

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Aviation Safety
Washington, D.C. 20594

September 9, 2020

Computed Tomography Specialist's Factual Report

CEN20LA113

A. ACCIDENT

Location: Clark, Missouri
Date: March 4, 2020
Time: 1842 central standard time
Airplane: Bell 206 L1 helicopter, N32AE

B. GROUP

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

C. SUMMARY

On March 4, 2020, about 1842 central standard time, a Bell 206 L1 helicopter, N32AE, impacted terrain during a forced landing following an inflight loss of engine power near Clark, Missouri. The commercial pilot, two crew members, and one patient were uninjured. The helicopter tailboom sustained substantial damage during the autorotation. The helicopter was registered to and operated by Air Evac EMS Inc. as a Title 14 Code of Federal Regulations Part 135 helicopter air ambulance patient transfer flight. Night visual meteorological conditions prevailed in the area about the time of the accident, and the flight was operated on a company visual flight rules flight plan. The flight originated from the Northeast Regional Medical Center Heliport, near Kirksville, Missouri, about 1812 and was destined for the Boone Hospital Center Heliport, near Columbia, Missouri.

The internal configuration of an engine pressure measurement tube weld was documented using radiographic images that were collected from May 14-18, 2020 in Chicago, Illinois. A total of 2,201 computed tomography (CT) slice images were examined, processed, and analyzed by the NTSB to evaluate the components.

Review of the images determined that there were indications of three voids within the tube weld area. The void indications ranged in diameter from 0.0019 to 0.0026 inches.

D. DETAILS OF THE INVESTIGATION

1.0 General

The internal configuration of an engine pressure measurement tube weld was subjected to x-ray radiograph and computed tomography (CT) scanning to document its internal conditions. The scanning was conducted from May 14-18, 2020 by Varex, Inc under the direction of the NTSB using the Actis 500/225 micro focus system.

For the CT scans, the component was loaded into the imaging unit and placed on a turntable. The component was 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 component was scanned in two sections – the tube weld area and the “cut end” of the tube. The “cut end” of the tube was scanned to provide reference landmarks for any internal features noted in the tube weld area. In addition, a fine wire was attached to the outside of the tube and included in the weld area scan. This fine wire also provided a reference point for any internal features.

The component was scanned using a total of 2,201 slices, and the total size of the combined data sets was approximately 17.2 GB. The complete scan protocol is 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 component.

Table 1
Scan Protocol

Component	Annunciator panel
Number of slices	2201
Voxel ¹ Size - X Direction (mm)	0.0048
Voxel Size - Y Direction (mm)	0.0048
Voxel Size - Z Direction (mm)	0.005
Image Projections per Revolution	1800
Exposure time (ms)	285.61
Frames to Avg (frames per projection)	2
X-ray Source Voltage (kV)	210
X-ray Source Current (mA)	0.375
Source Filter Thickness (mm)	1
Source Filter Material	Brass
Image Matrix Size	2048 x 2048

The data set of slice images was 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 component 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 component 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 component are shown in figures 1 through 12. Review of the images determined that there were indications of three voids within the tube weld area. The void indications ranged in diameter from 0.0019 to 0.0026 inches.

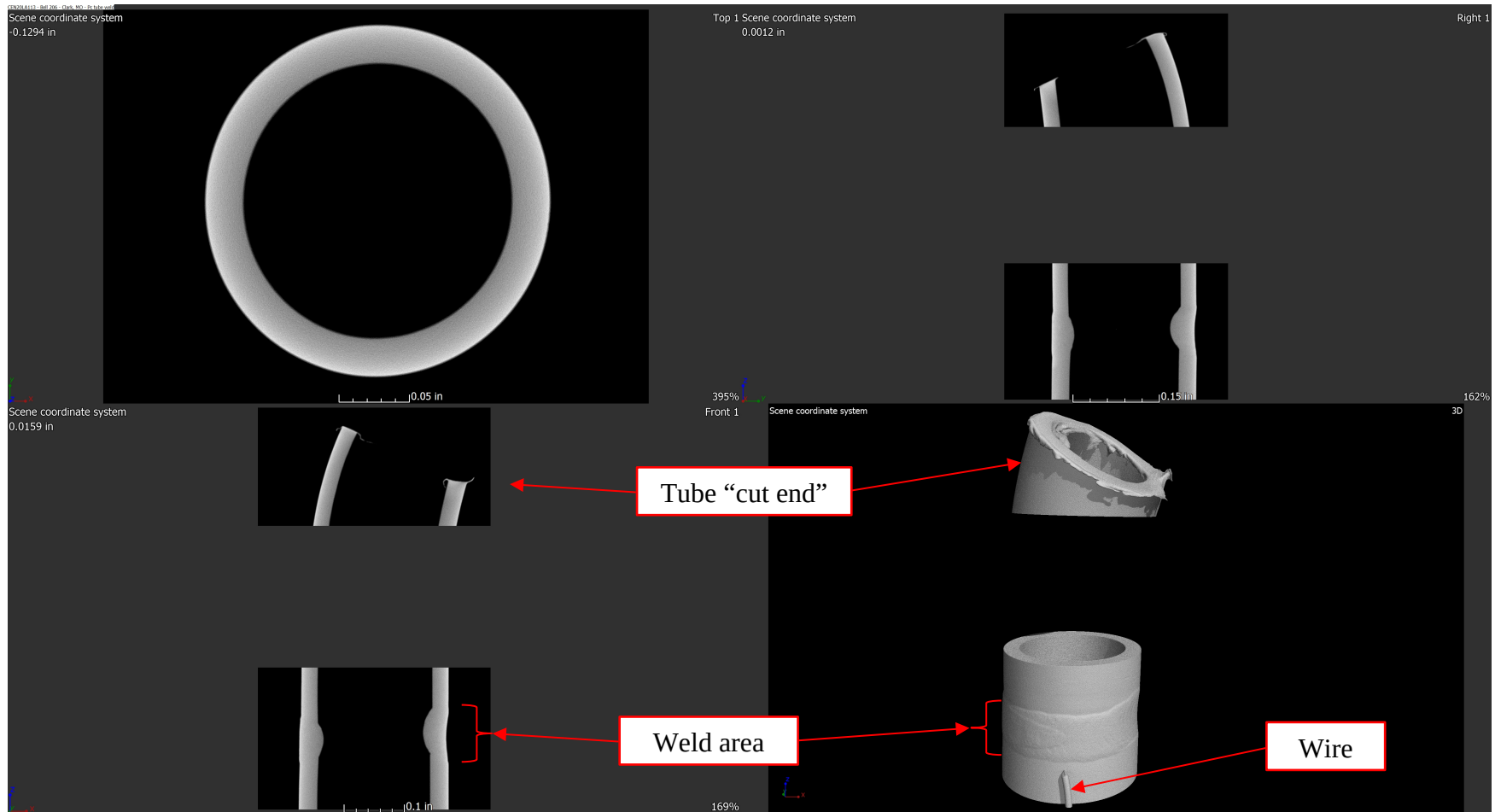


Figure 1
Engine pressure measurement tube weld - overview

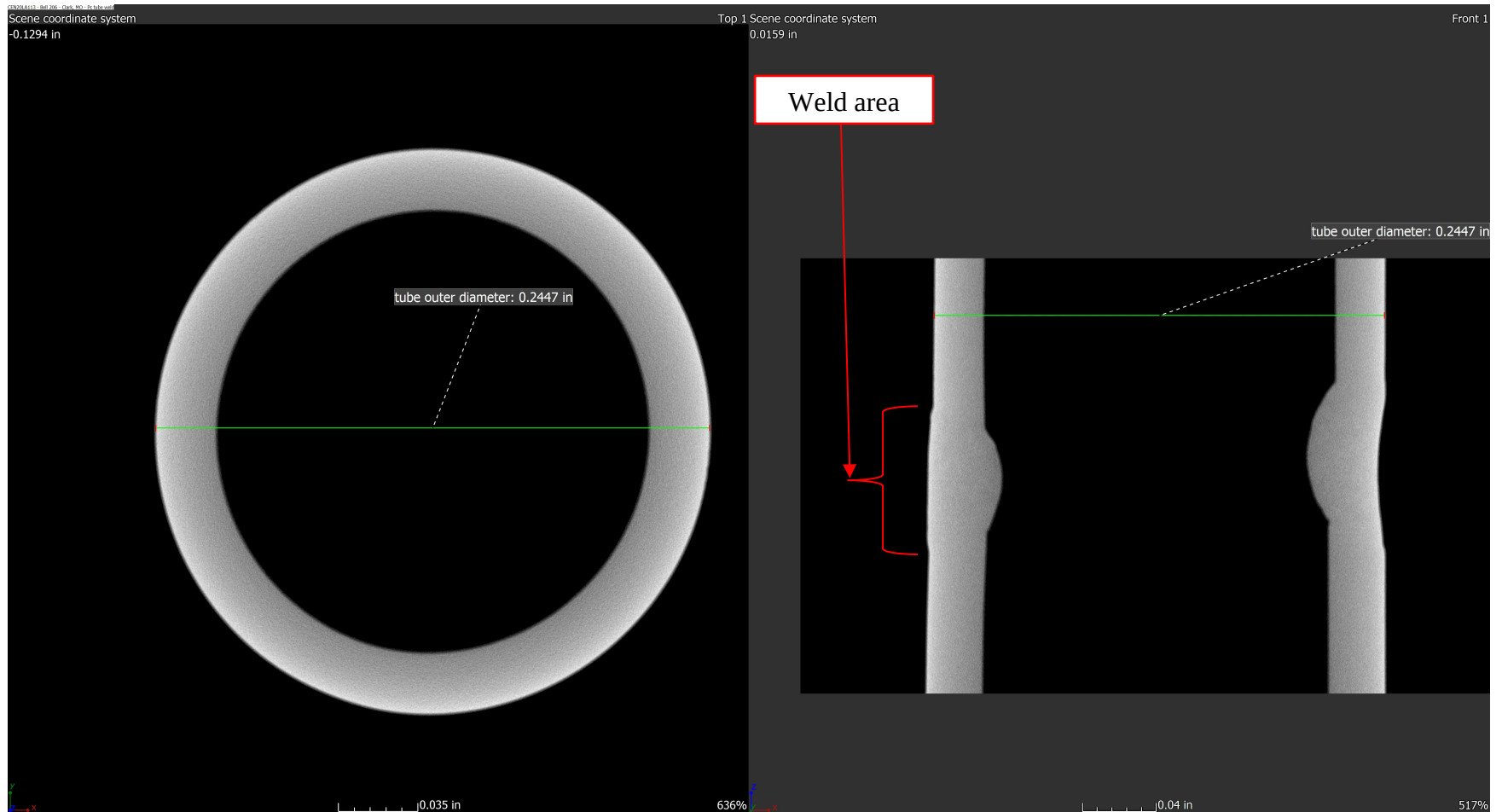


Figure 2
Engine pressure measurement tube weld – tube outer diameter

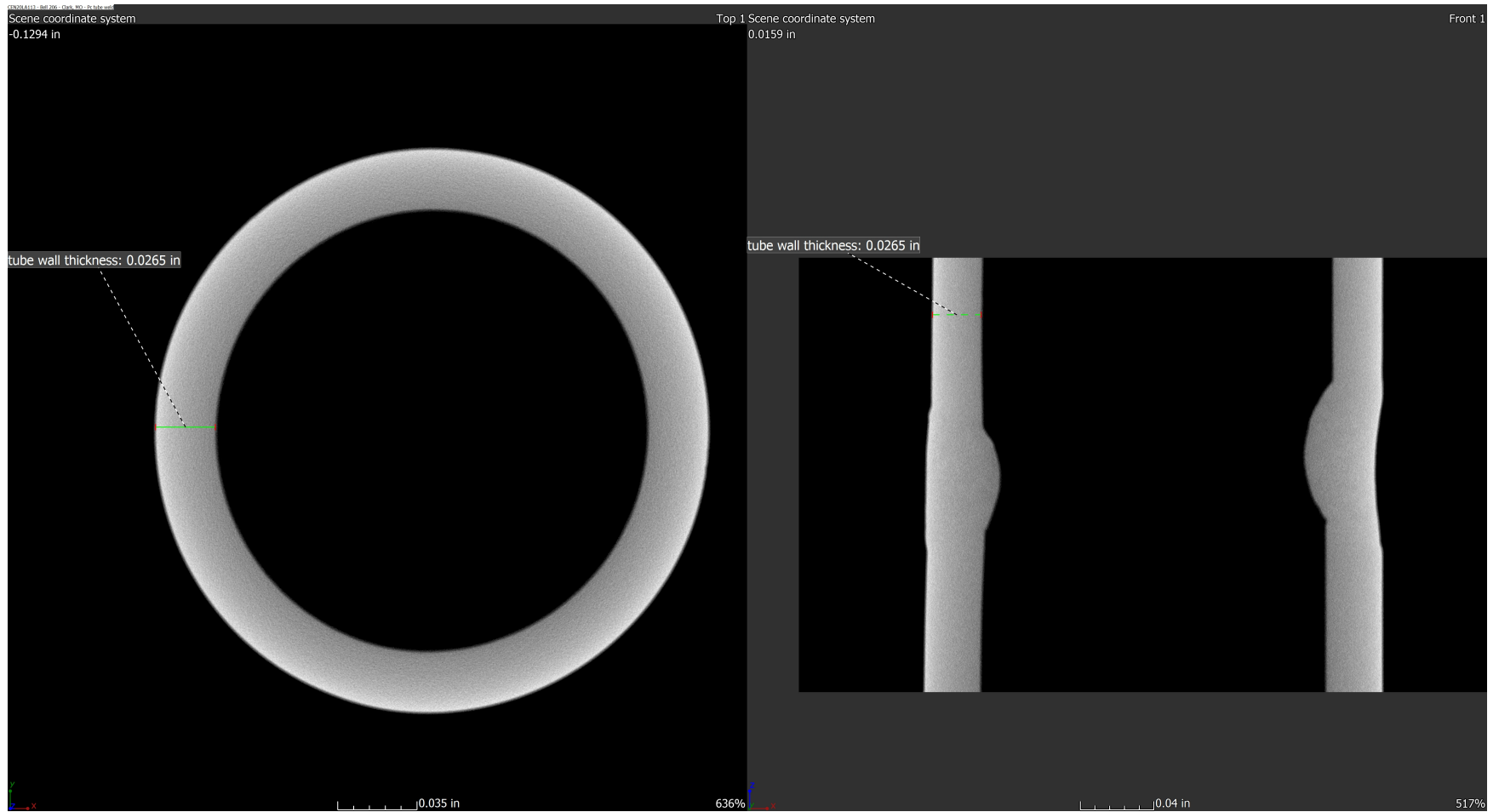


Figure 3
Engine pressure measurement tube weld – tube wall thickness

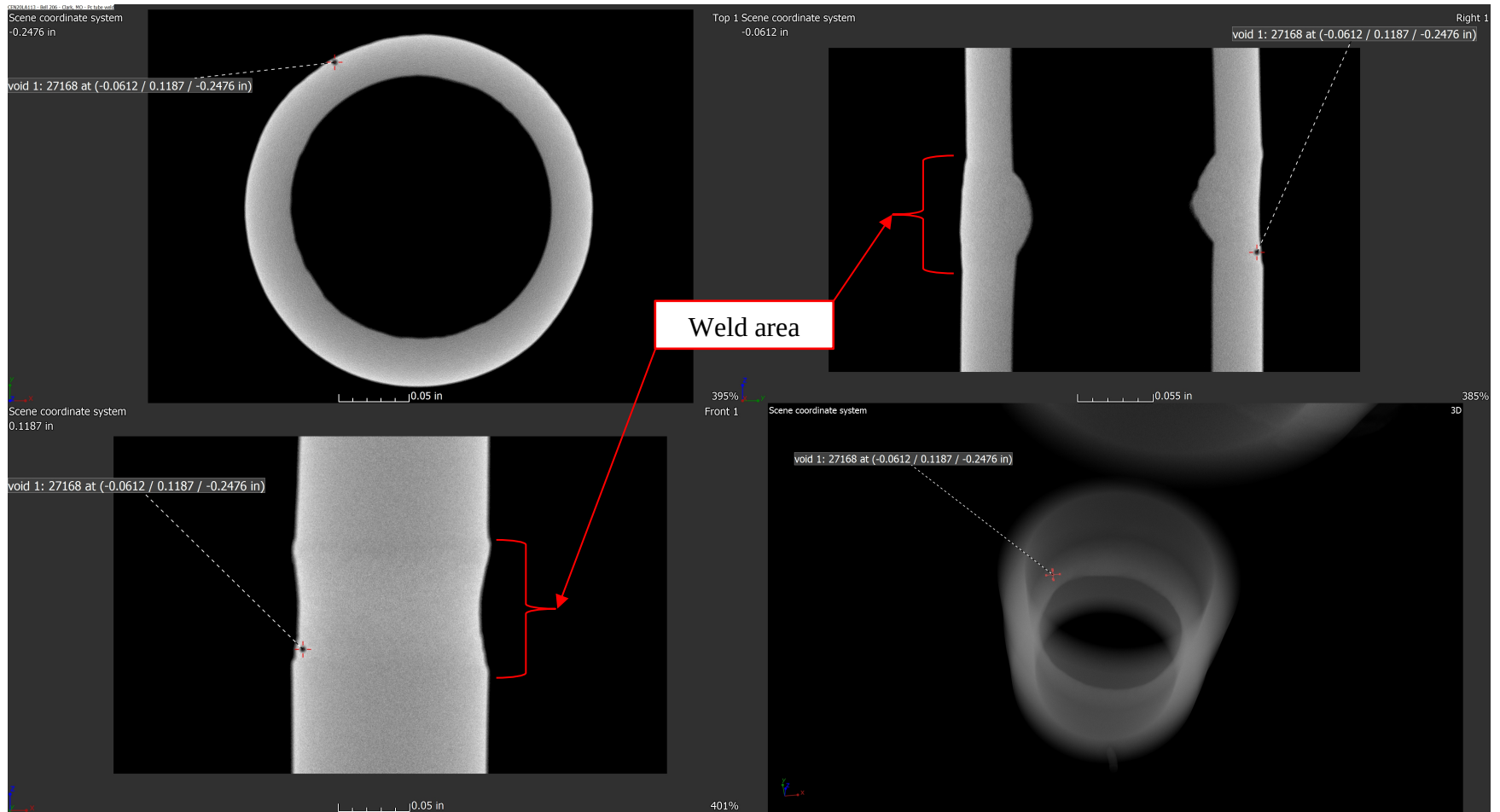


Figure 4
Engine pressure measurement tube weld – void 1 overview

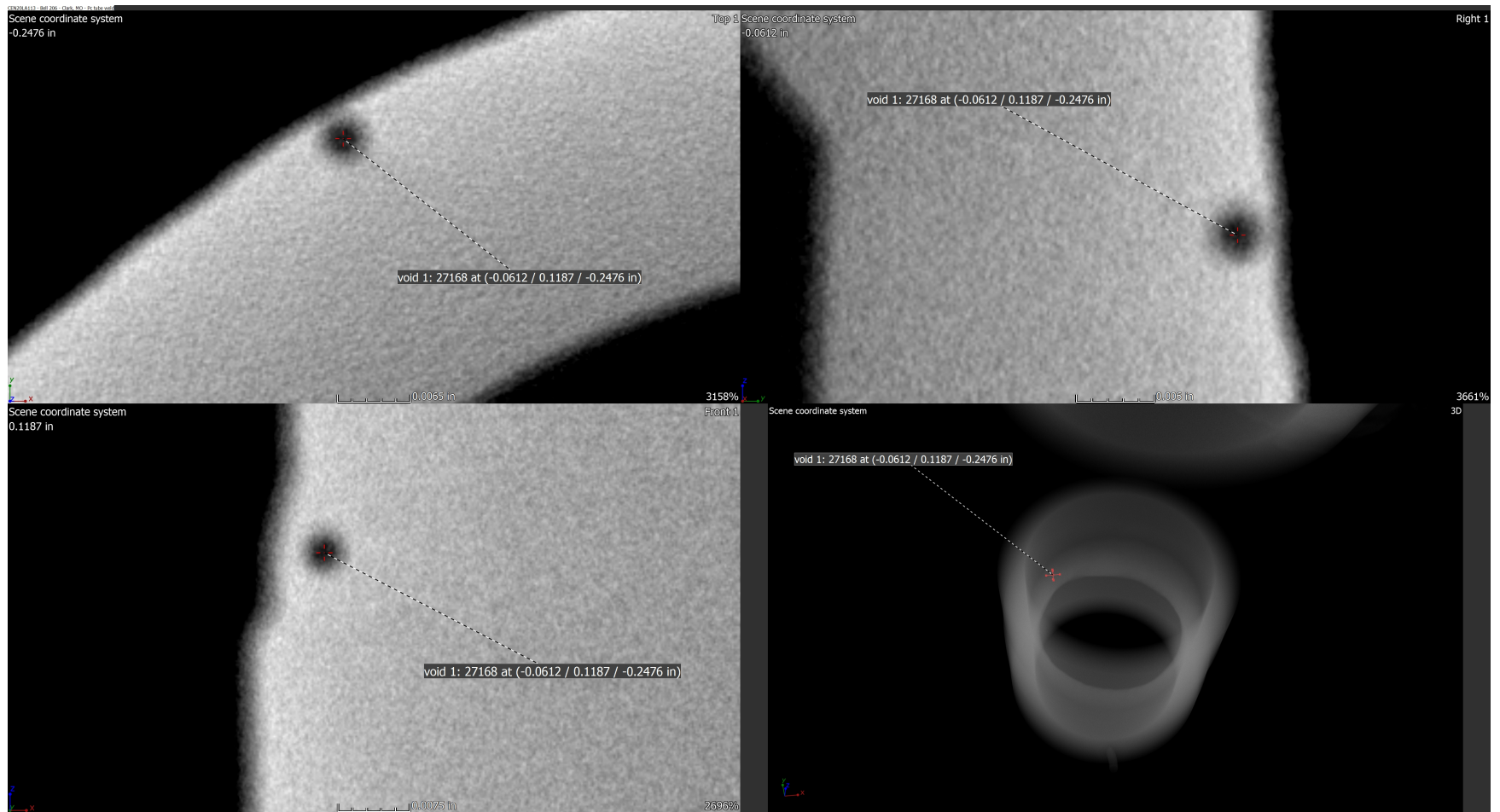


Figure 5
Engine pressure measurement tube weld – void 1 close up view

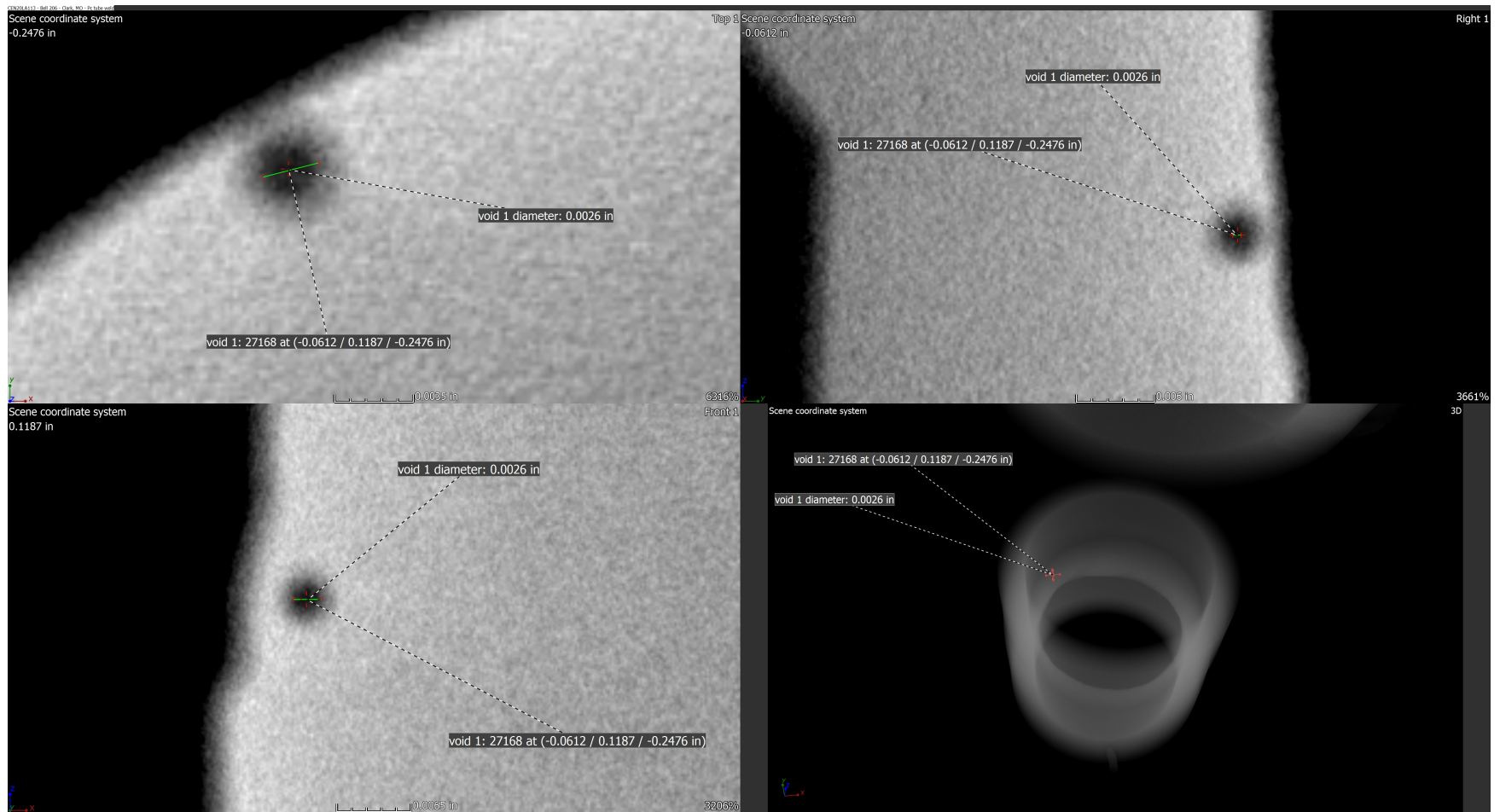


Figure 6
Engine pressure measurement tube weld – void 1 diameter

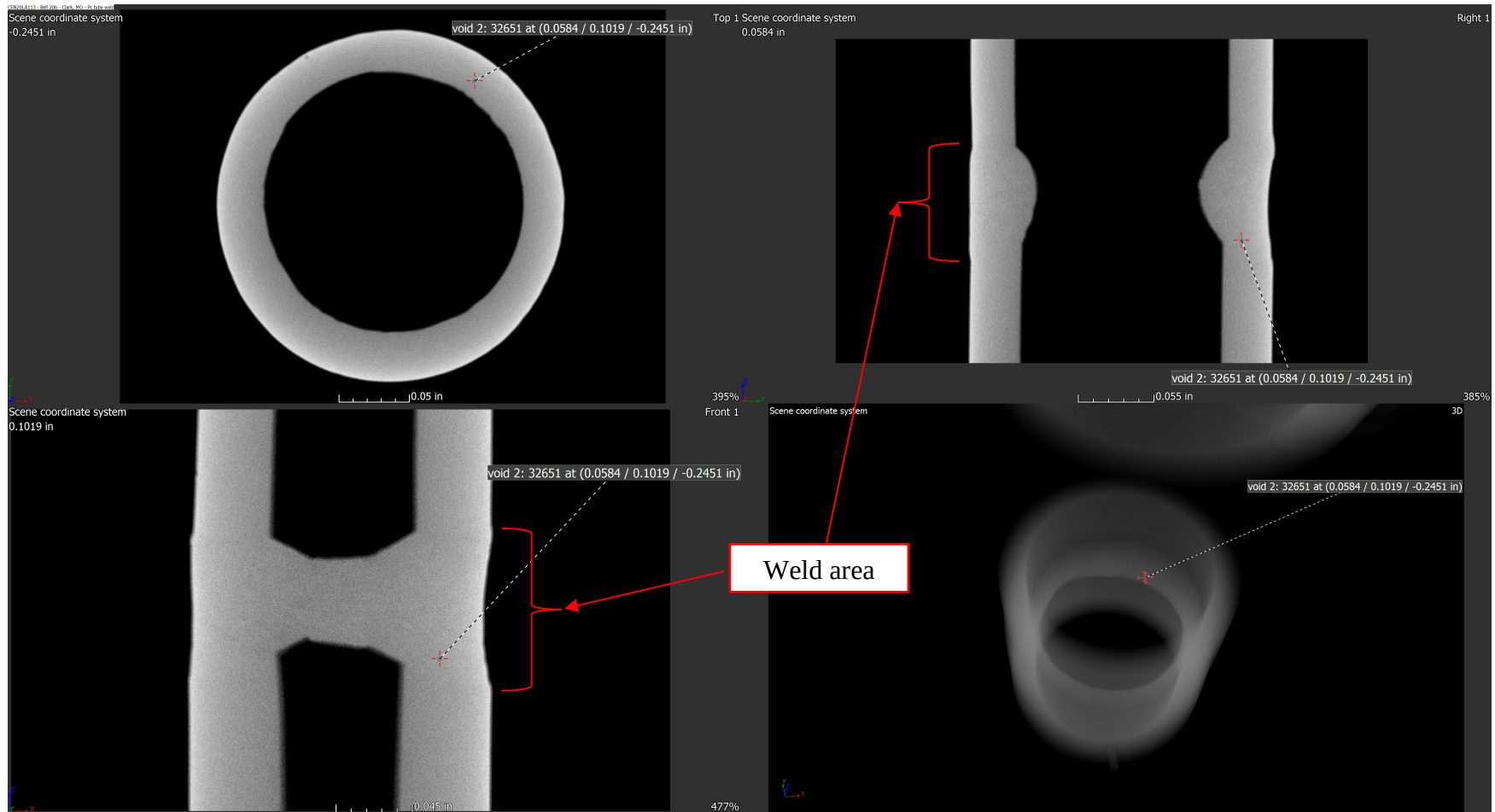


Figure 7
Engine pressure measurement tube weld – void 2 overview

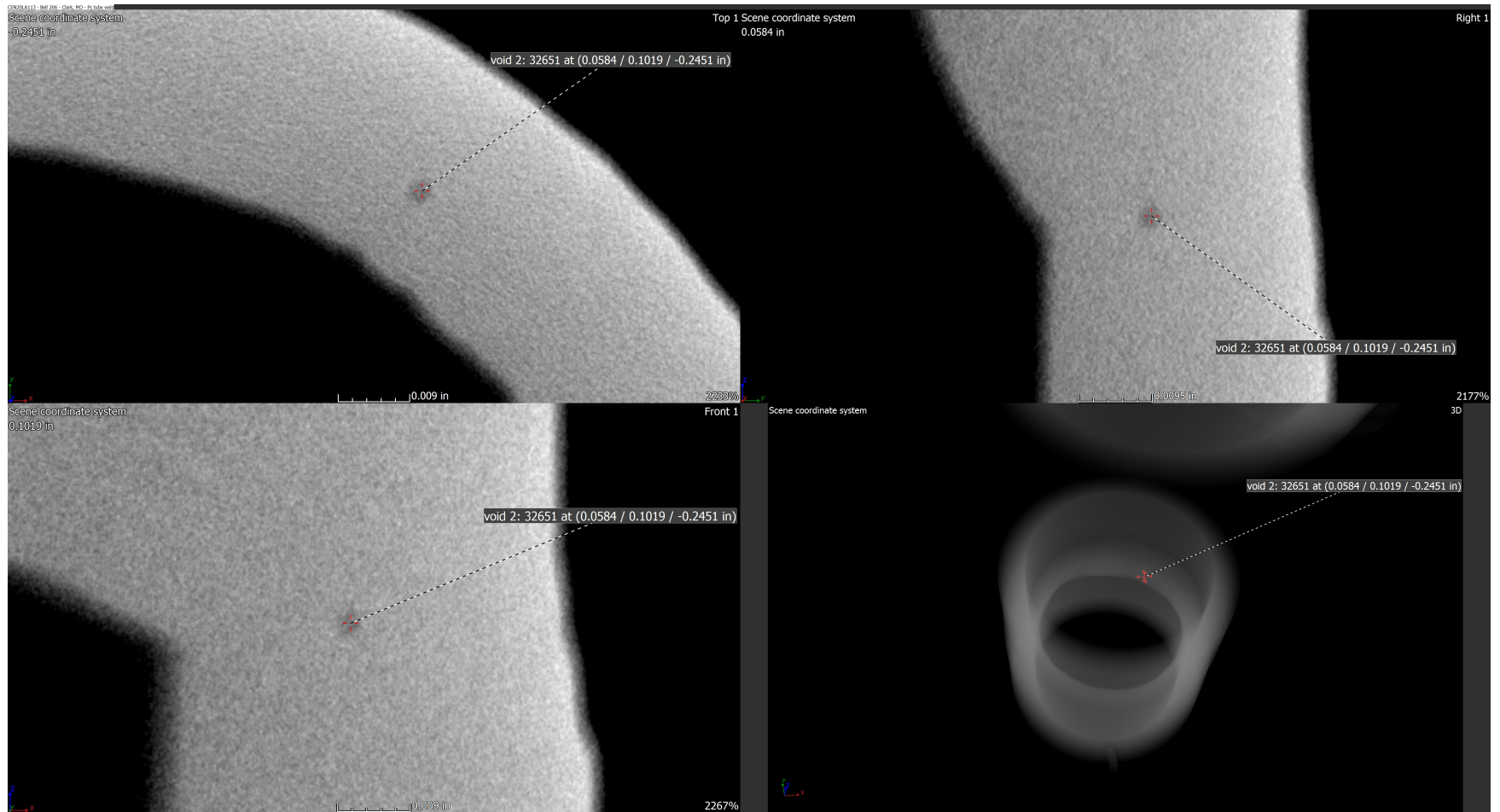


Figure 8
Engine pressure measurement tube weld – void 2 close up view

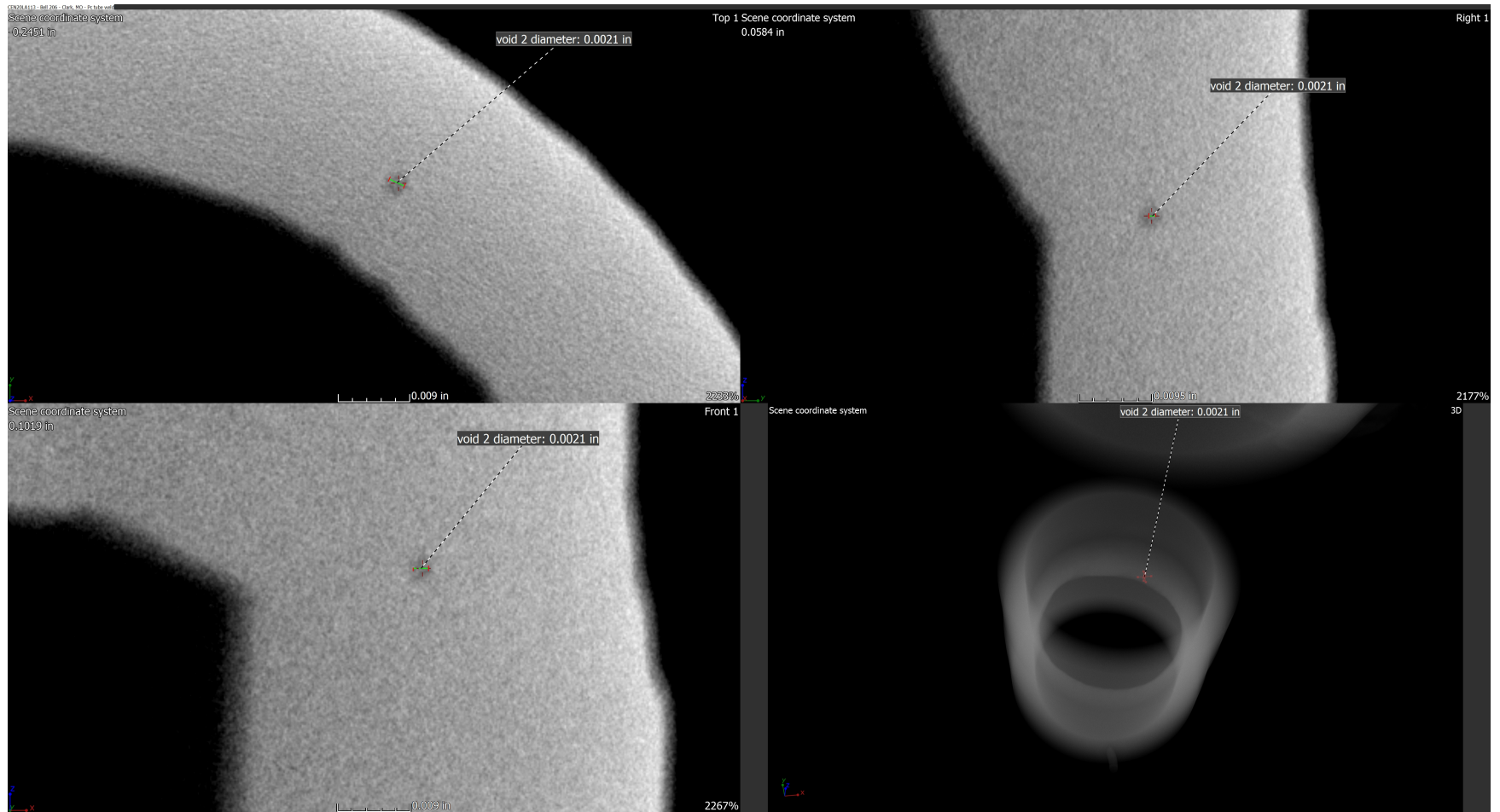


Figure 9
Engine pressure measurement tube weld – void 2 diameter



Figure 10
Engine pressure measurement tube weld – void 3 overview

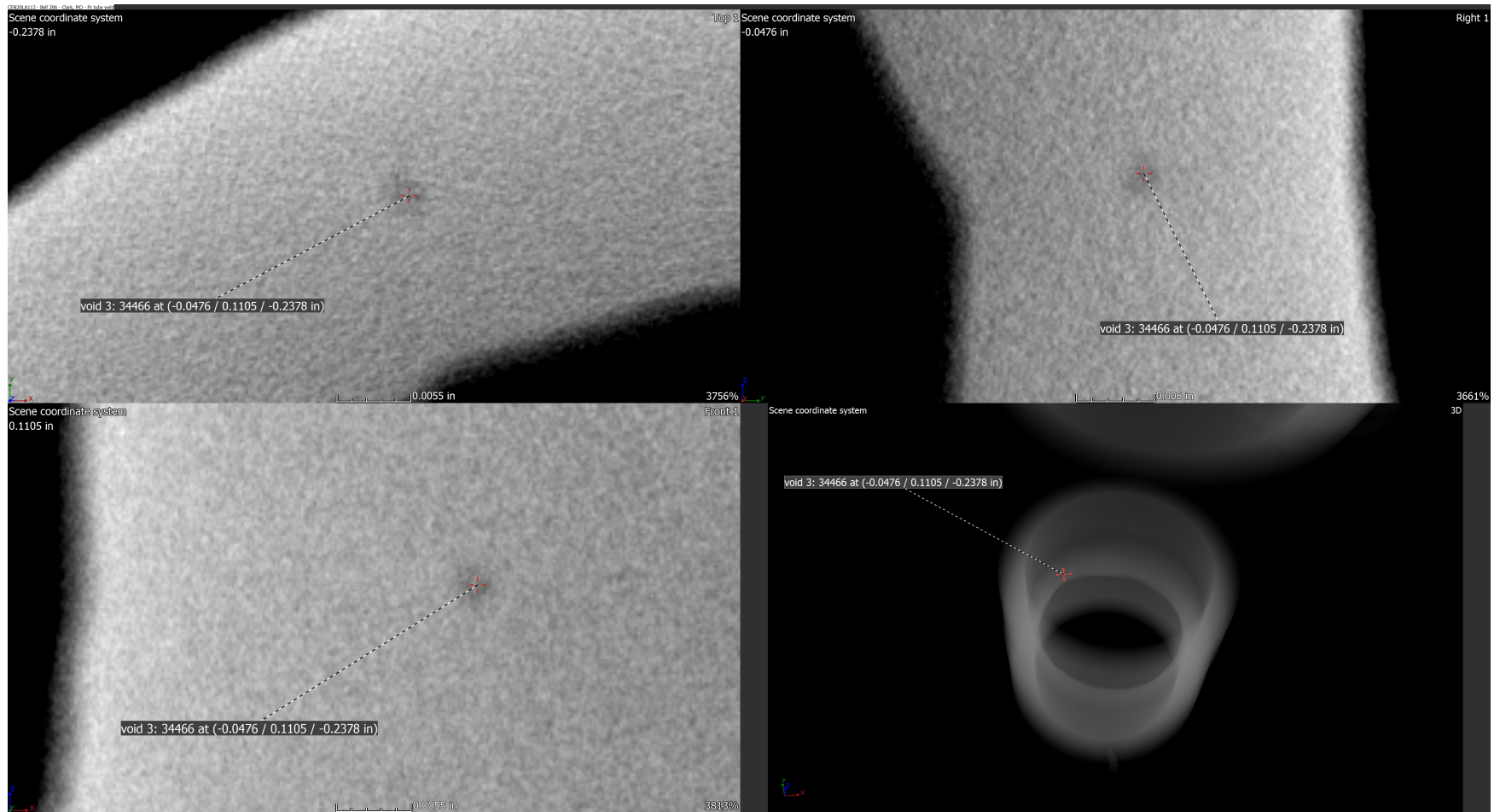


Figure 11
Engine pressure measurement tube weld – void 3 close up view

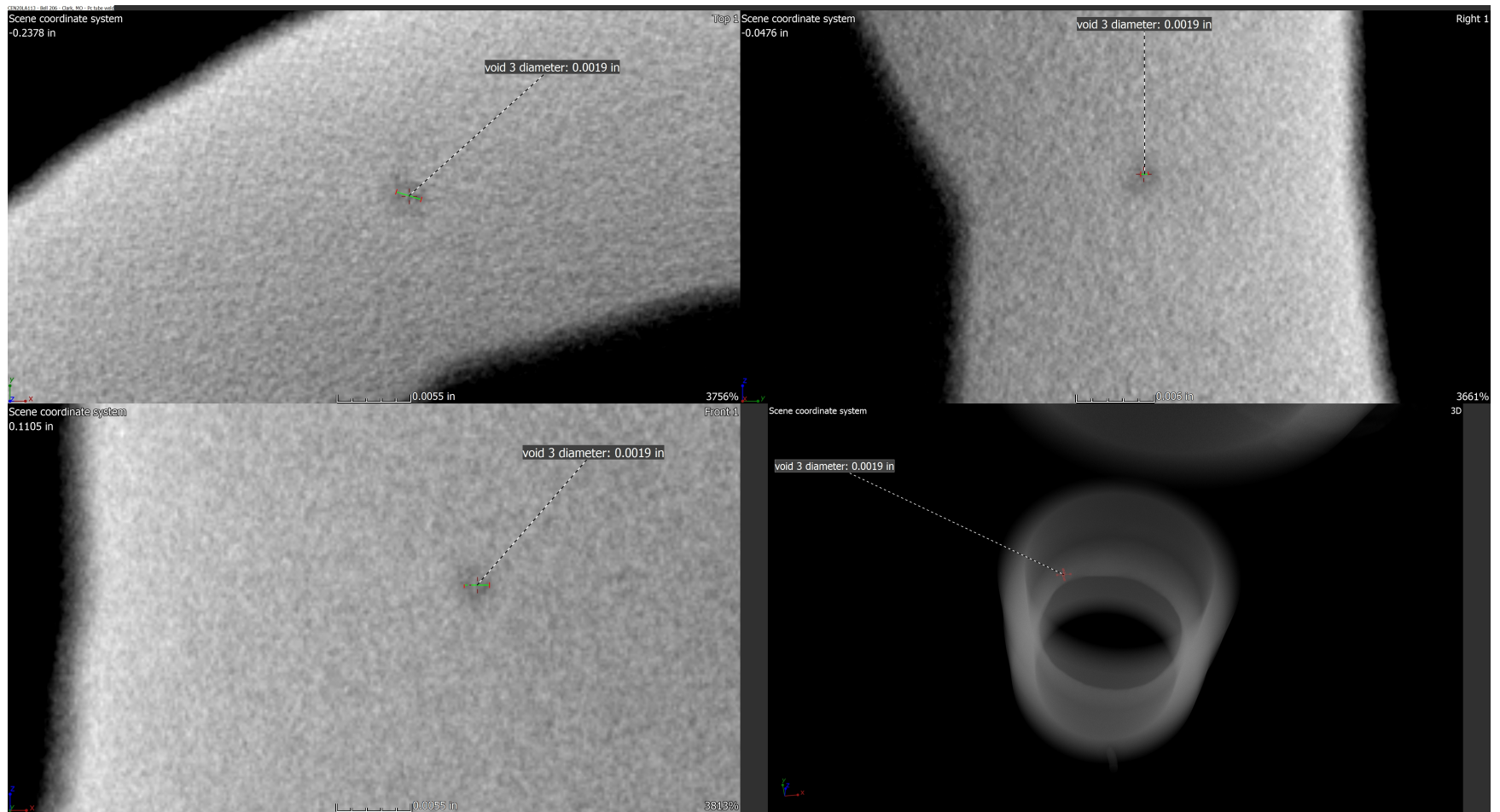


Figure 12
Engine pressure measurement tube weld – void 3 diameter

Scott Warren
Lead Aerospace Engineer
(Computed Tomography Specialist)