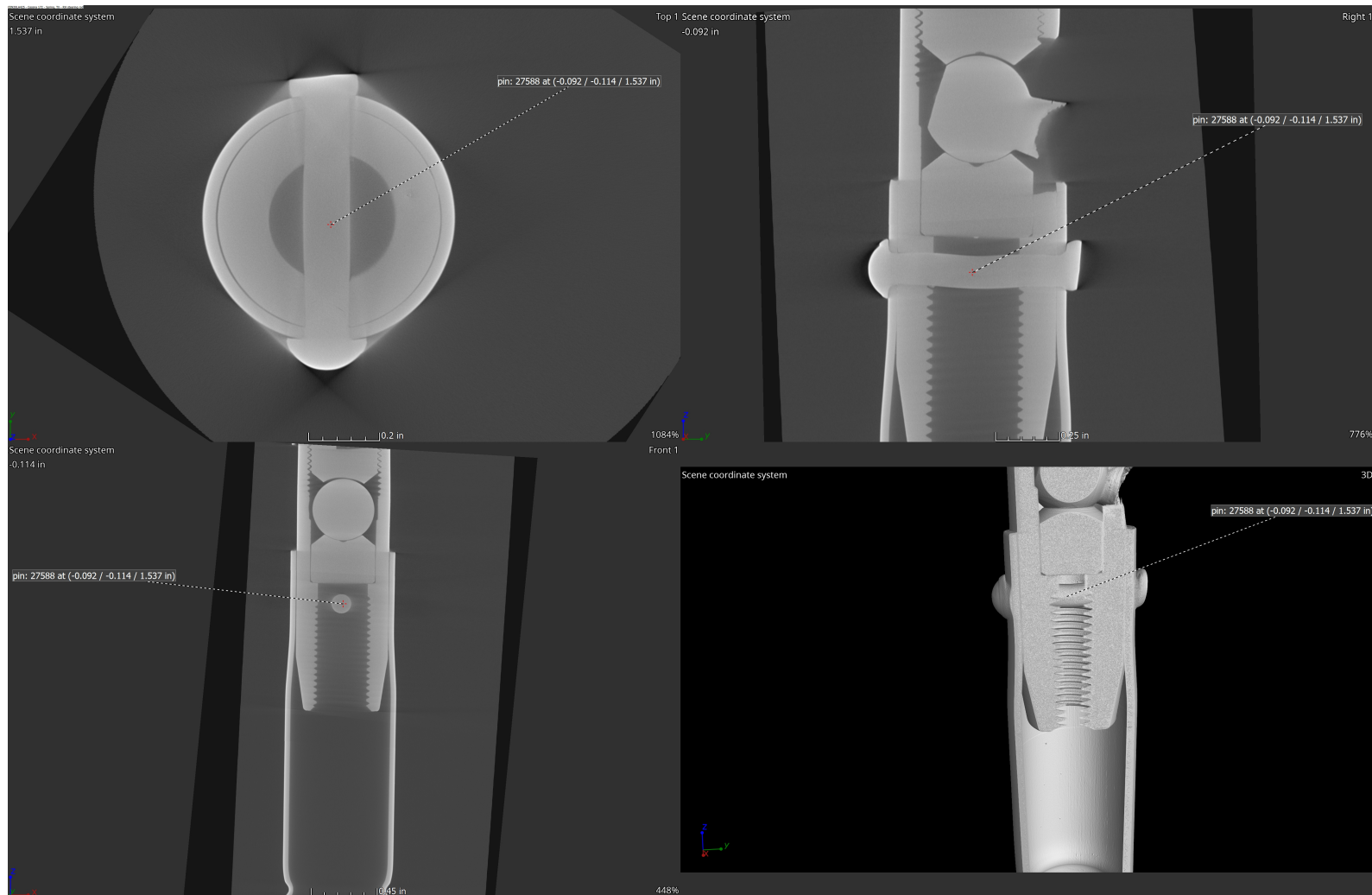


Figure 14
Right steering tube – pin

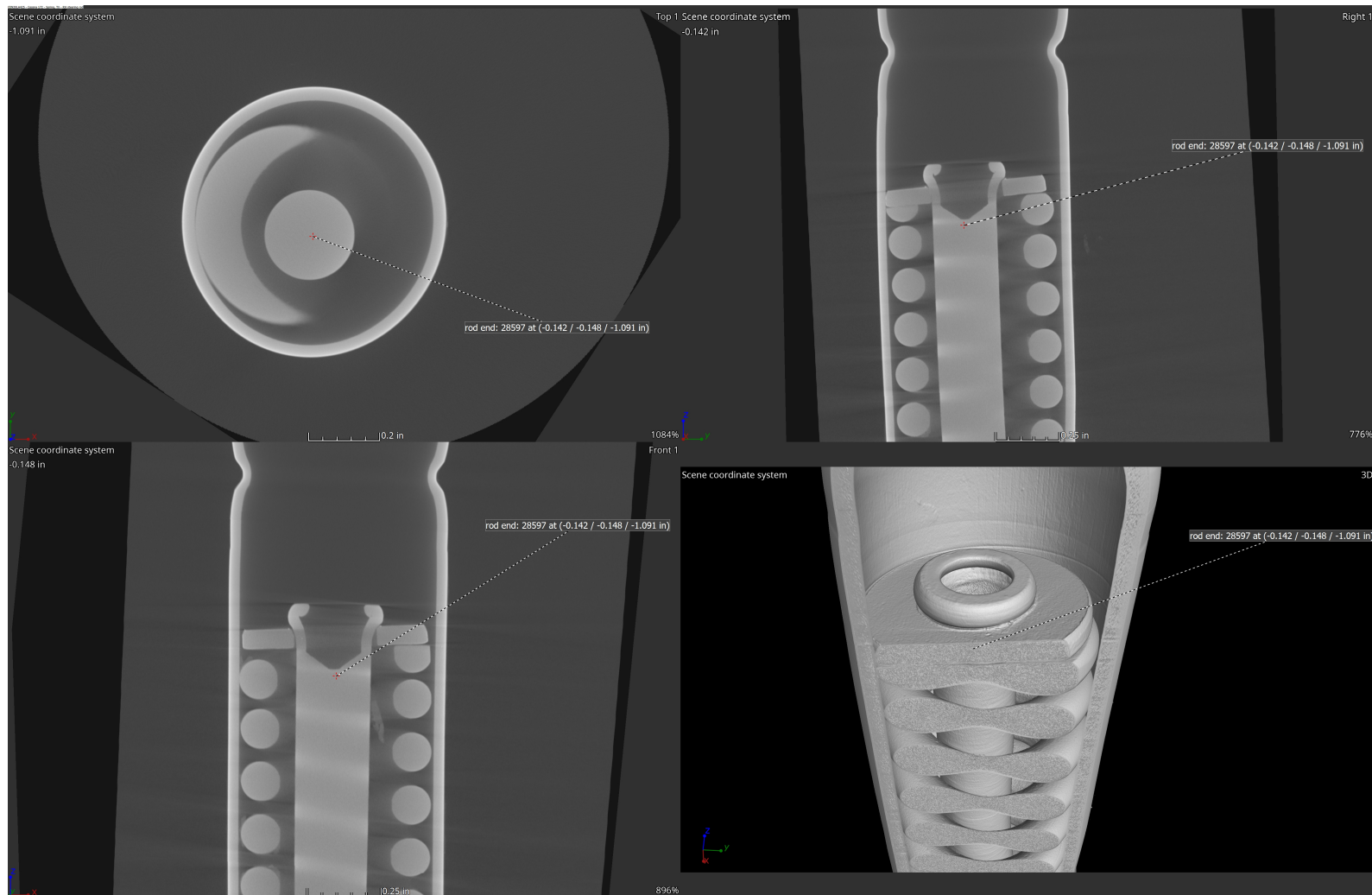


Figure 15
Right steering tube – rod end

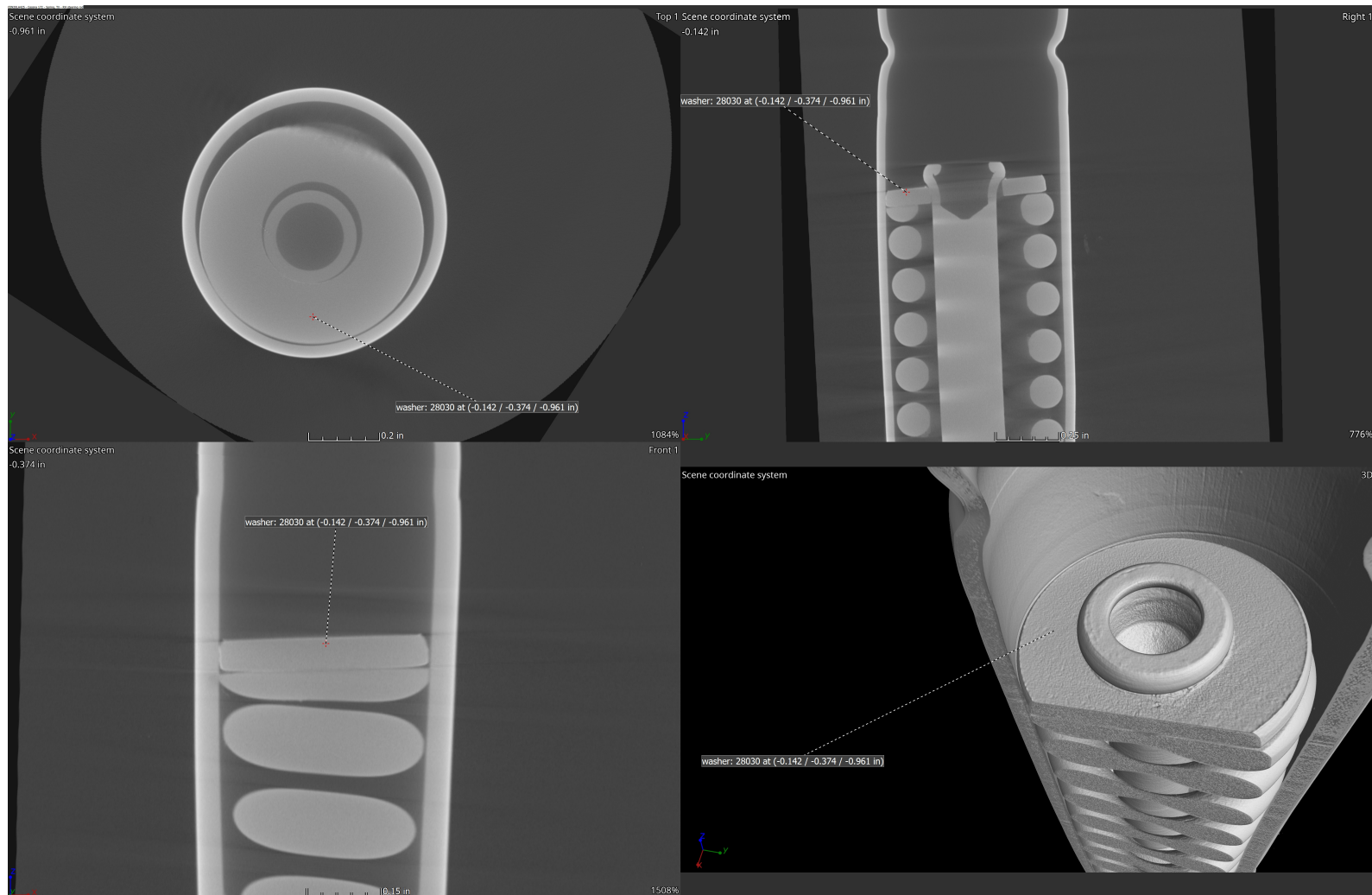


Figure 16
Right steering tube – washer

Scott Warren
Lead Aerospace Engineer
(Computed Tomography Specialist)