NATIONAL TRANSPORTATION SAFETY BOARD
Office of Aviation Safety
Washington, D.C. 20594

January 14, 2021

Computed Tomography Specialist's Factual Report

CEN20LA353

A. ACCIDENT

Location:	Inverness, Mississippi
Date:	August 20, 2020
Time:	0900 central daylight time
Airplane:	Air Tractor 602 airplane, N604MG

B. GROUP

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

C. SUMMARY

On August 20, 2020, about 0900 central daylight time, an Air Tractor 602 airplane, N604MG, was substantially damaged when it was involved in an accident near Inverness, Mississippi. The pilot was not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 137 aerial application flight.

The internal configuration of the fuel control unit (FCU) and the propellor governor from the accident aircraft were documented using radiographic images that were collected from November 2-4, 2020 in Chicago, Illinois. A total of 937 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, there were no indications of missing or damaged parts, contamination, or any other anomalies.

D. DETAILS OF THE INVESTIGATION

1.0 General

The fuel control unit (FCU) and the propellor governor 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 2-4, 2020 by Varex, Inc under the direction of the NTSB using the Actis 1000 1 megavolt (MV) 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 937 slices, and the total size of the combined data sets was approximately 7.3 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	Propellor governor	Fuel control unit
Number of slices	431	506
Voxel[1] Size - X Direction (millimeters(mm))	0.27	0.27
Voxel Size - Y Direction (mm)	0.27	0.27
Voxel Size - Z Direction (mm)	0.40	0.40
Image Projections per Revolution	1800	1800
Exposure time (milliseconds (ms))	10	10
Frames to Avg (frames per projection)	2	2
X-ray Source Voltage (kilovolts)	1000	1000
X-ray beam characteristics	2.5 ms period, 4 pulses/view	2.5 ms period, 4 pulses/view
Source Filter Thickness (mm)	3.3	3.3
Source Filter Material	Steel	Steel
Image Matrix Size (pixels)	2048 x 2048	2048 x 2048

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 40. Review of the images determined that, when the scans were conducted, there were no indications of missing or damaged parts, contamination, or any other anomalies.

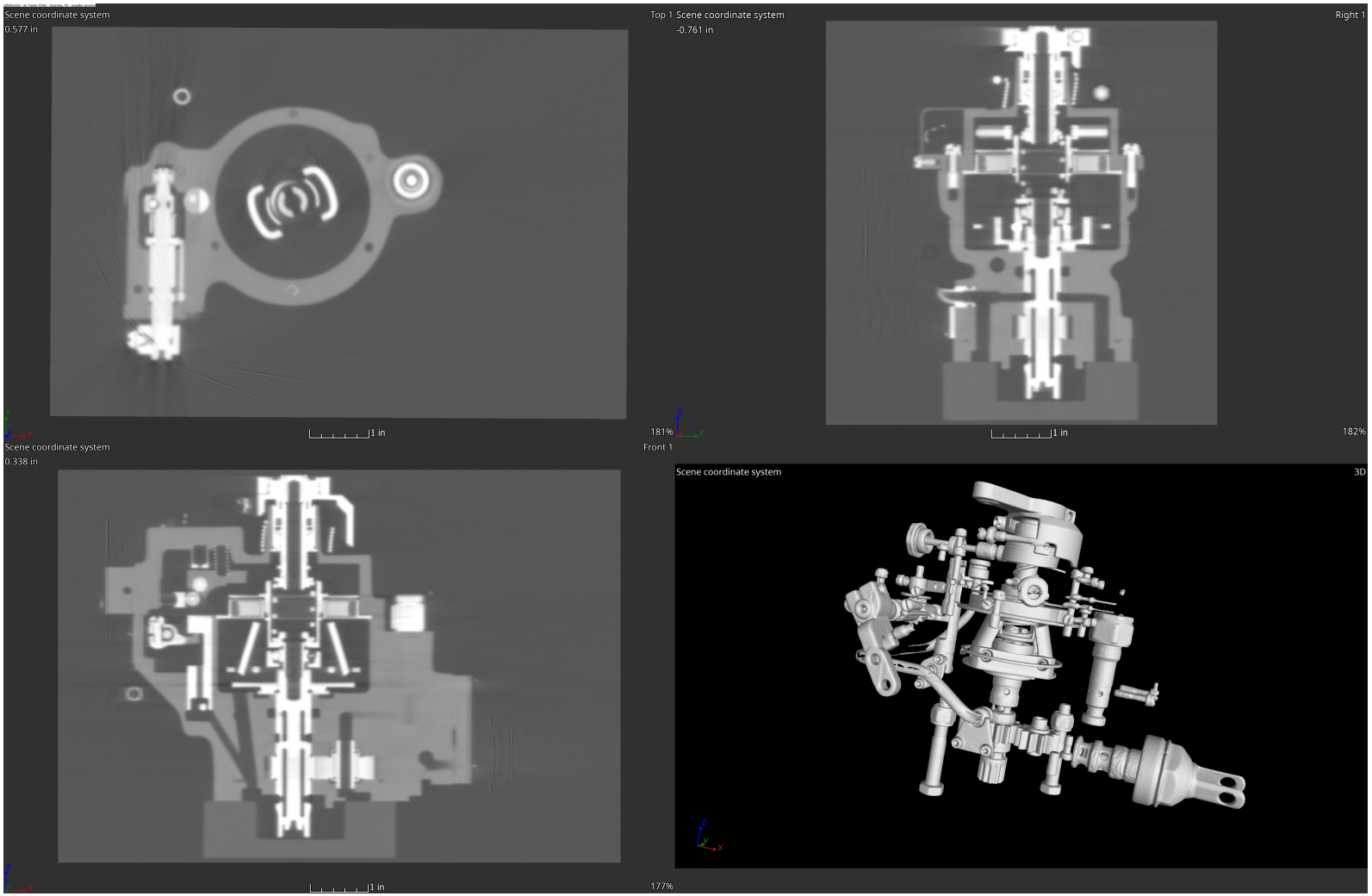


Figure 1
Propeller governor - overview

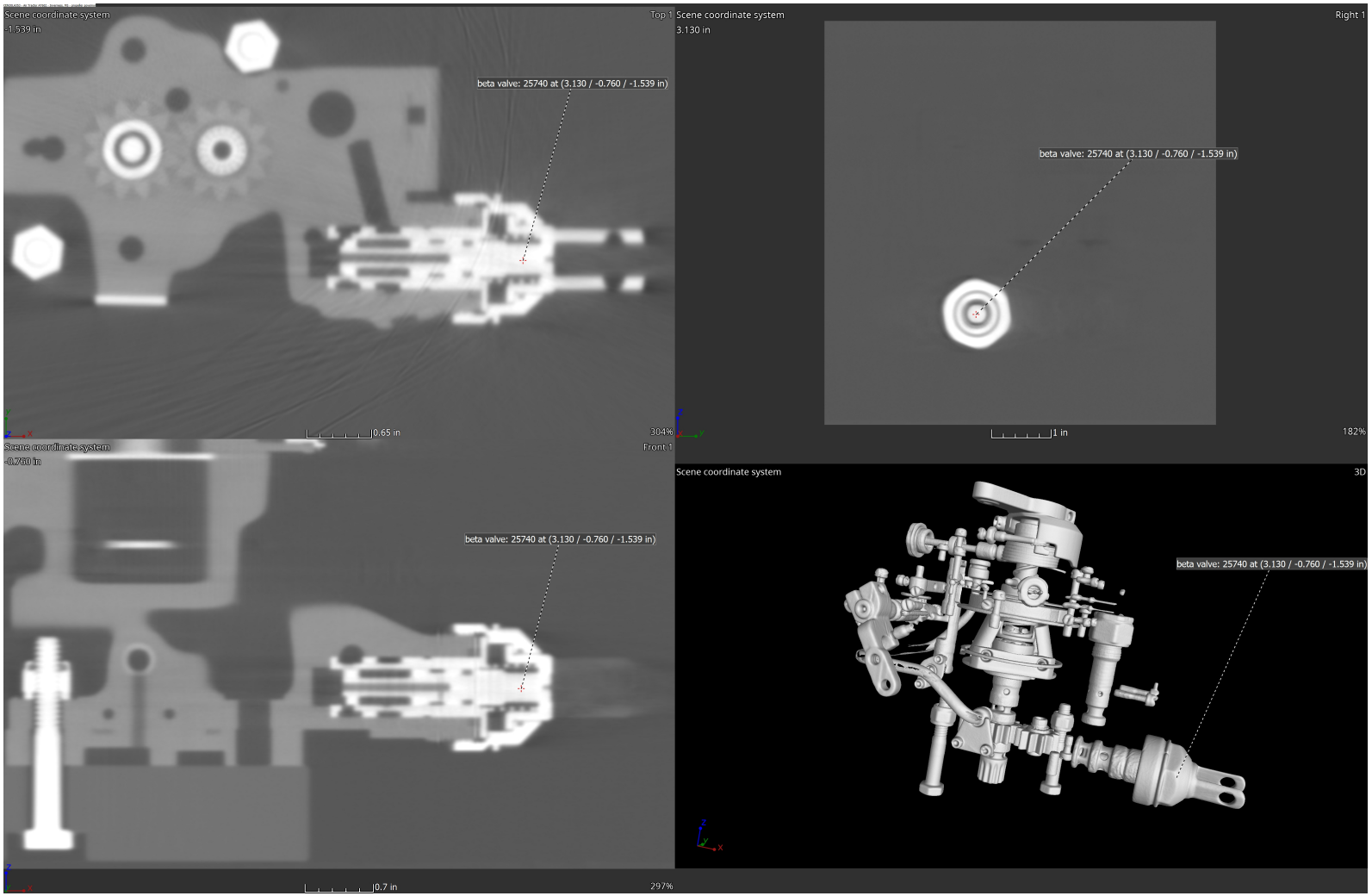


Figure 2
Propeller governor – beta valve

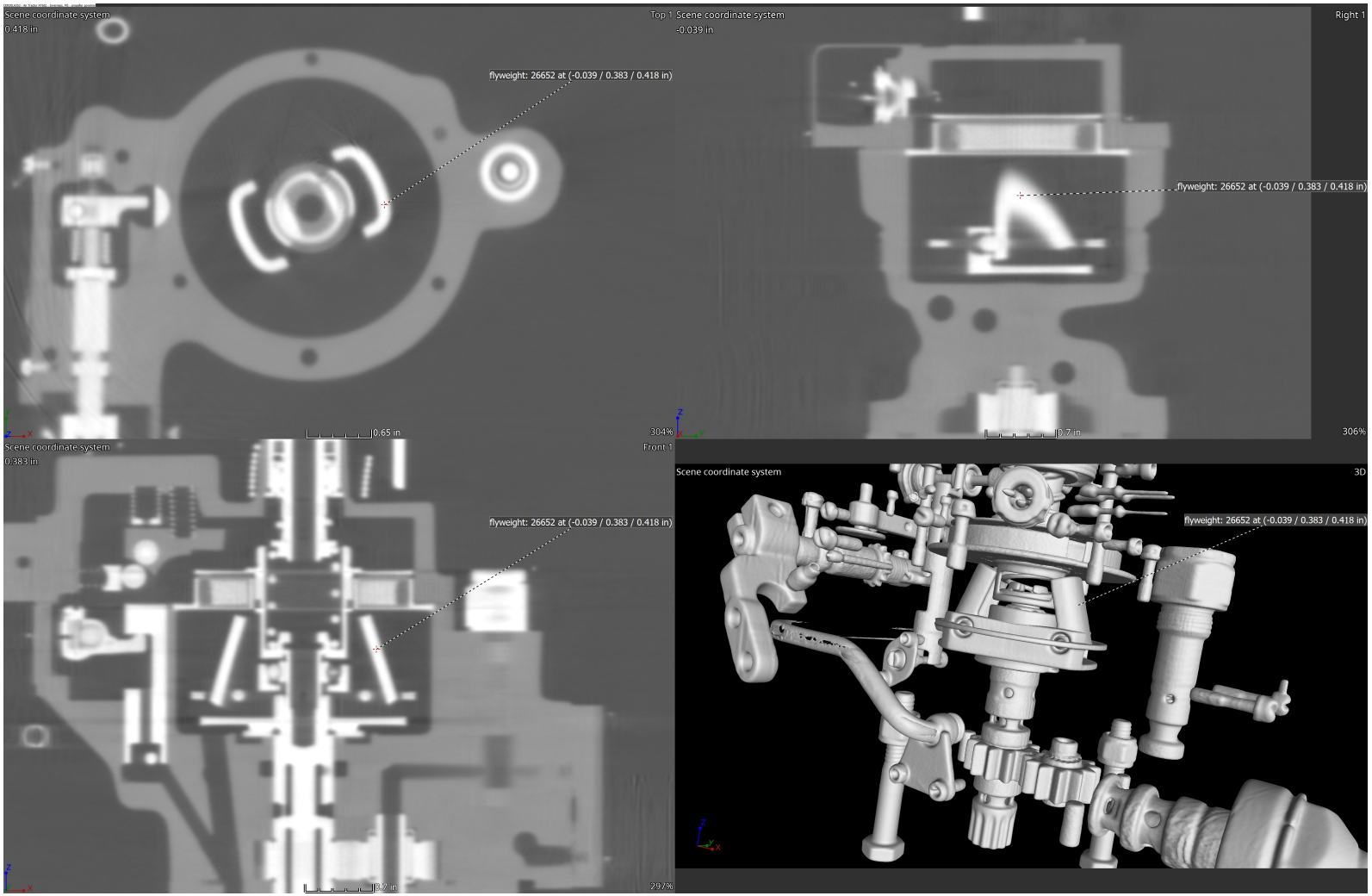


Figure 3
Propeller governor - flyweight

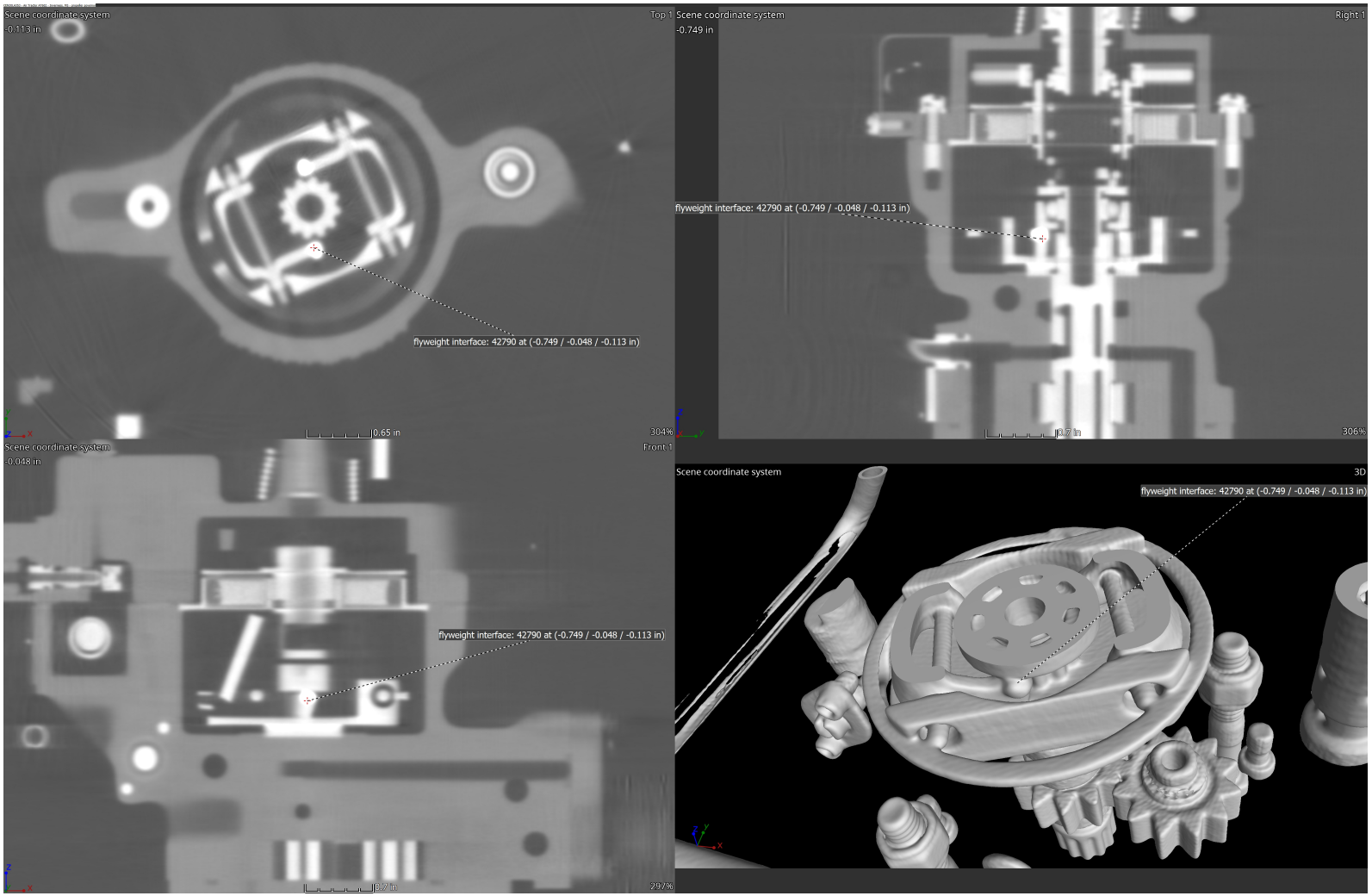


Figure 4
Propeller governor – flyweight interface

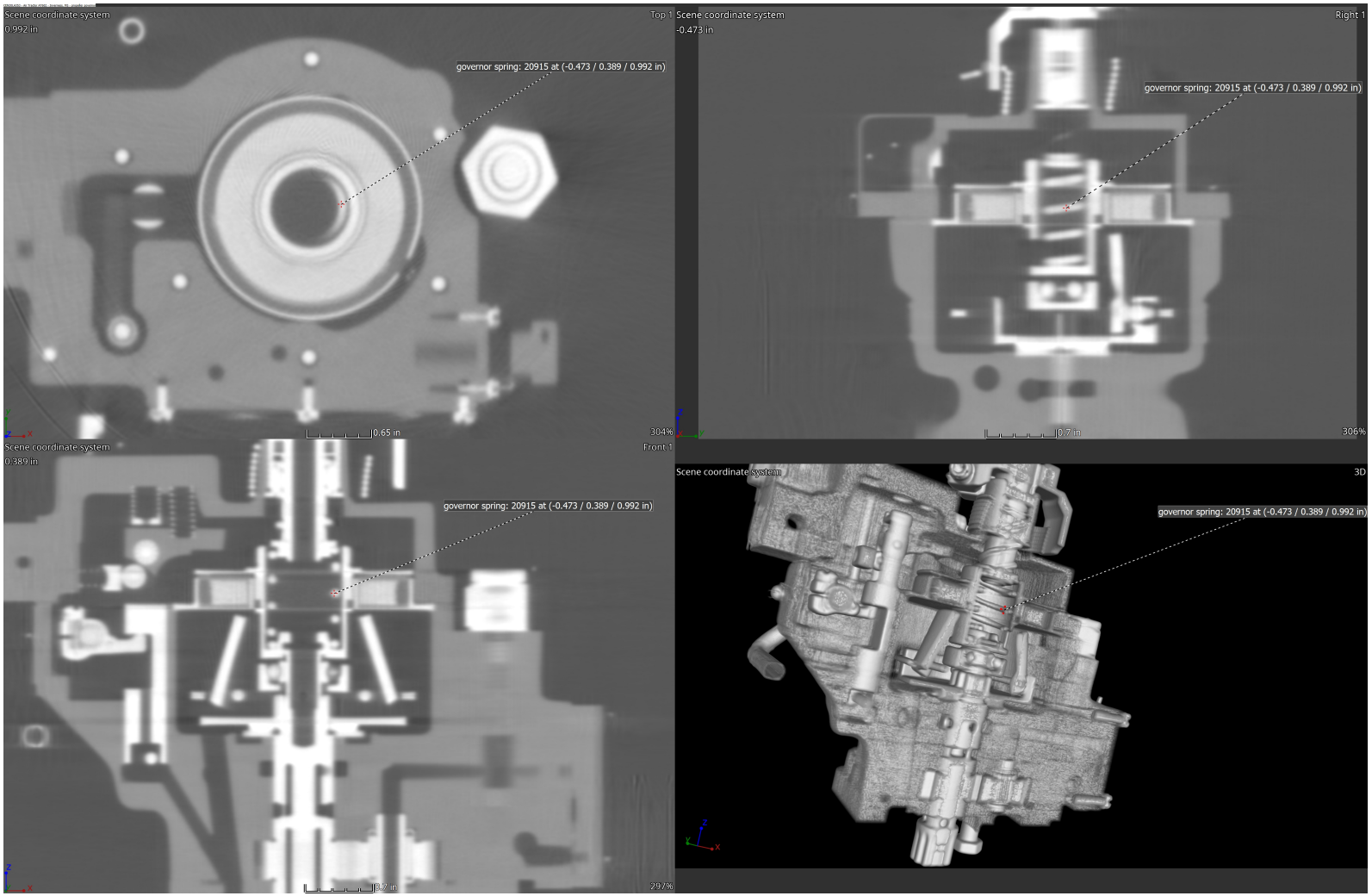


Figure 5
Propeller governor – governor spring

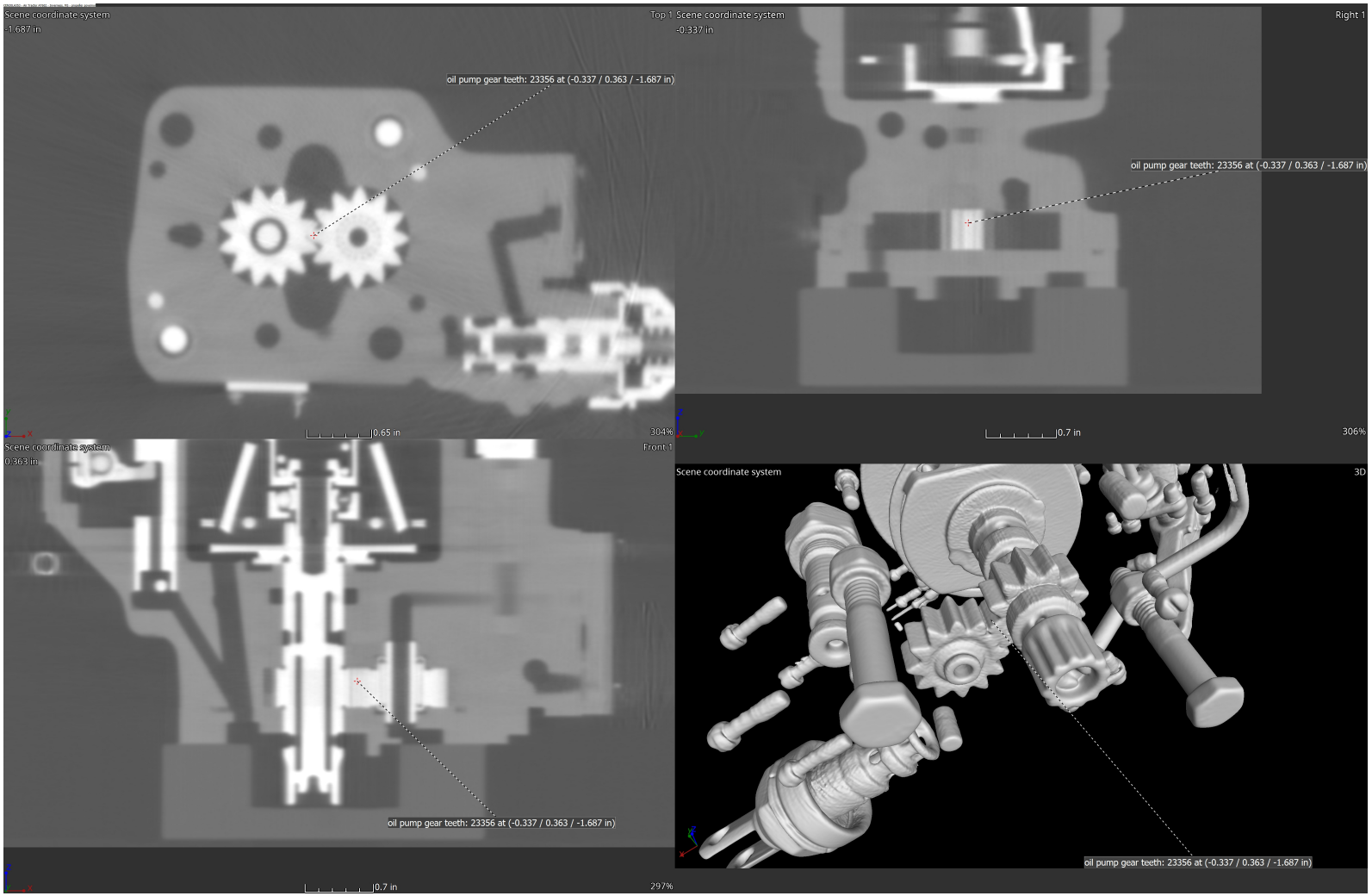


Figure 6
Propeller governor – oil pump gear teeth

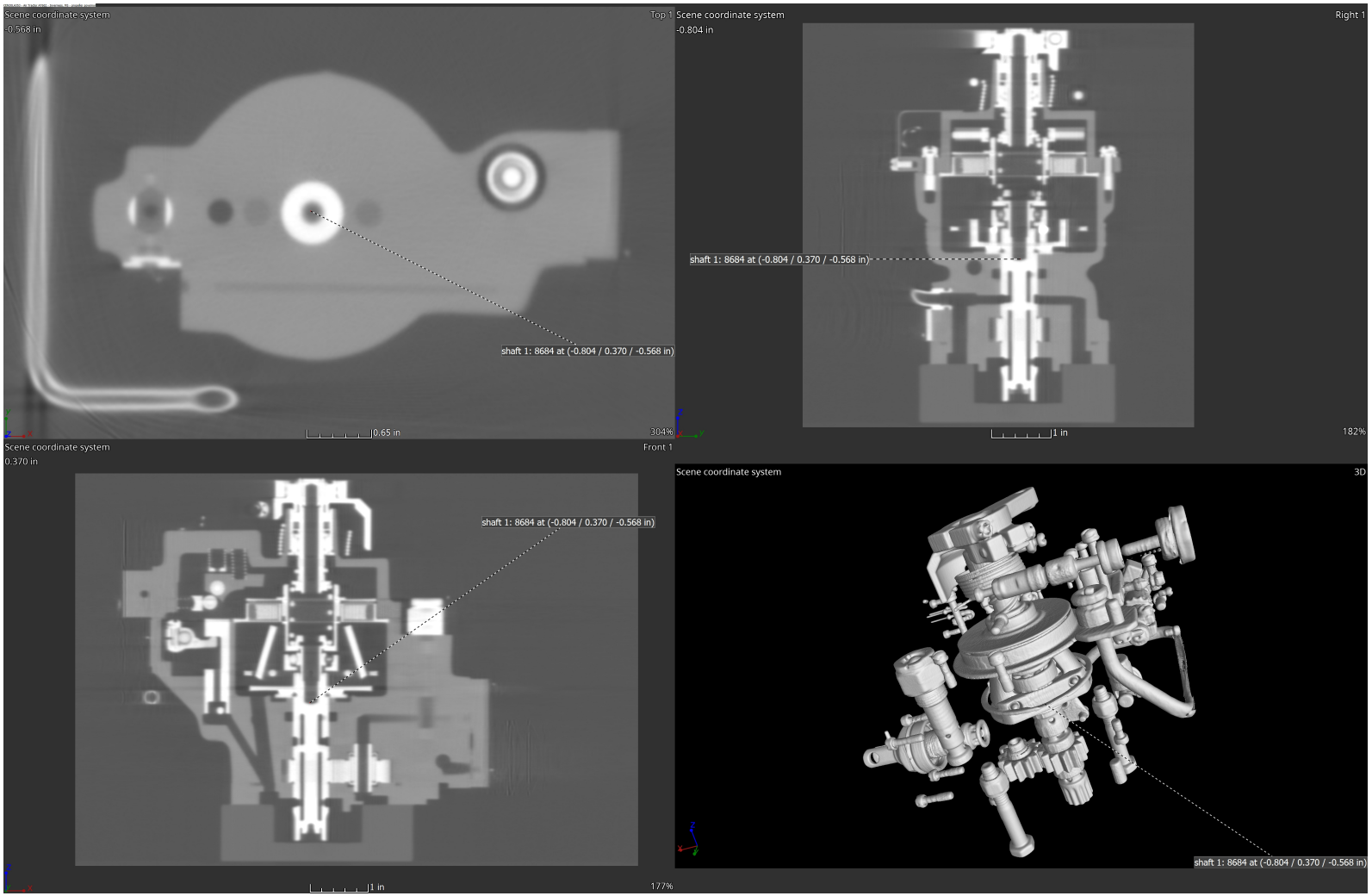


Figure 7
Propeller governor – shaft 1

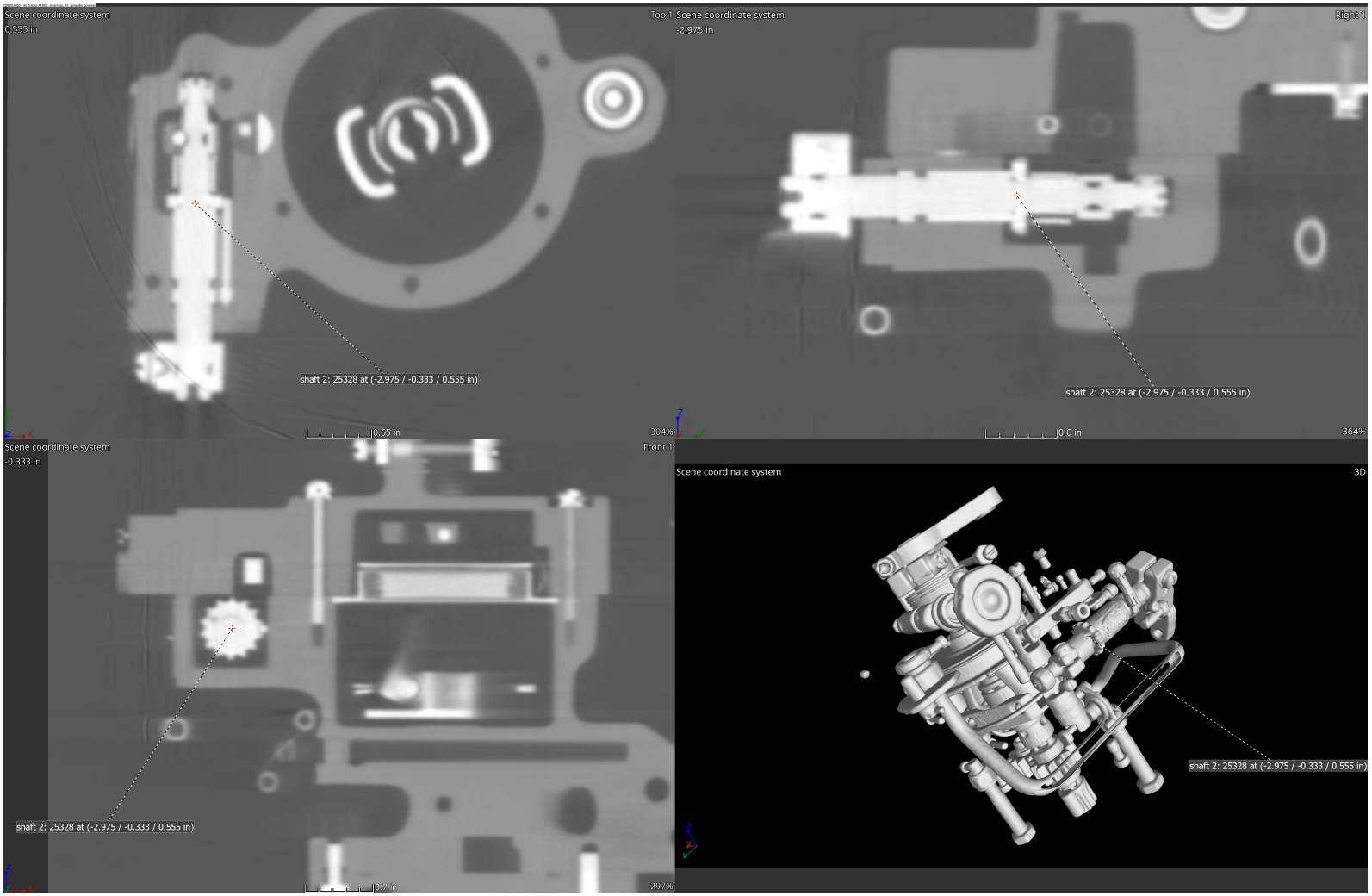


Figure 8
Propeller governor – shaft 2

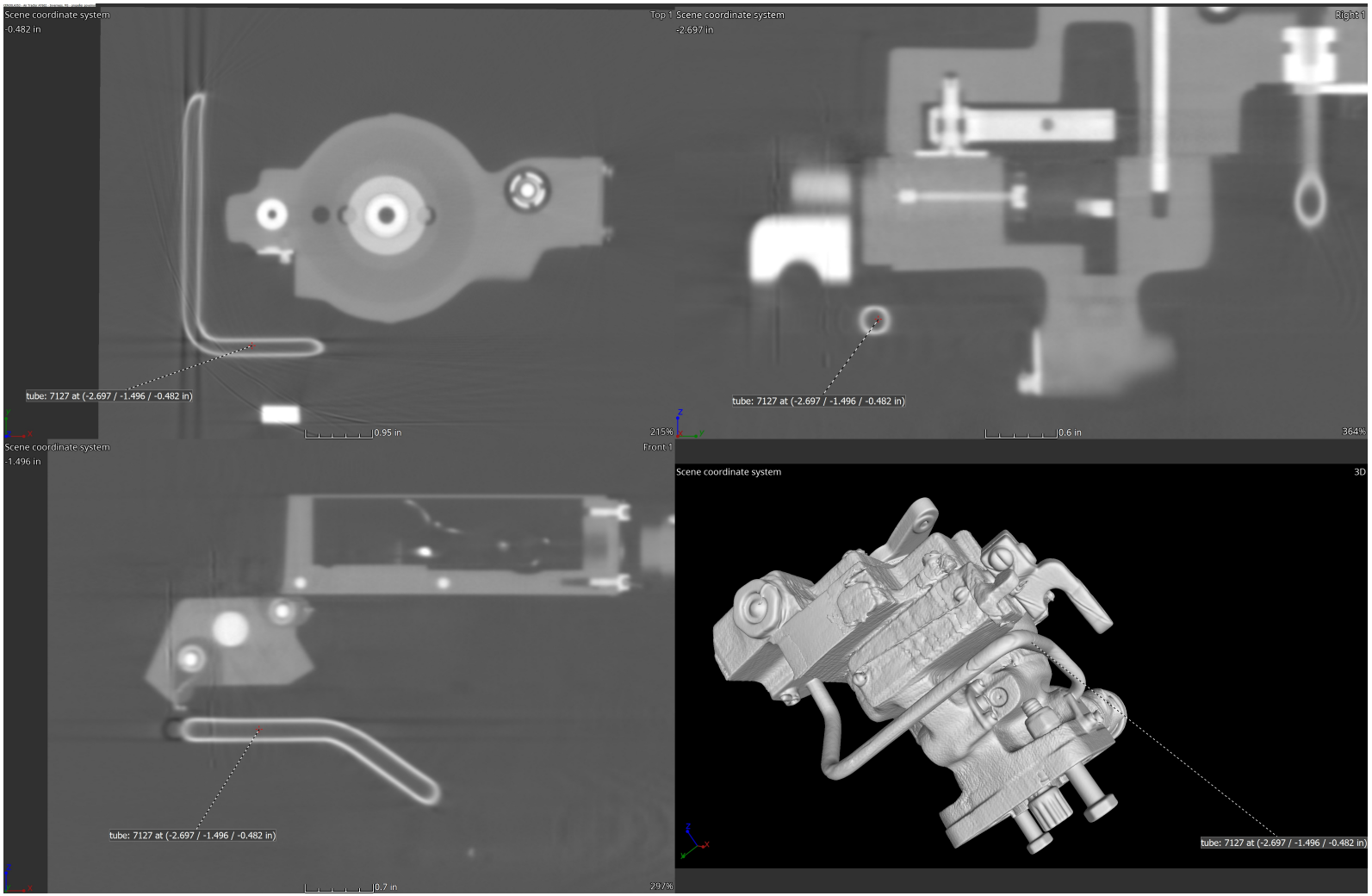


Figure 9
Propeller governor - tube

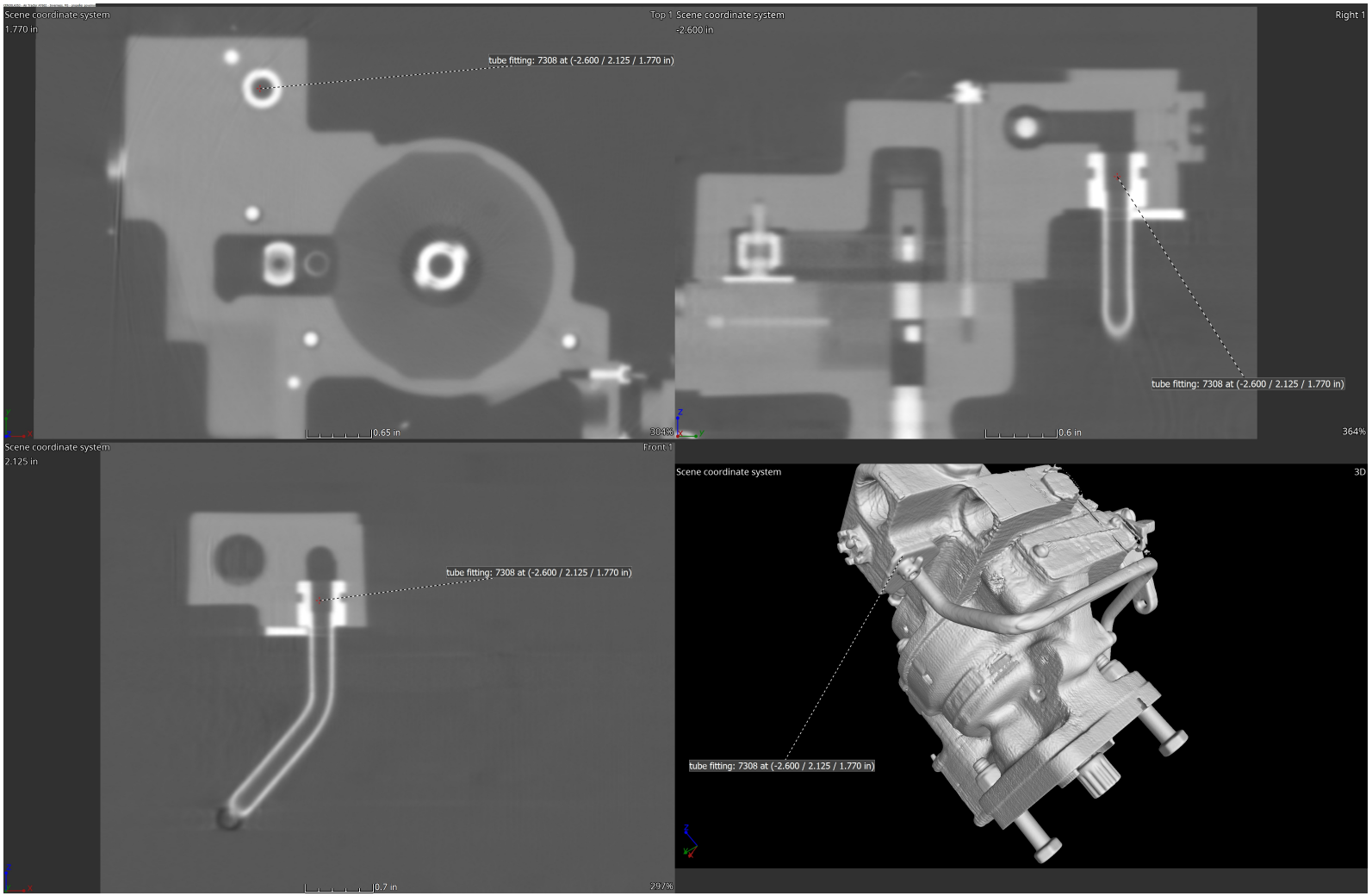


Figure 10
Propeller governor – tube fitting

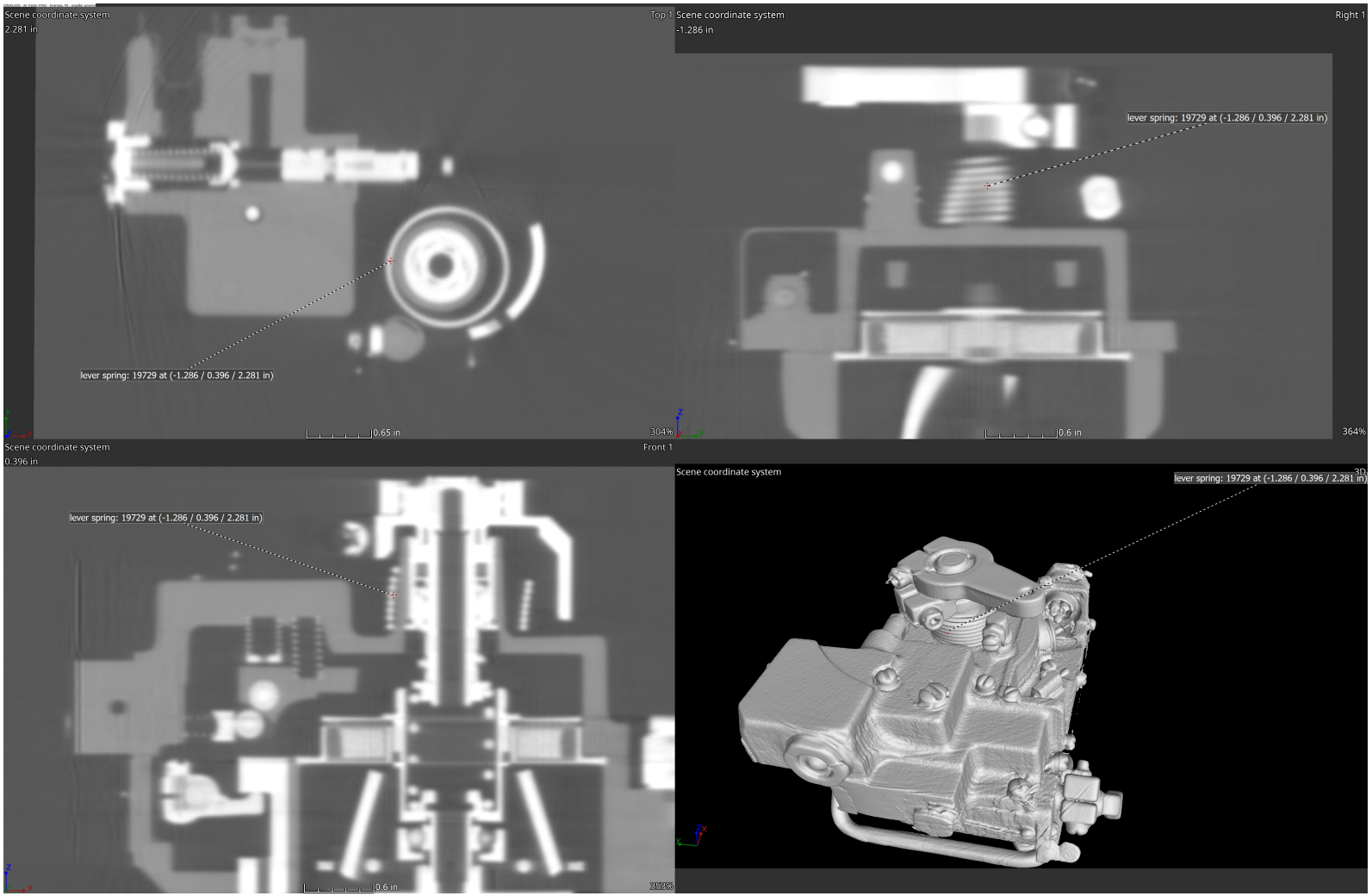


Figure 11
Propeller governor – lever spring

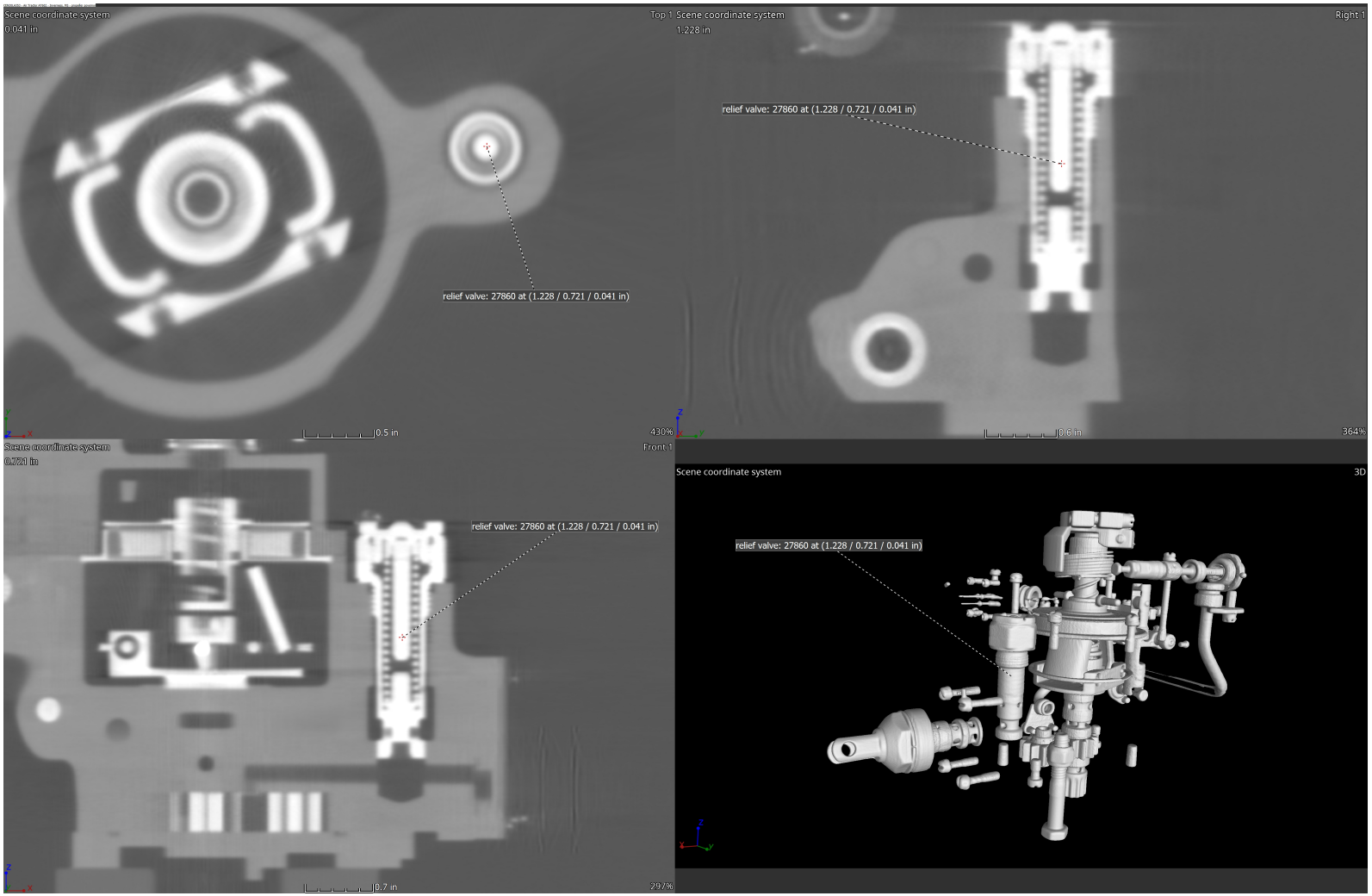


Figure 12
Propeller governor – relief valve

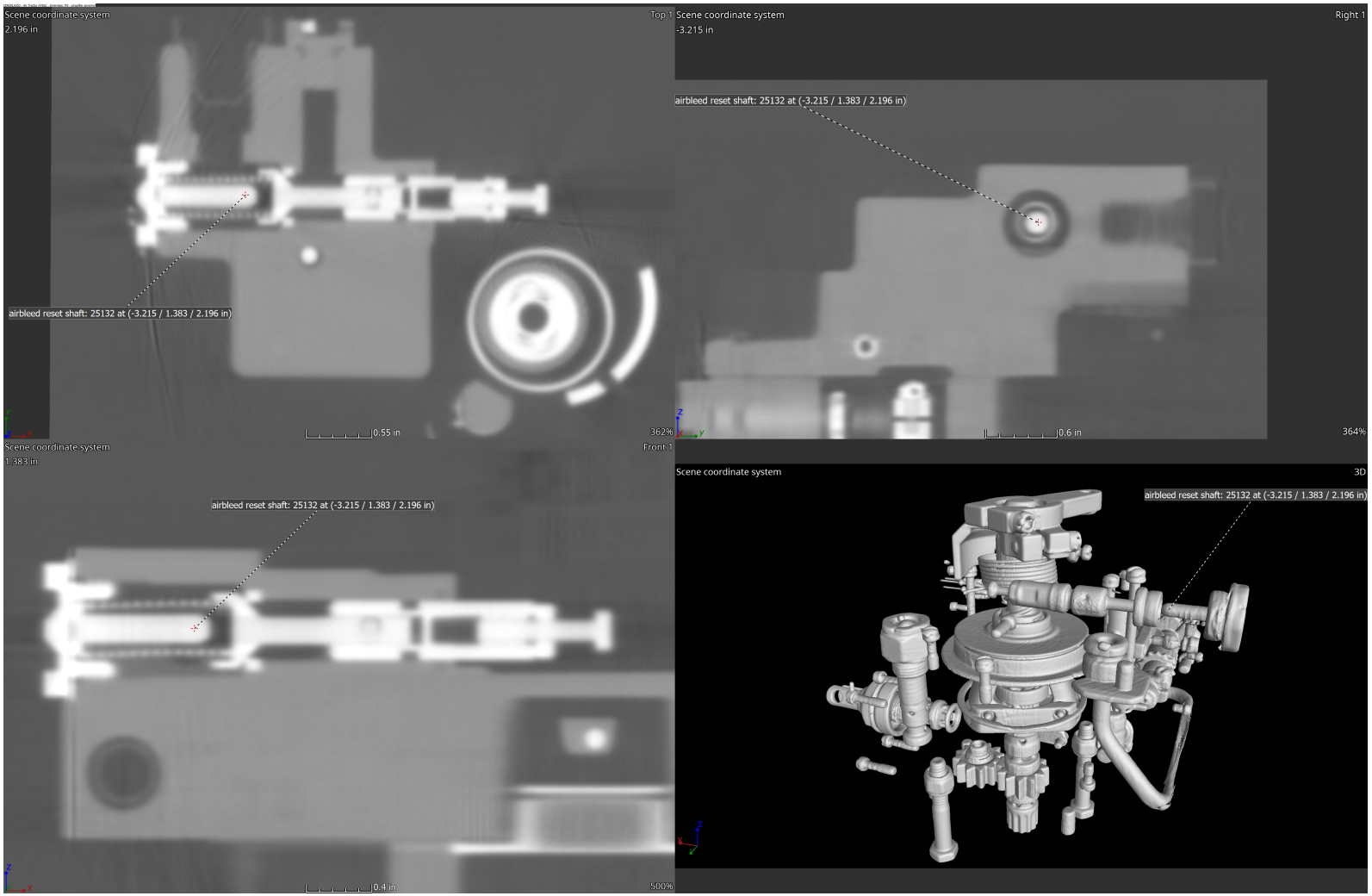


Figure 13
Propeller governor – airbleed reset shaft

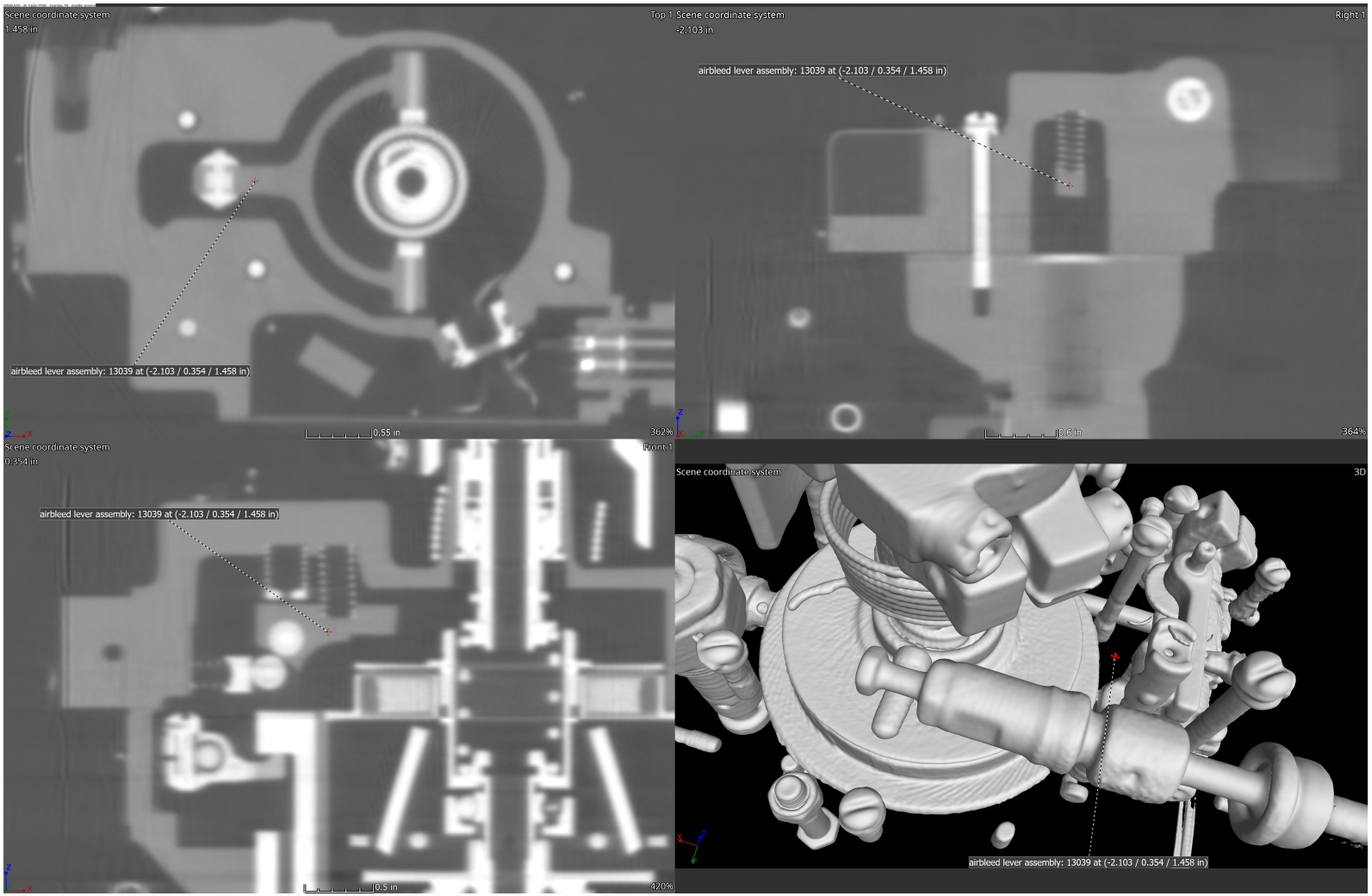


Figure 14
Propeller governor – airbleed lever assembly

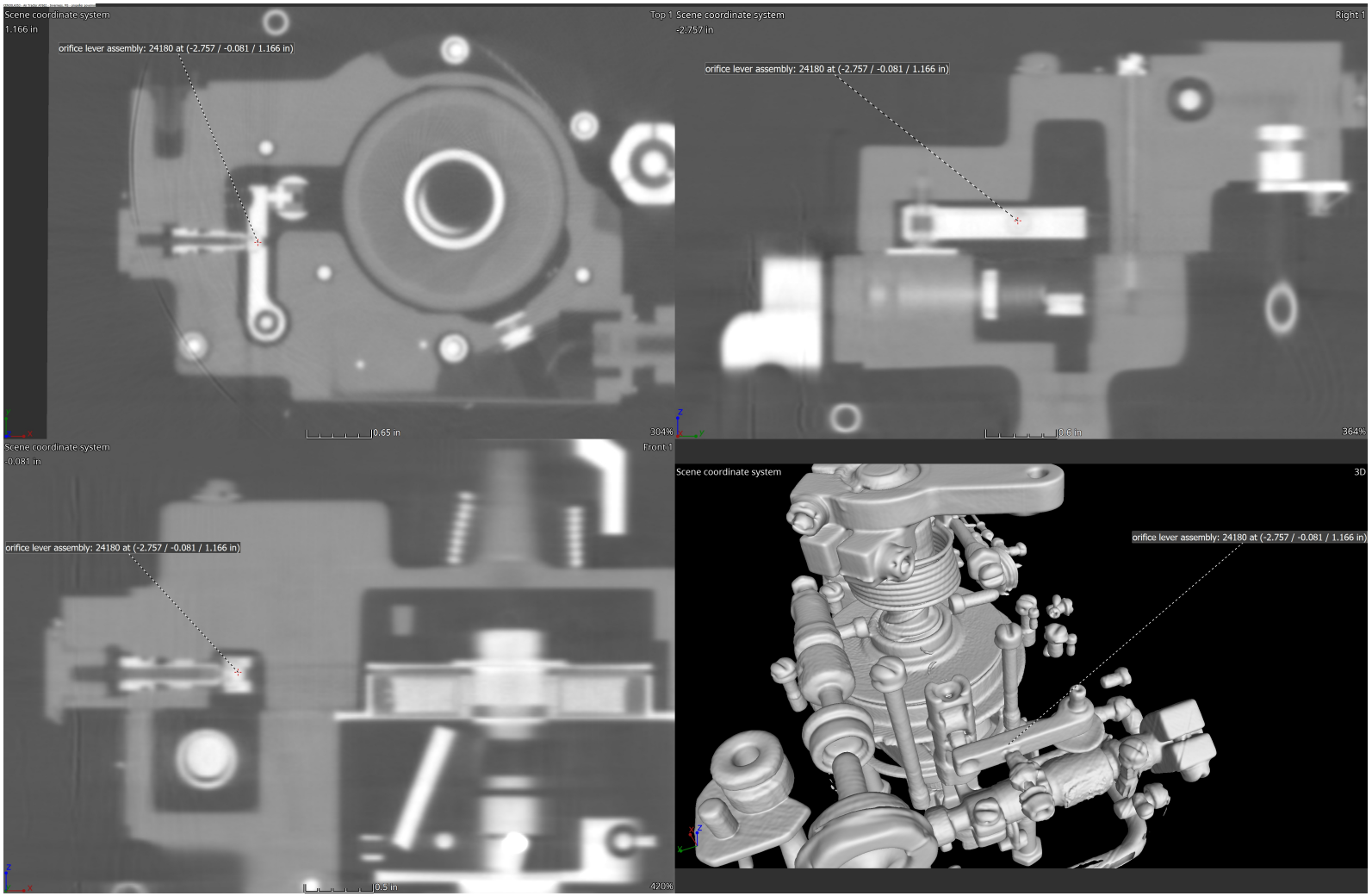


Figure 15
Propeller governor – orifice lever assembly

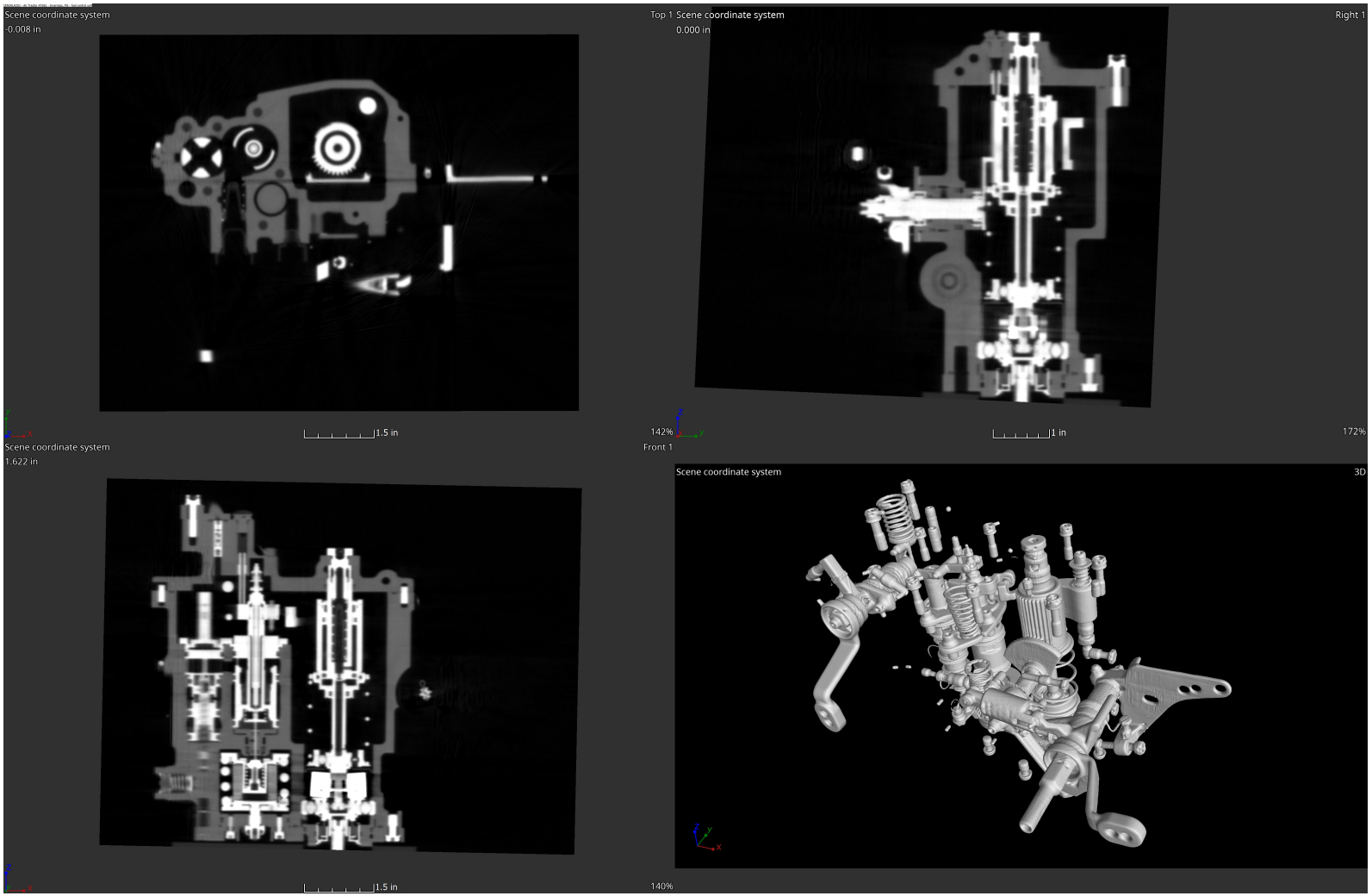


Figure 16
Fuel control unit - overview

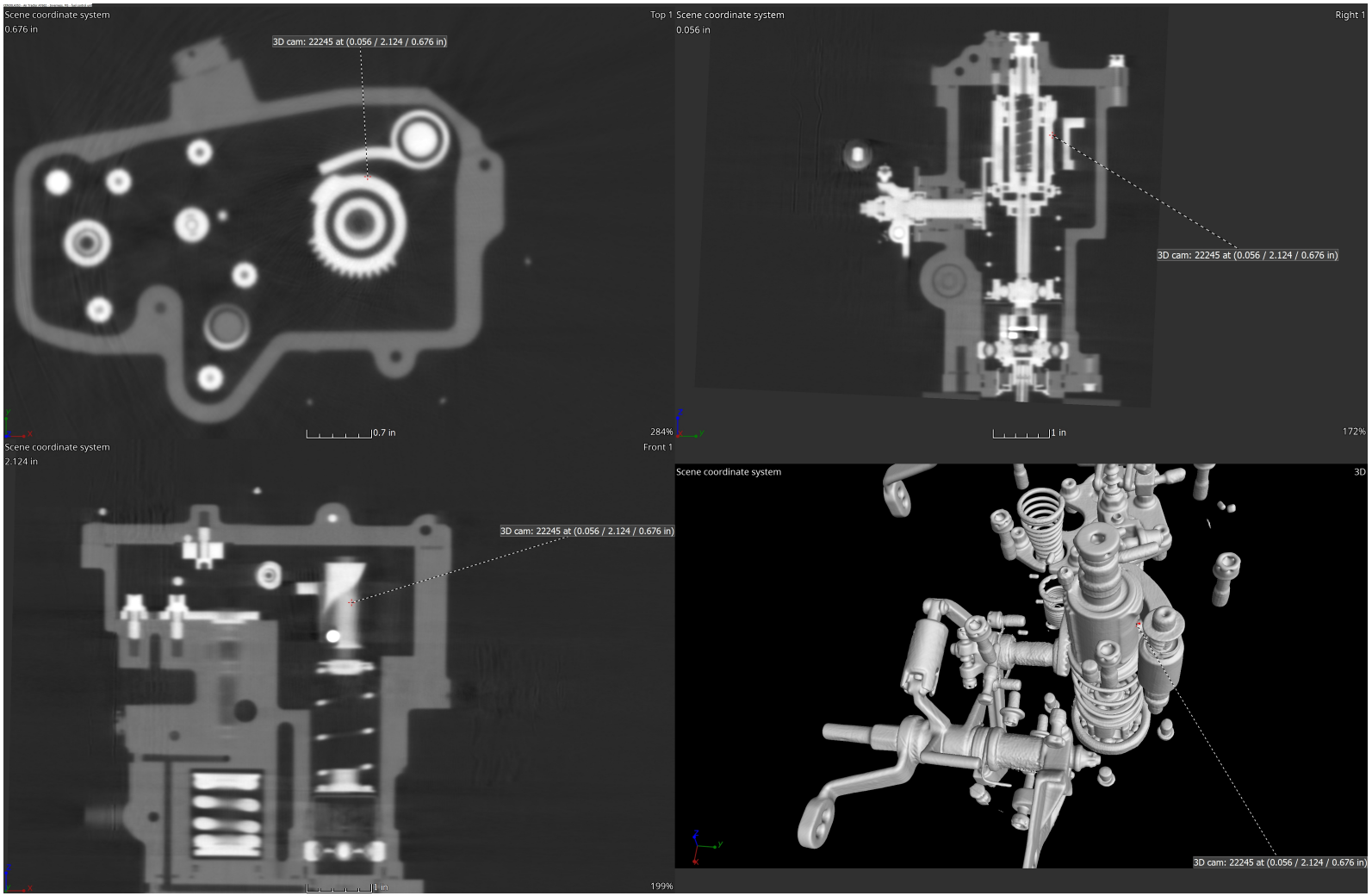


Figure 17
Fuel control unit – 3D cam

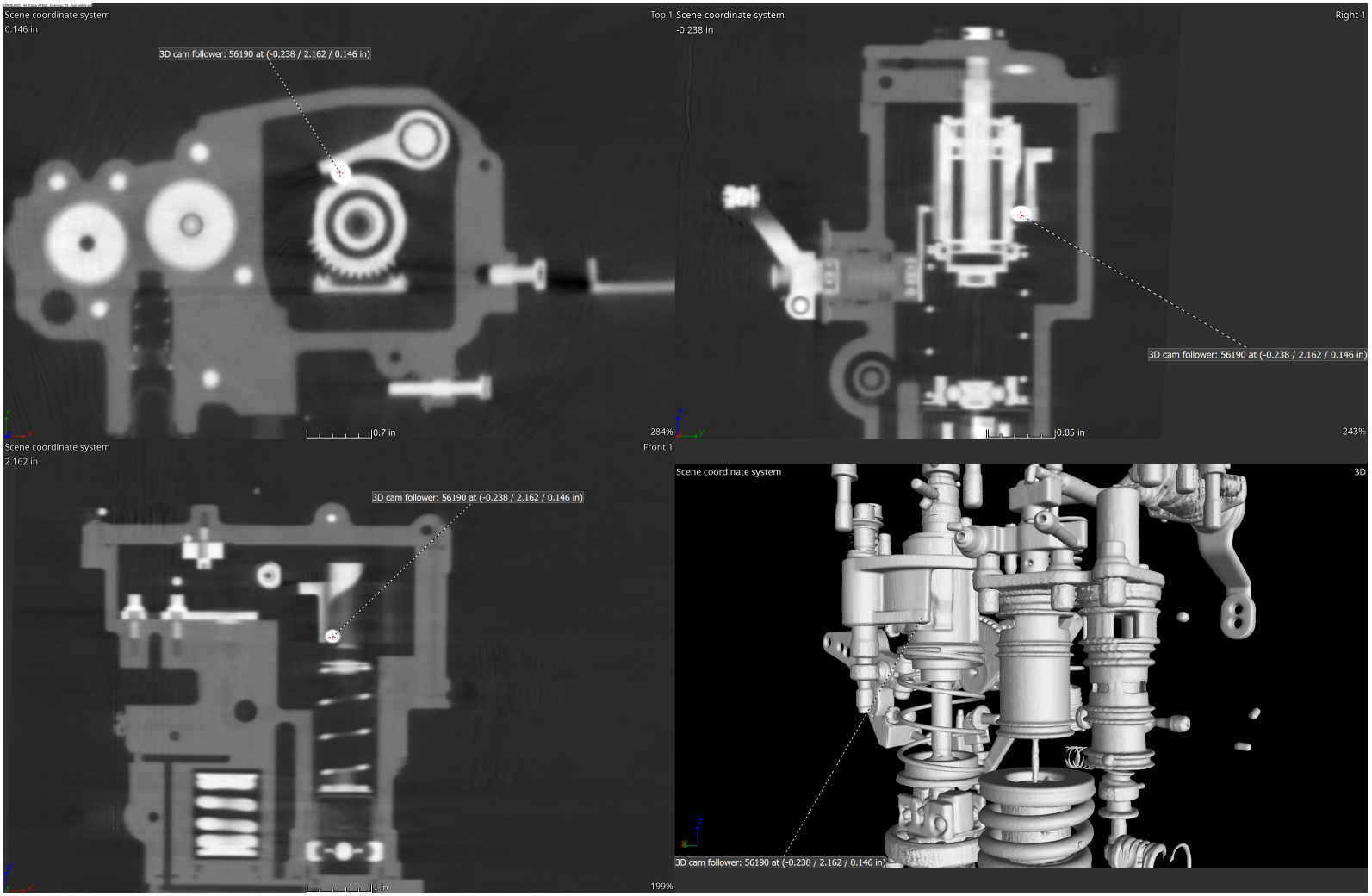


Figure 18
Fuel control unit – 3D cam follower

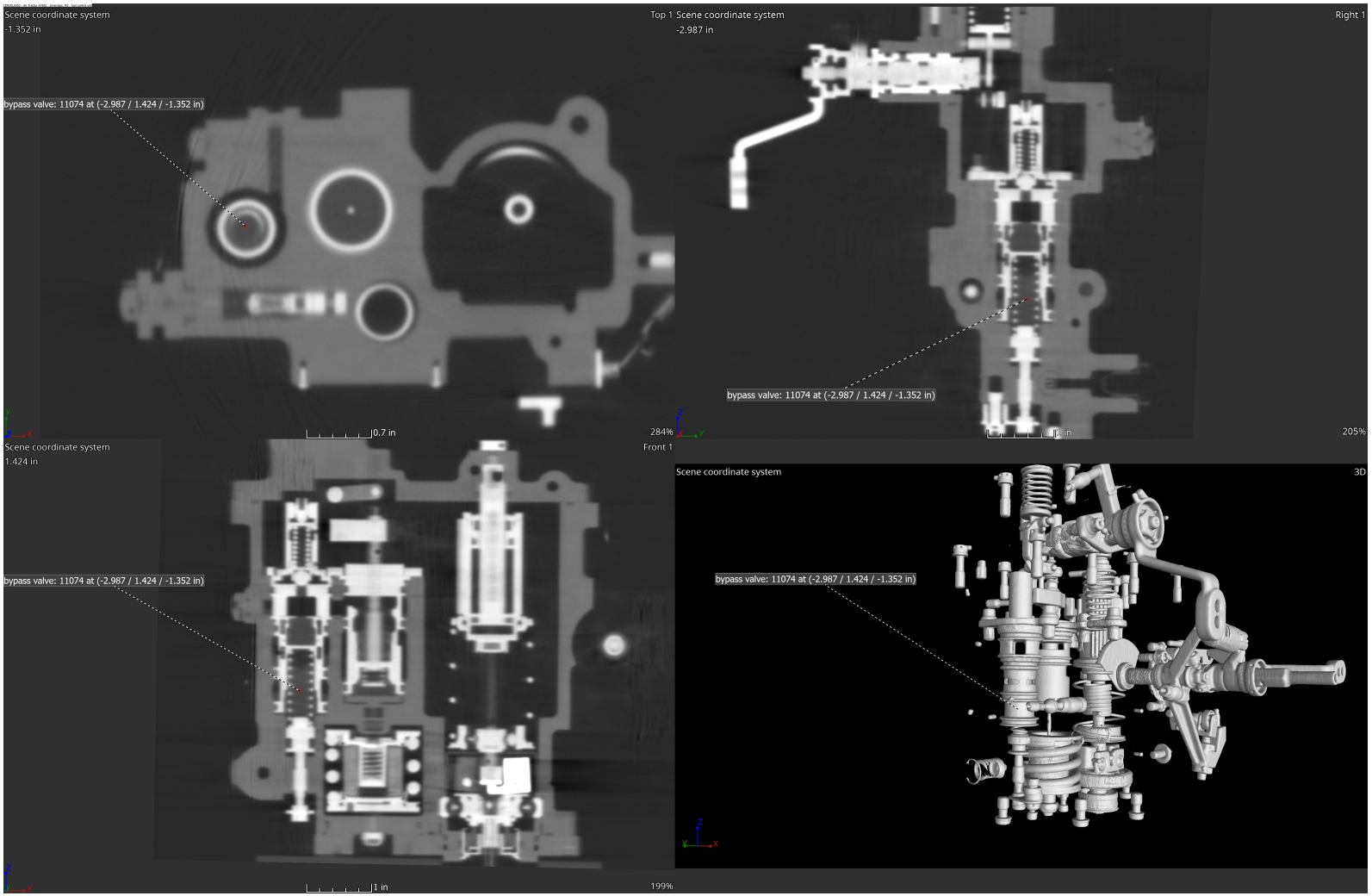


Figure 19
Fuel control unit – bypass valve

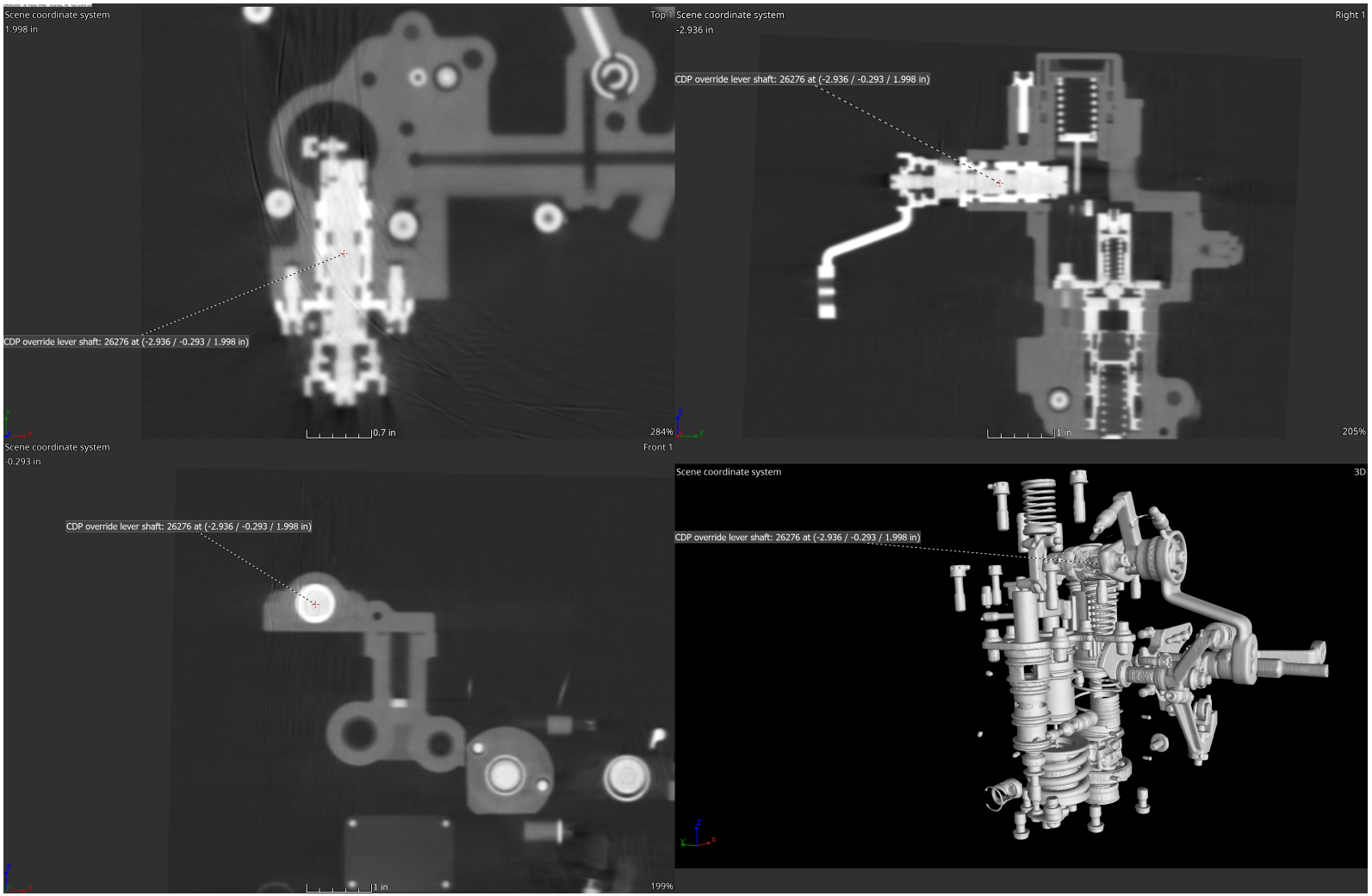


Figure 20
Fuel control unit – compressor discharge pressure (CDP) override lever shaft

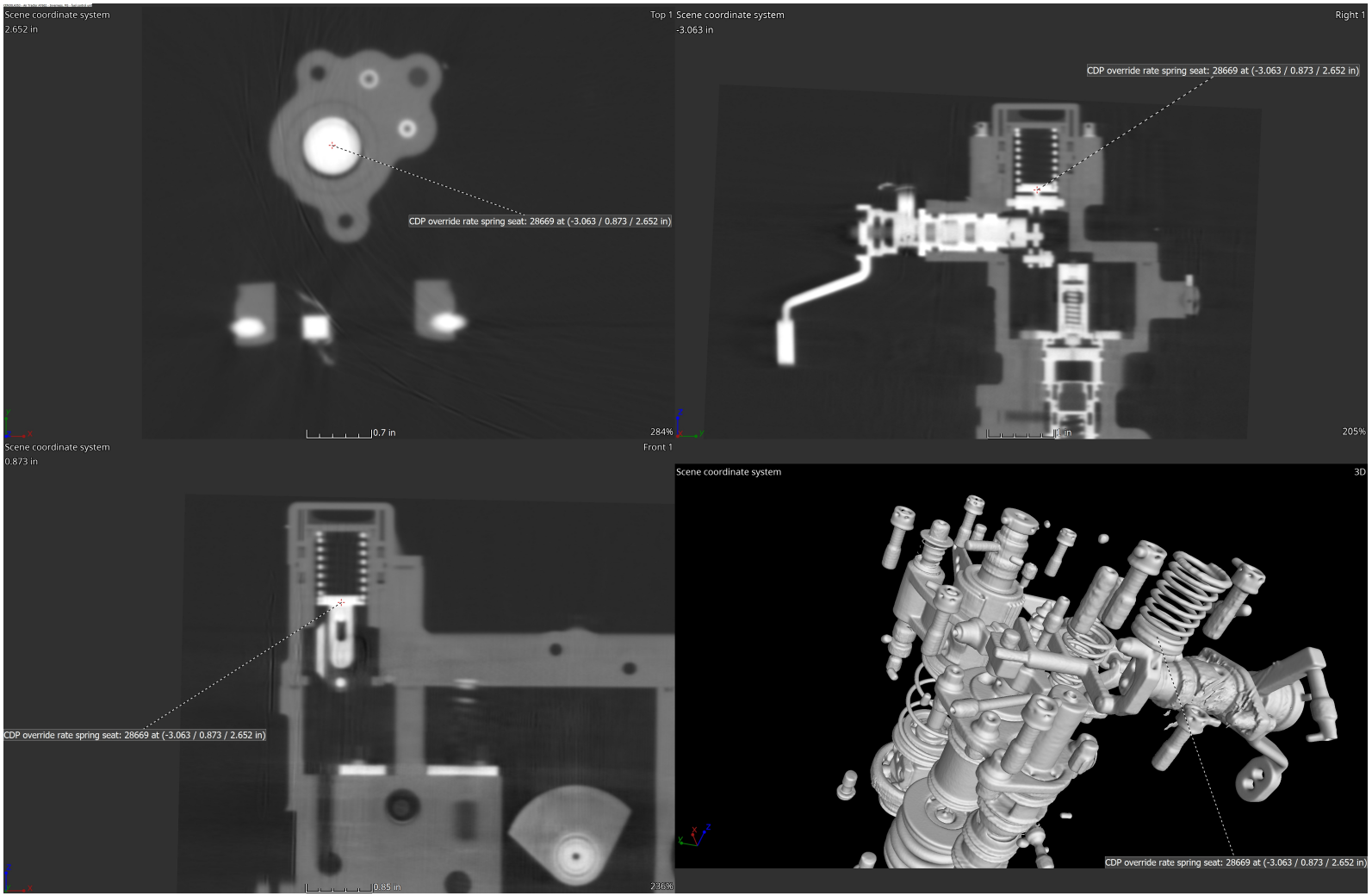


Figure 21
Fuel control unit – CDP override rate spring seat

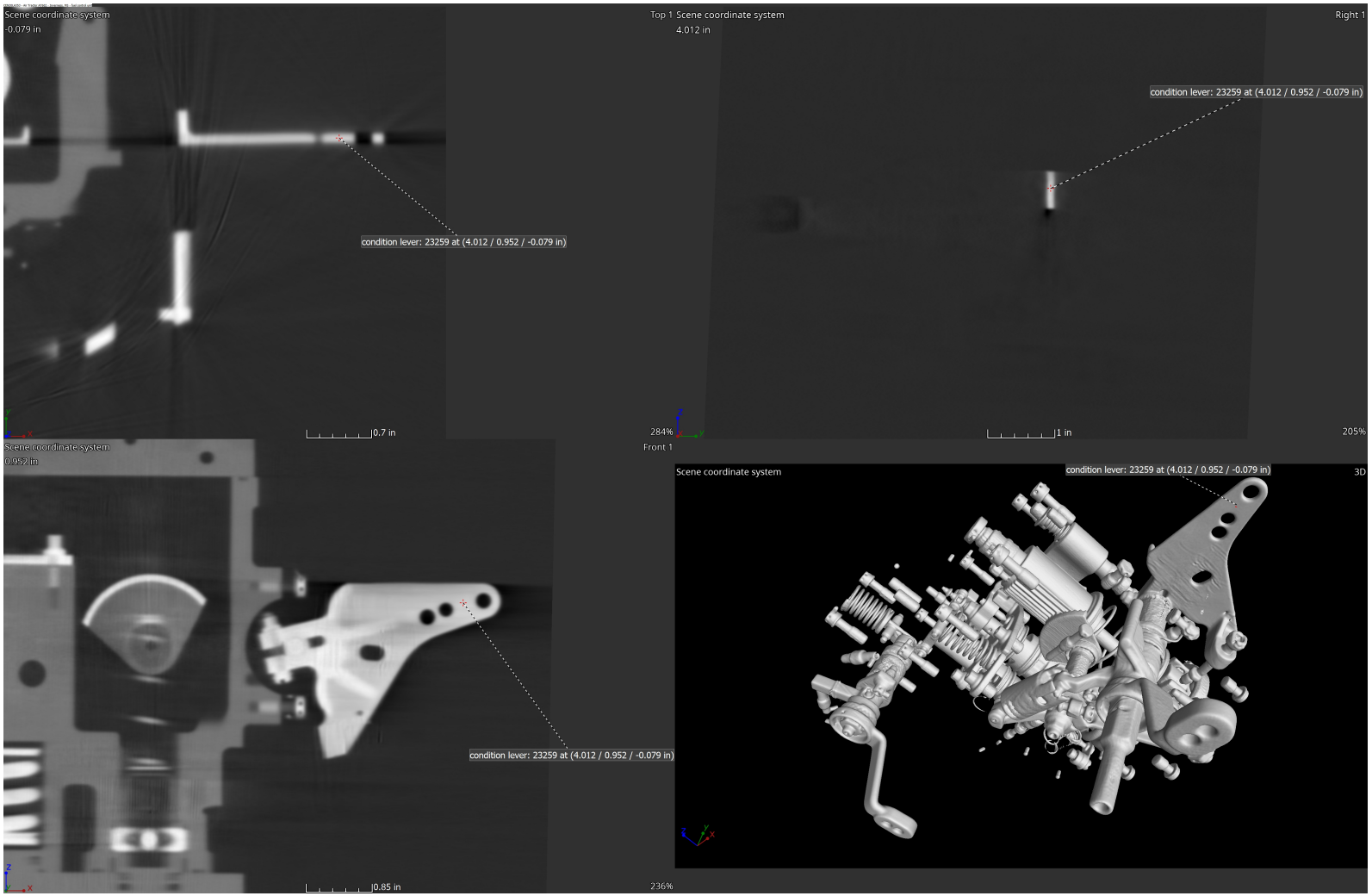


Figure 22
Fuel control unit – condition lever

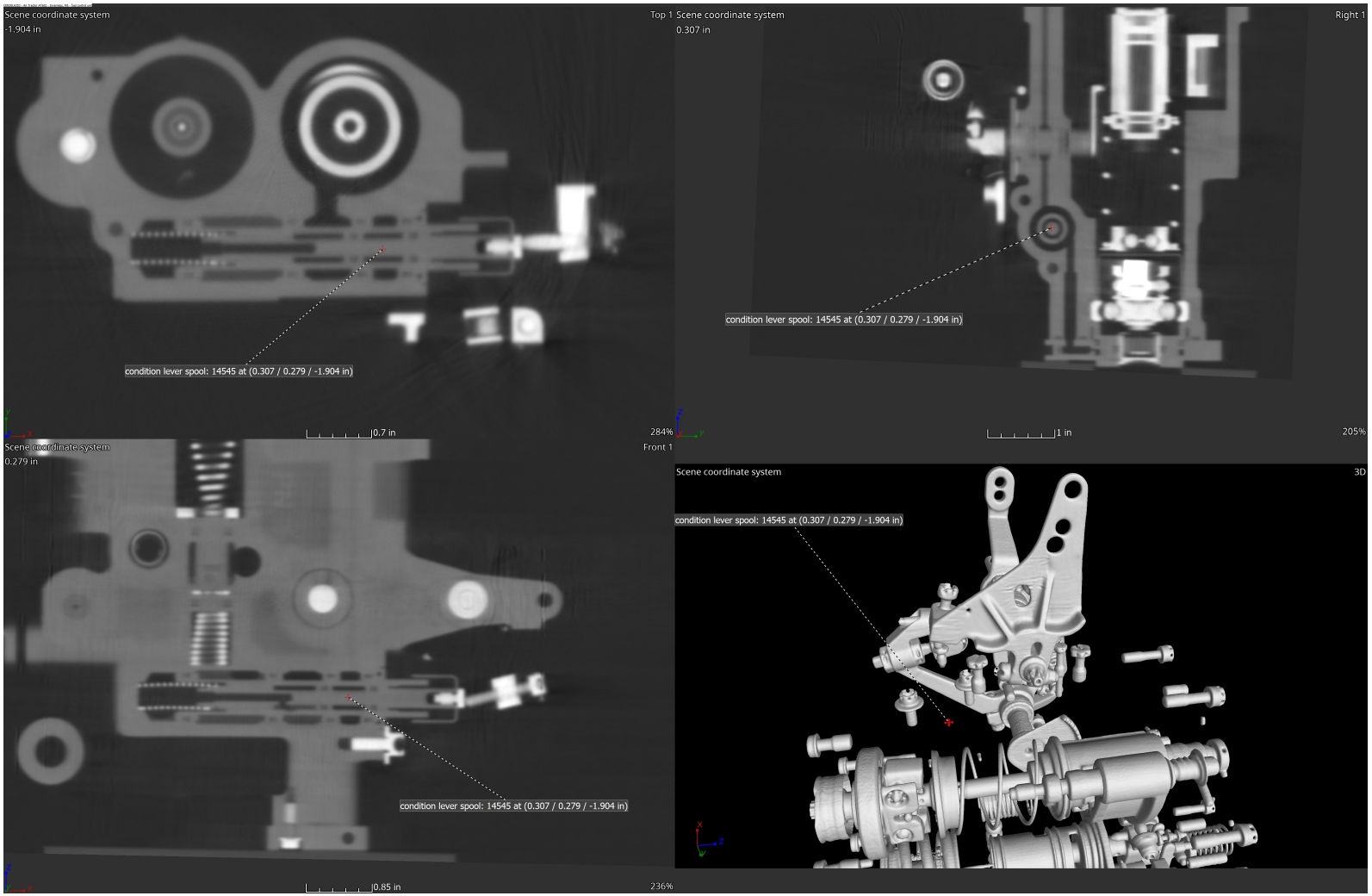


Figure 23
Fuel control unit – condition lever spool

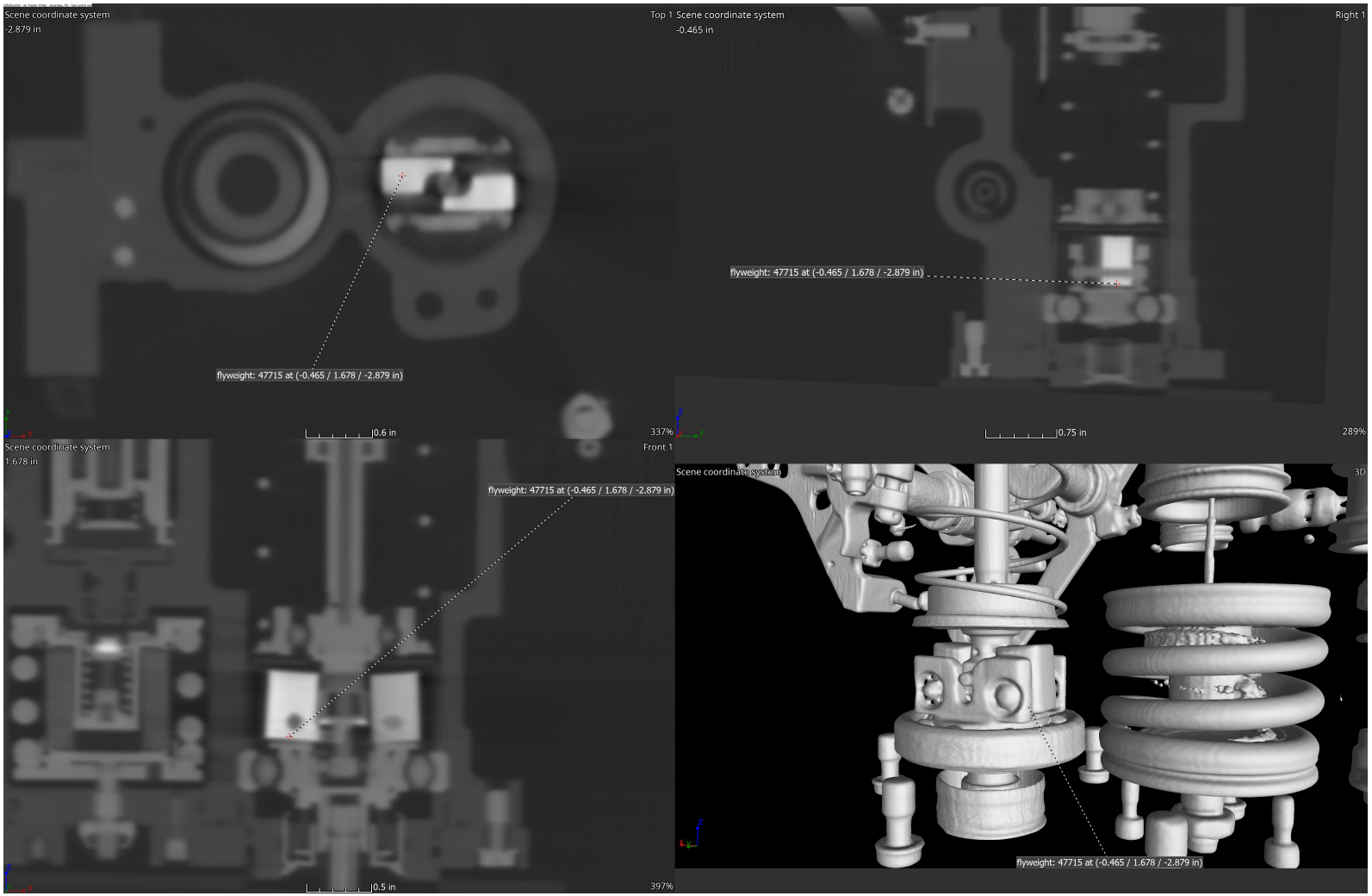


Figure 24
Fuel control unit - flyweight

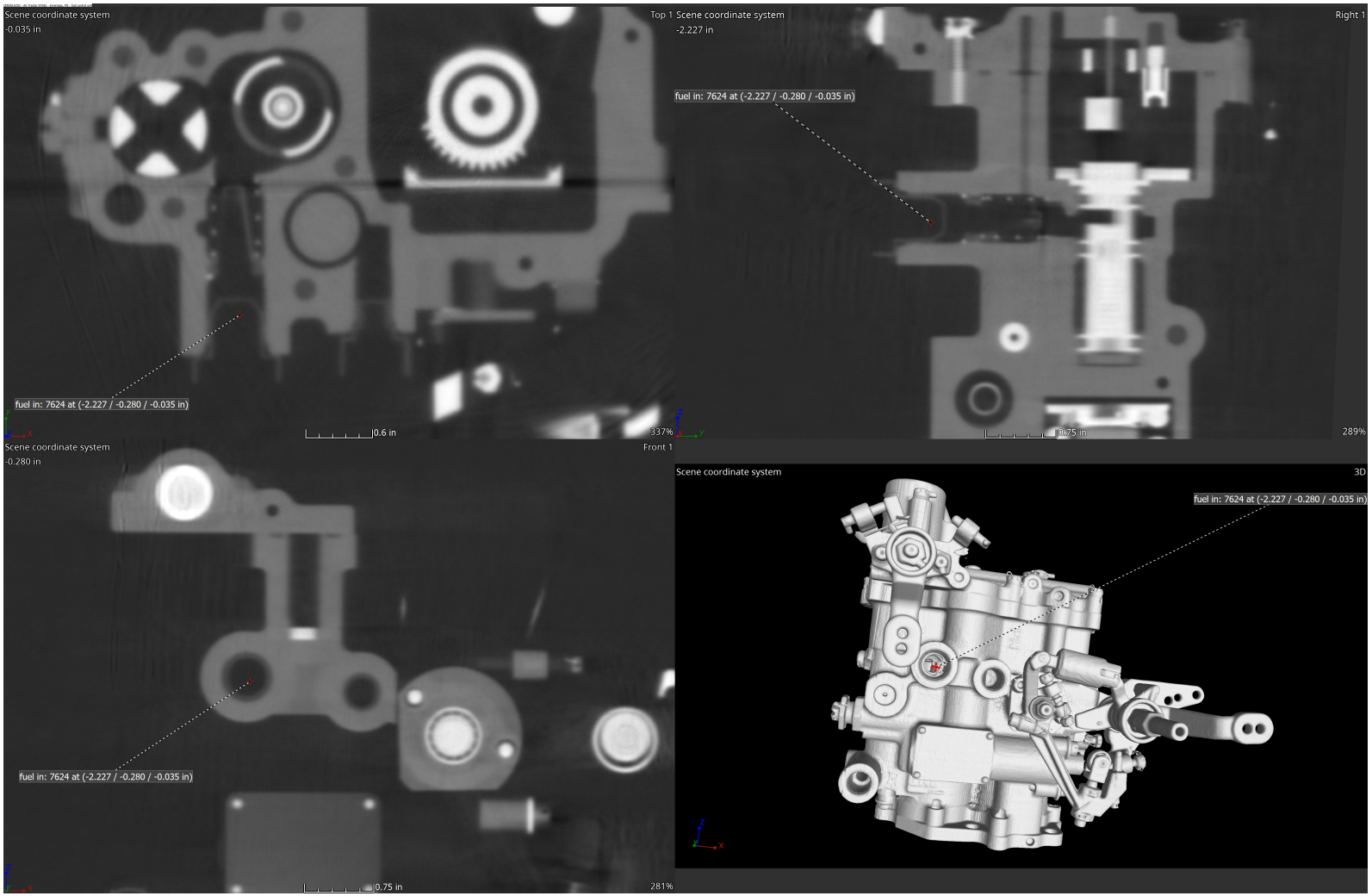


Figure 25
Fuel control unit – fuel “in” port

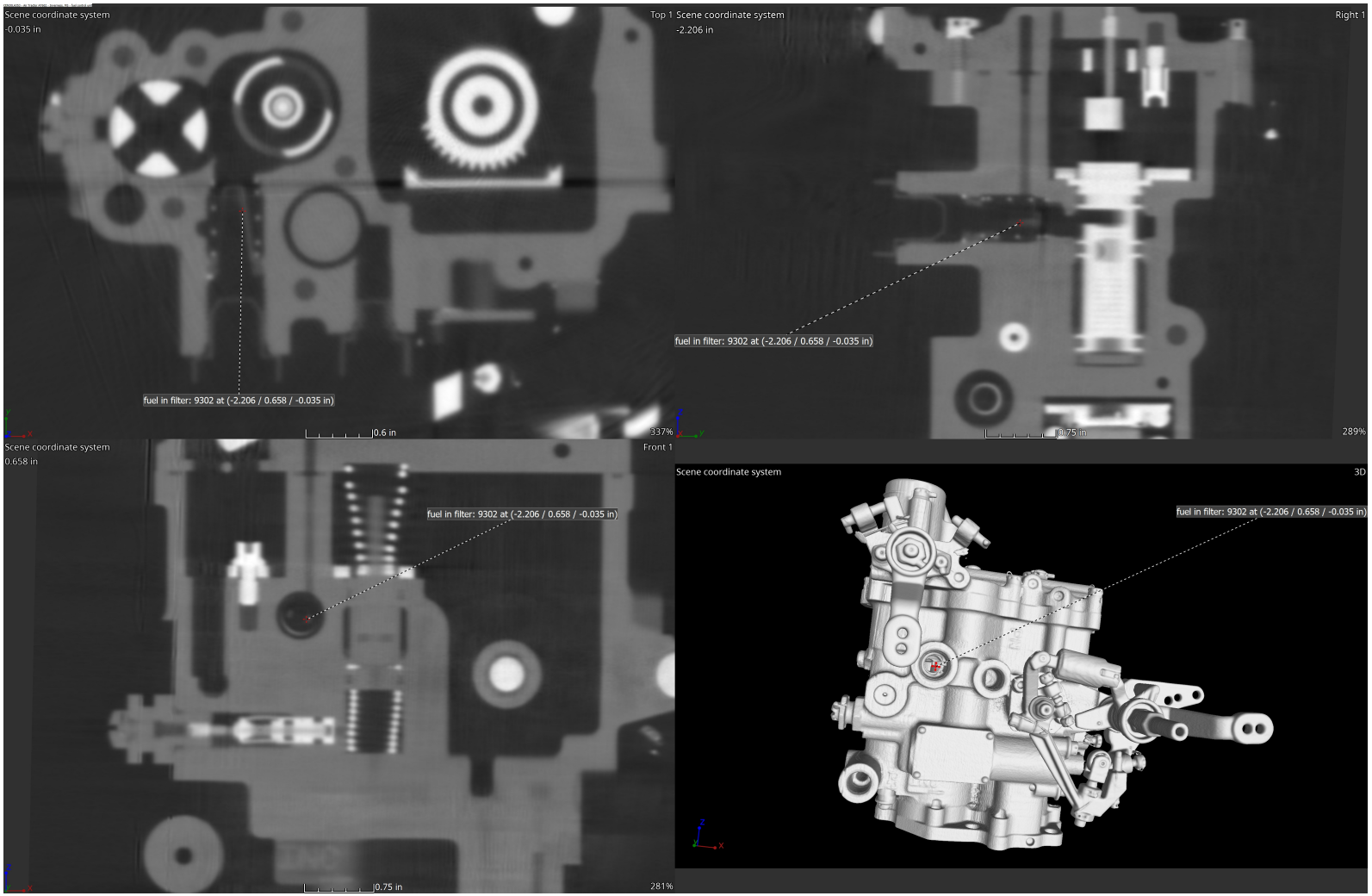


Figure 26
Fuel control unit – fuel “in” filter

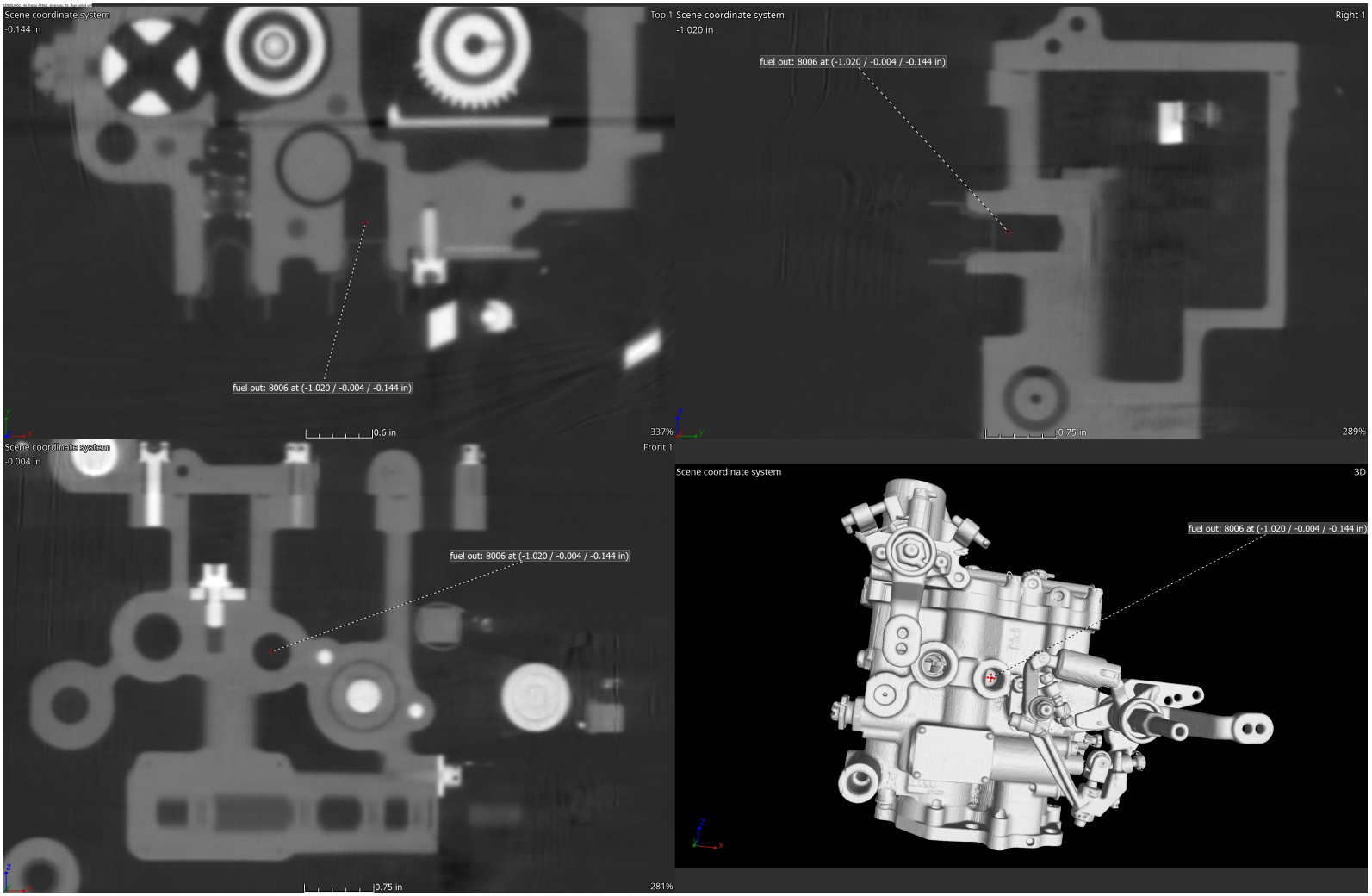


Figure 27
Fuel control unit – fuel “out” port

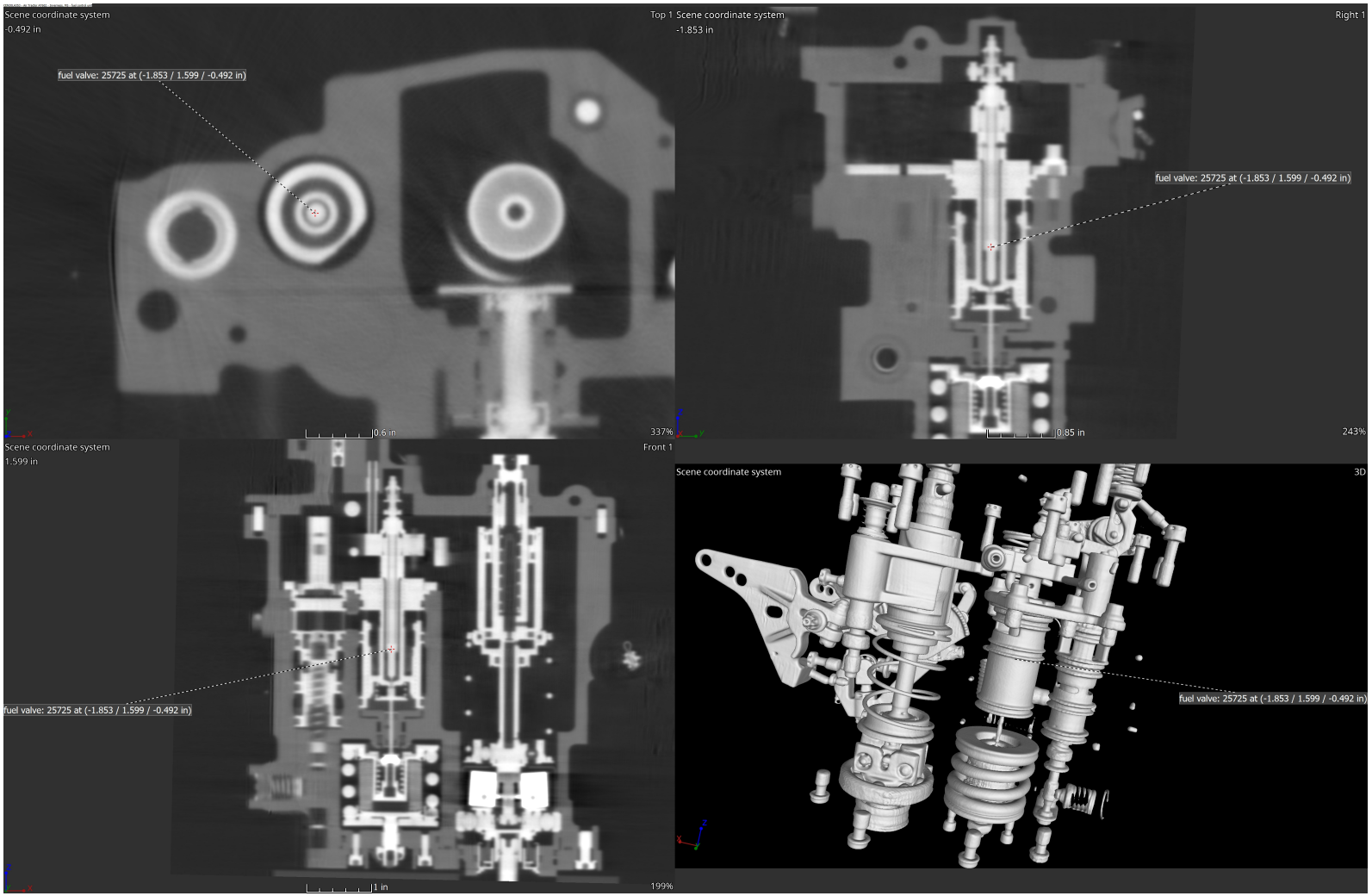


Figure 28
Fuel control unit – fuel valve

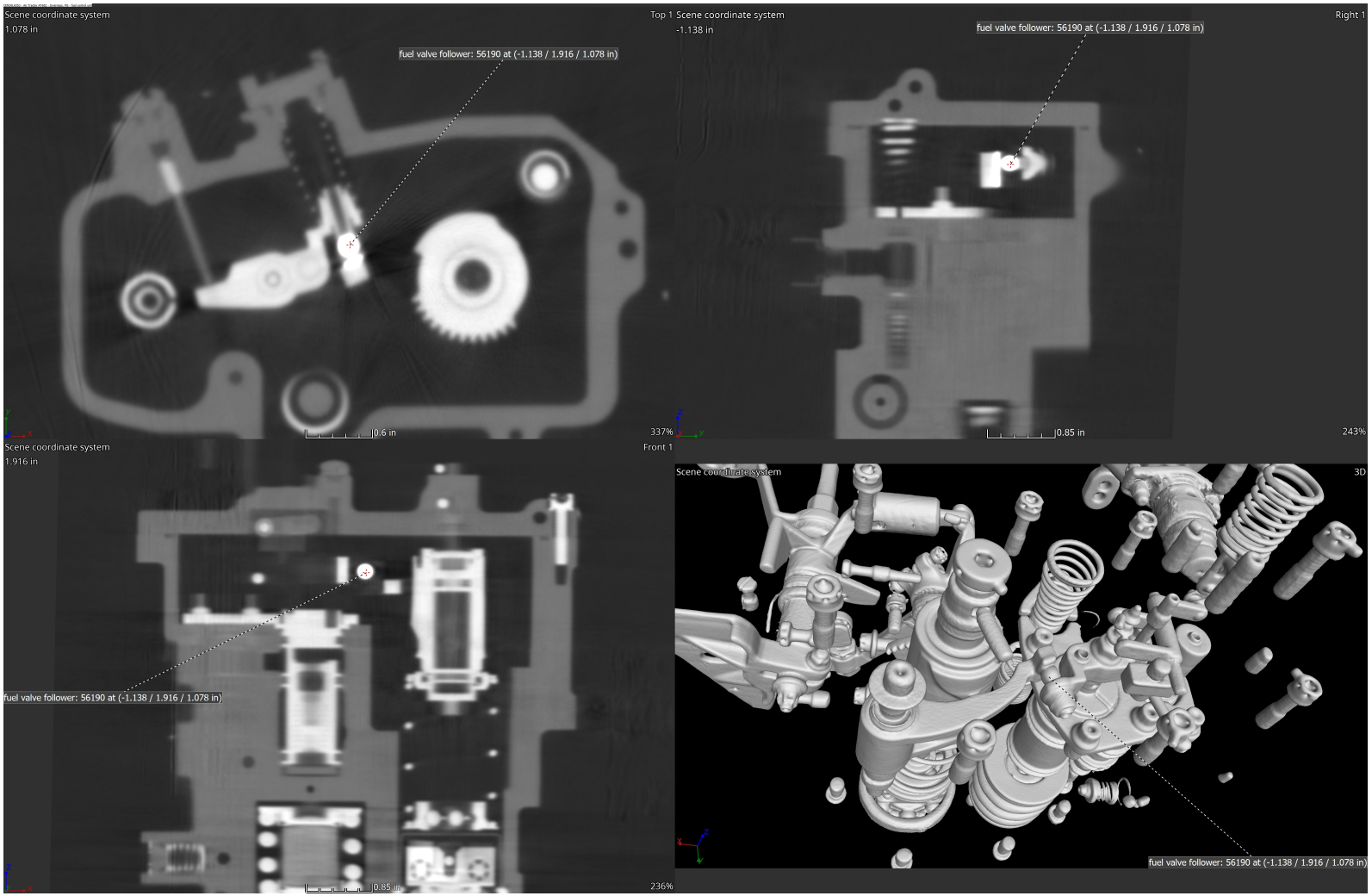


Figure 29
Fuel control unit – fuel valve follower

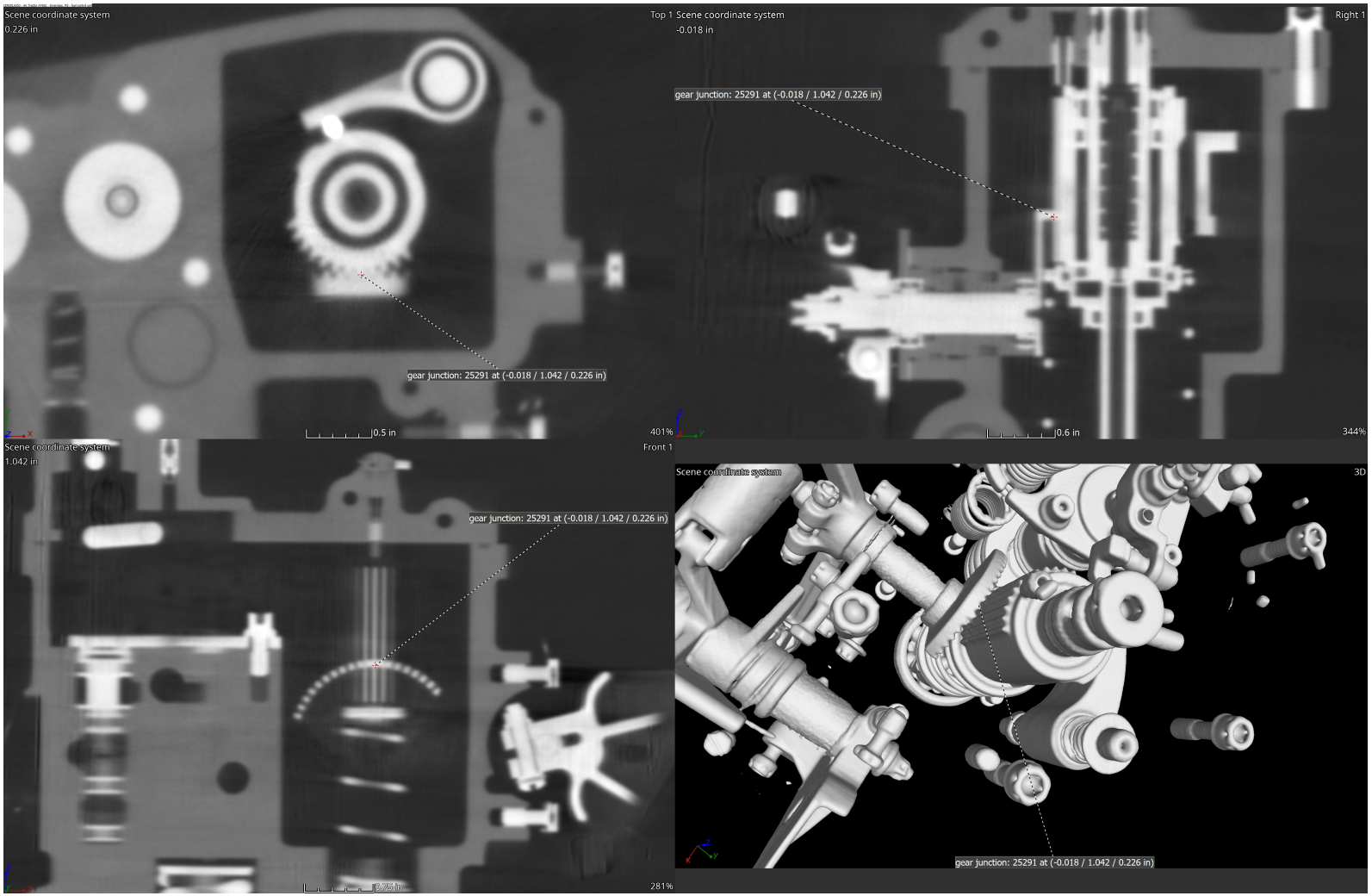


Figure 30
Fuel control unit – rack and pinion assembly - gear junction

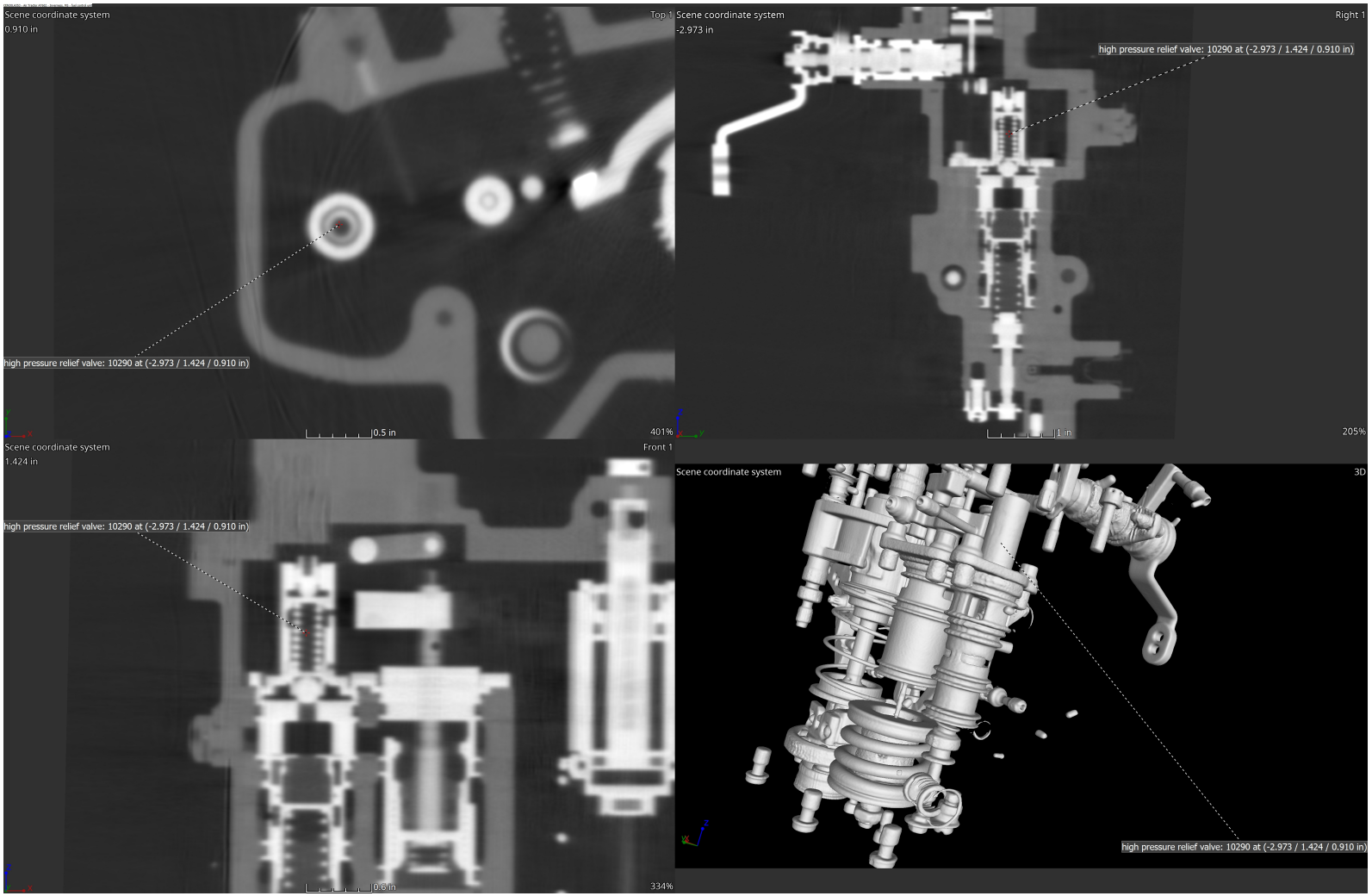


Figure 31
Fuel control unit – high pressure relief valve

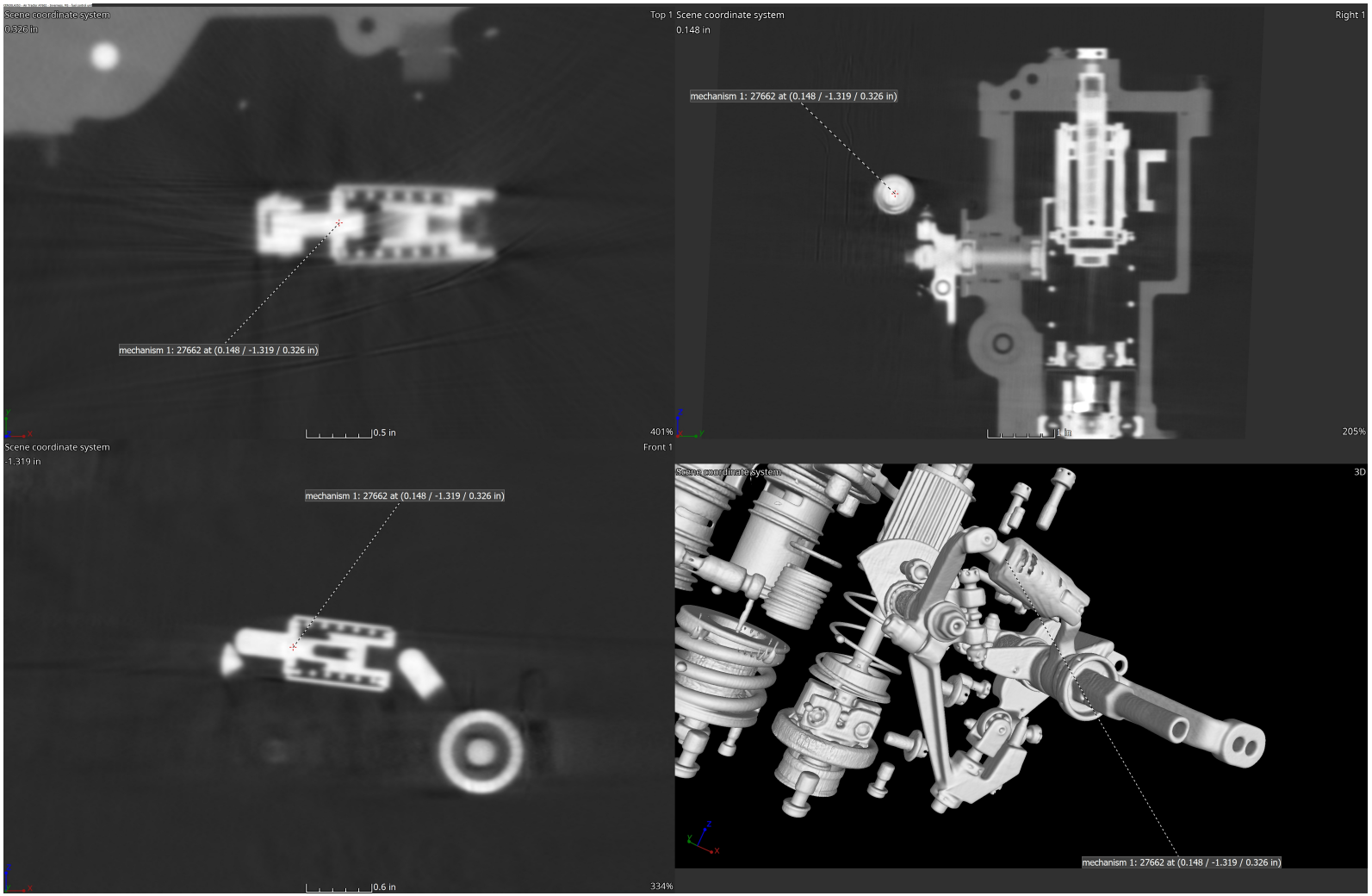


Figure 32
Fuel control unit – mechanism 1

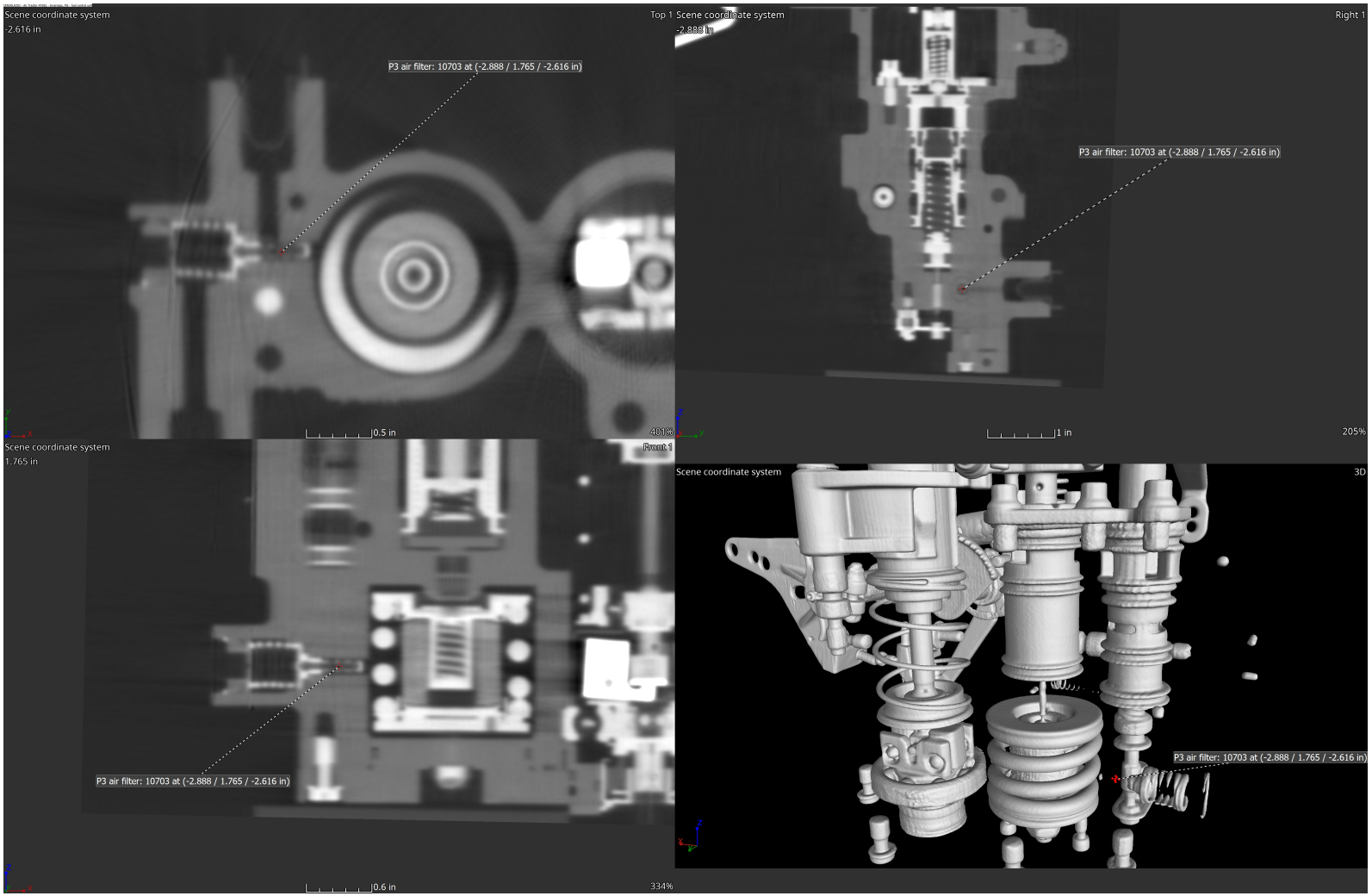


Figure 33
Fuel control unit – P3 air filter

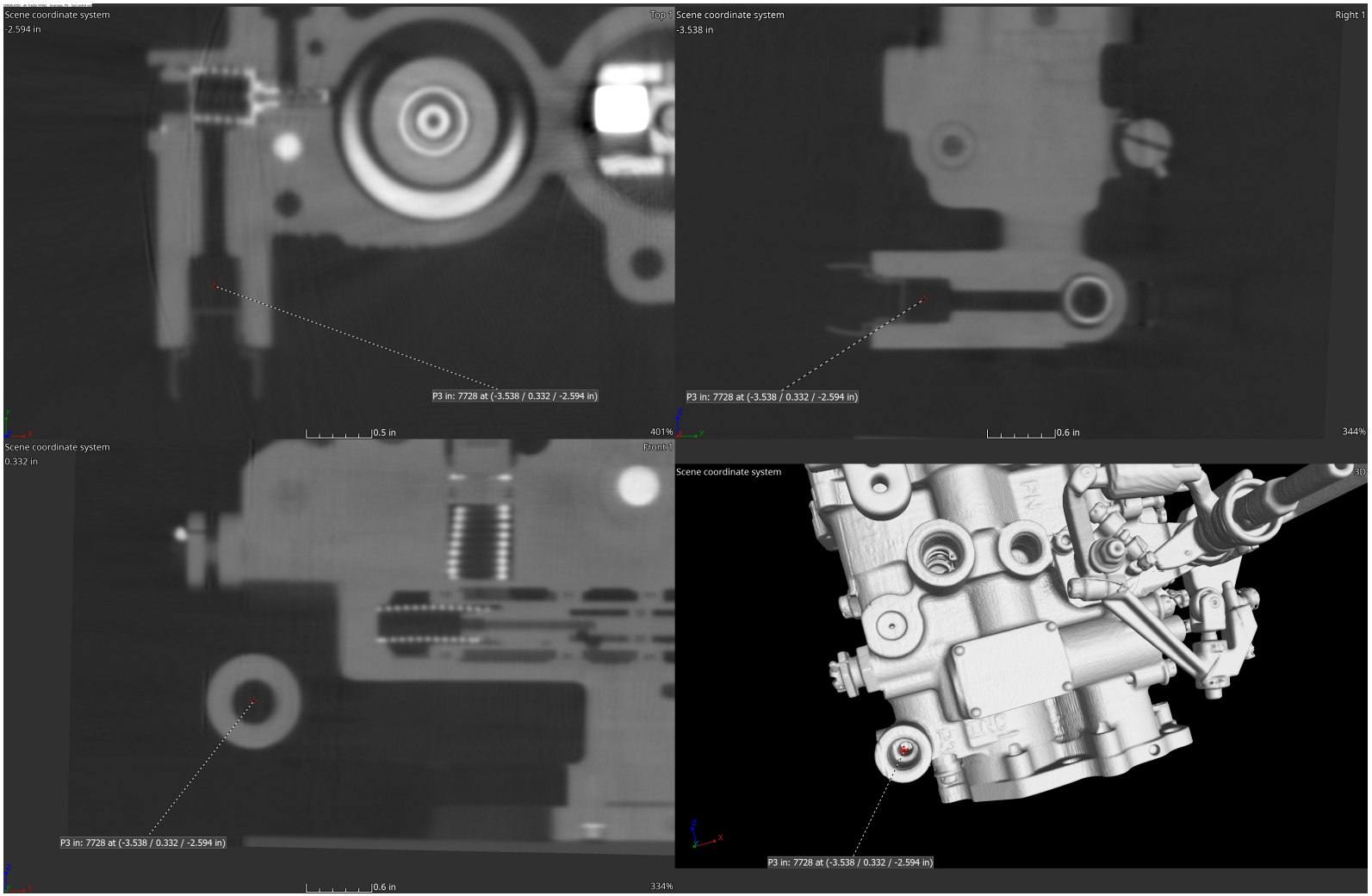


Figure 34
Fuel control unit – P3 “in” port

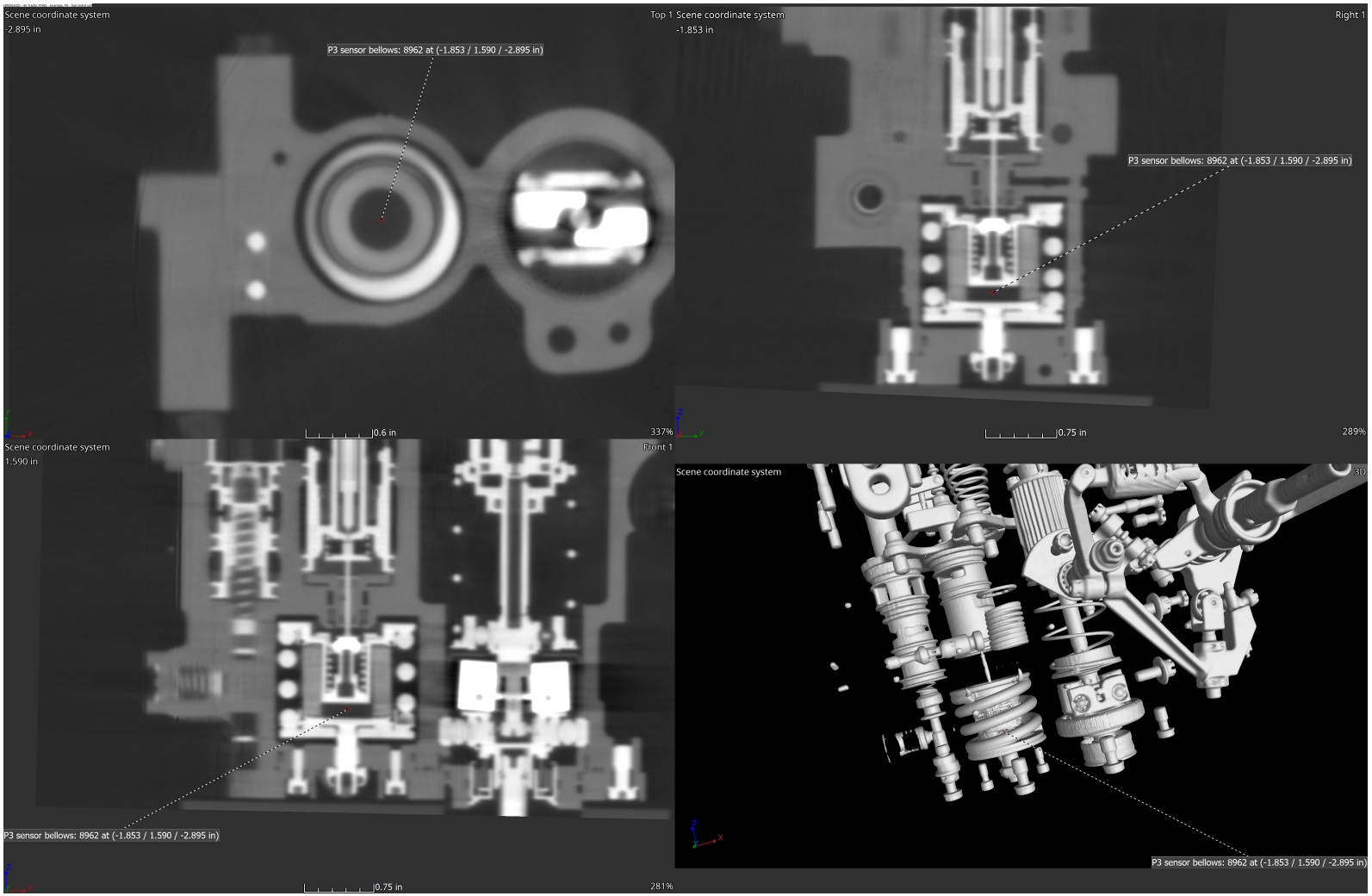


Figure 35
Fuel control unit – P3 sensor bellows

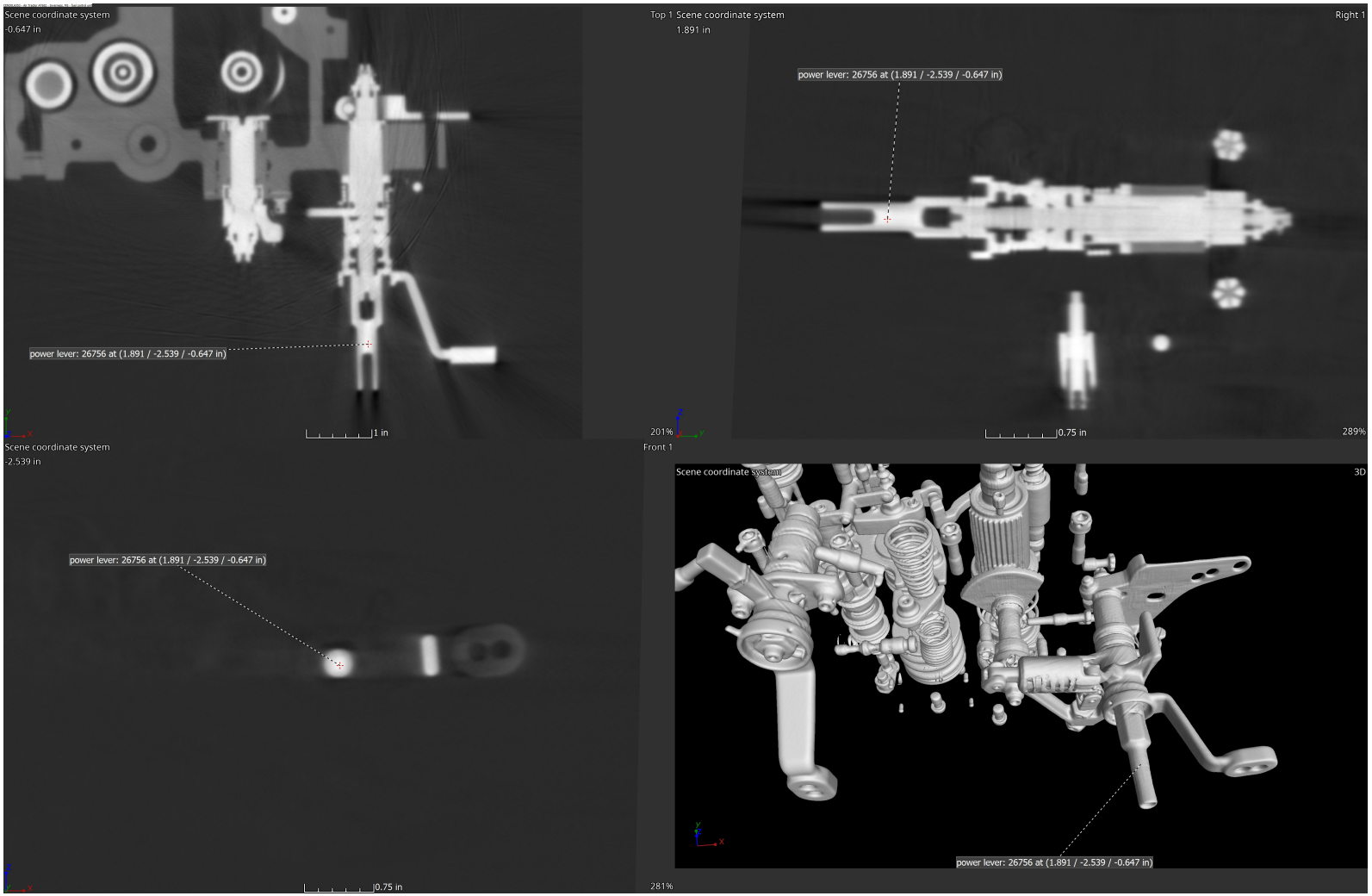


Figure 36
Fuel control unit – power lever

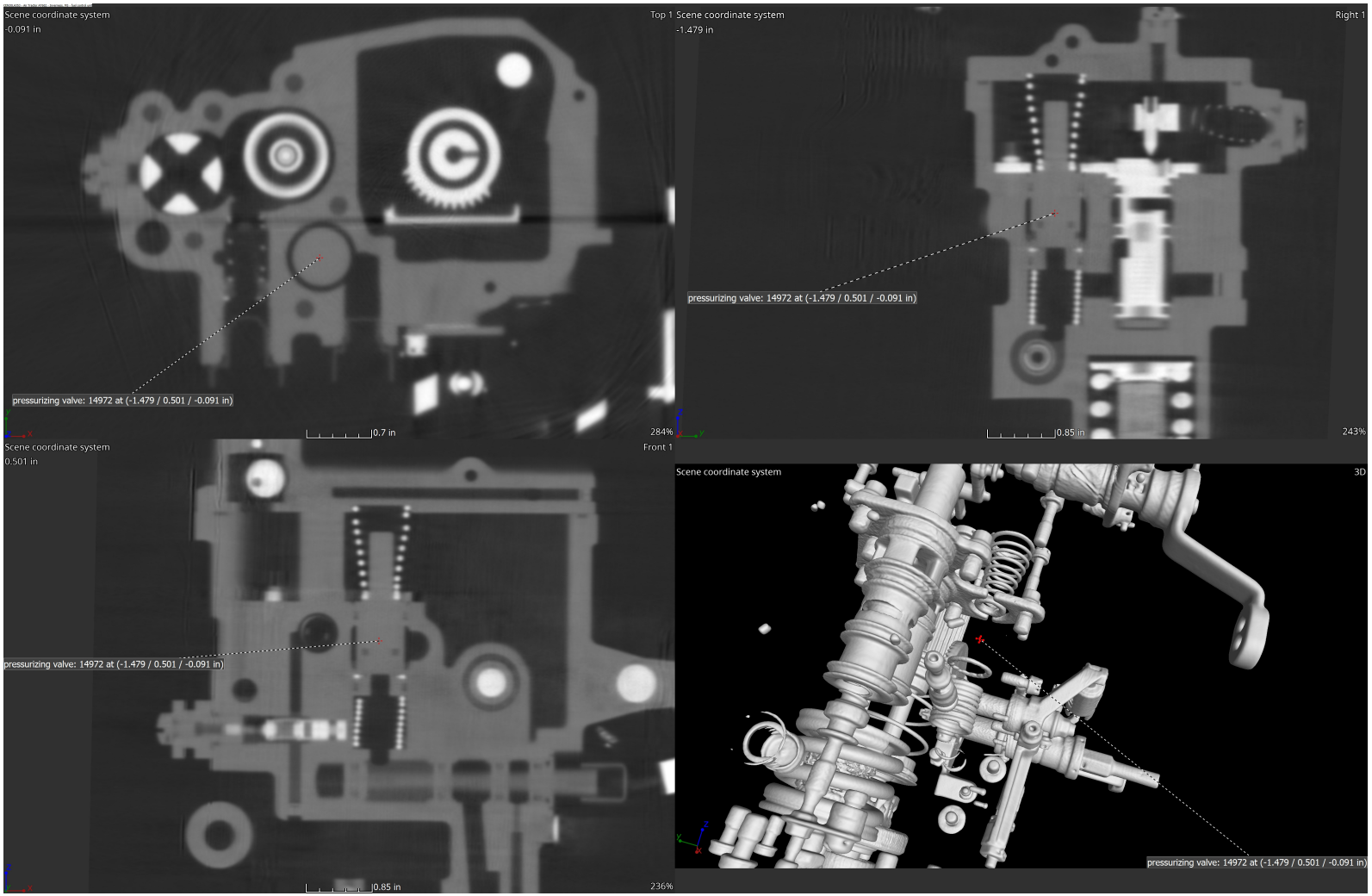


Figure 37
Fuel control unit – pressurizing valve

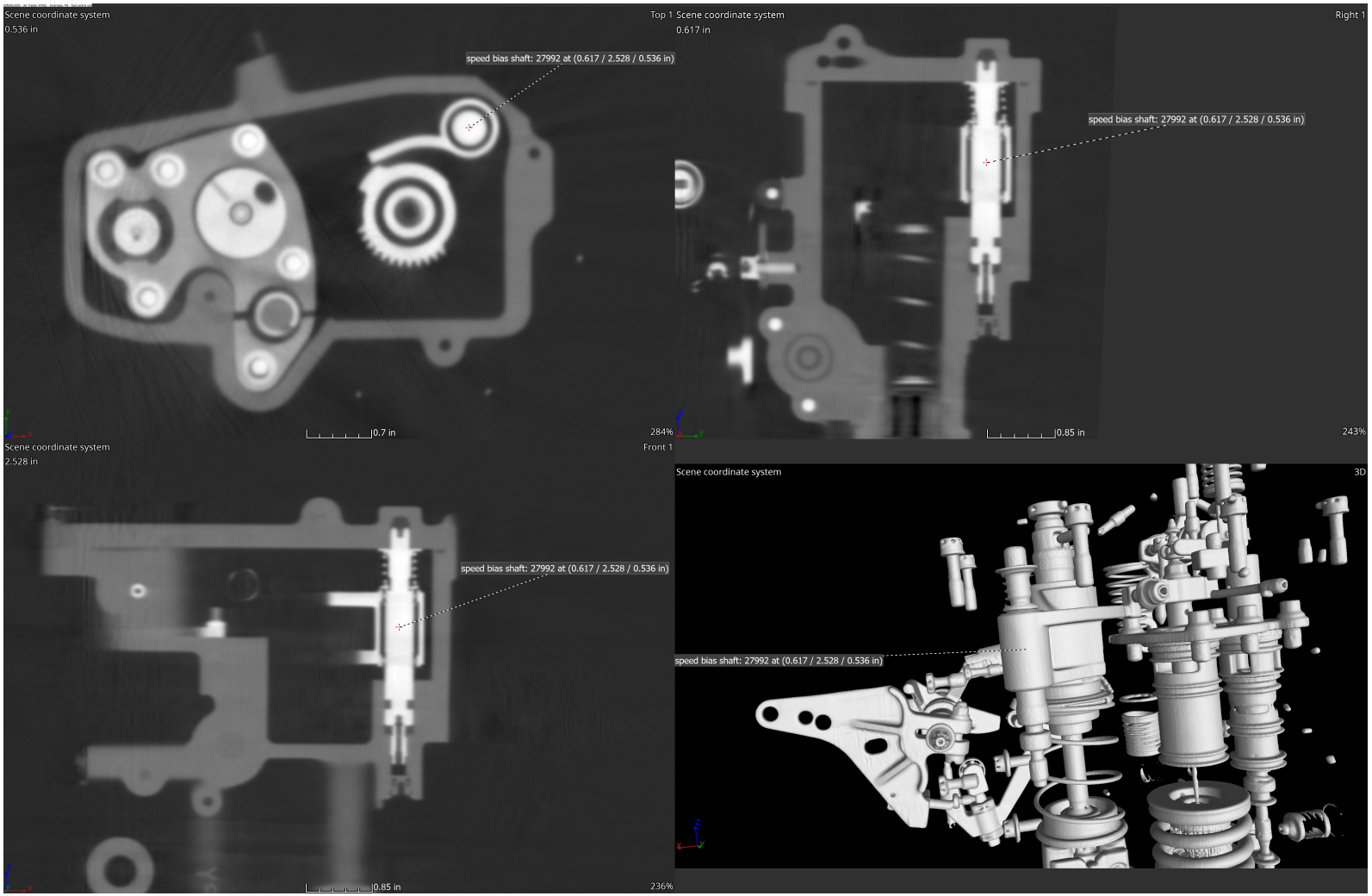


Figure 38
Fuel control unit – speed bias shaft

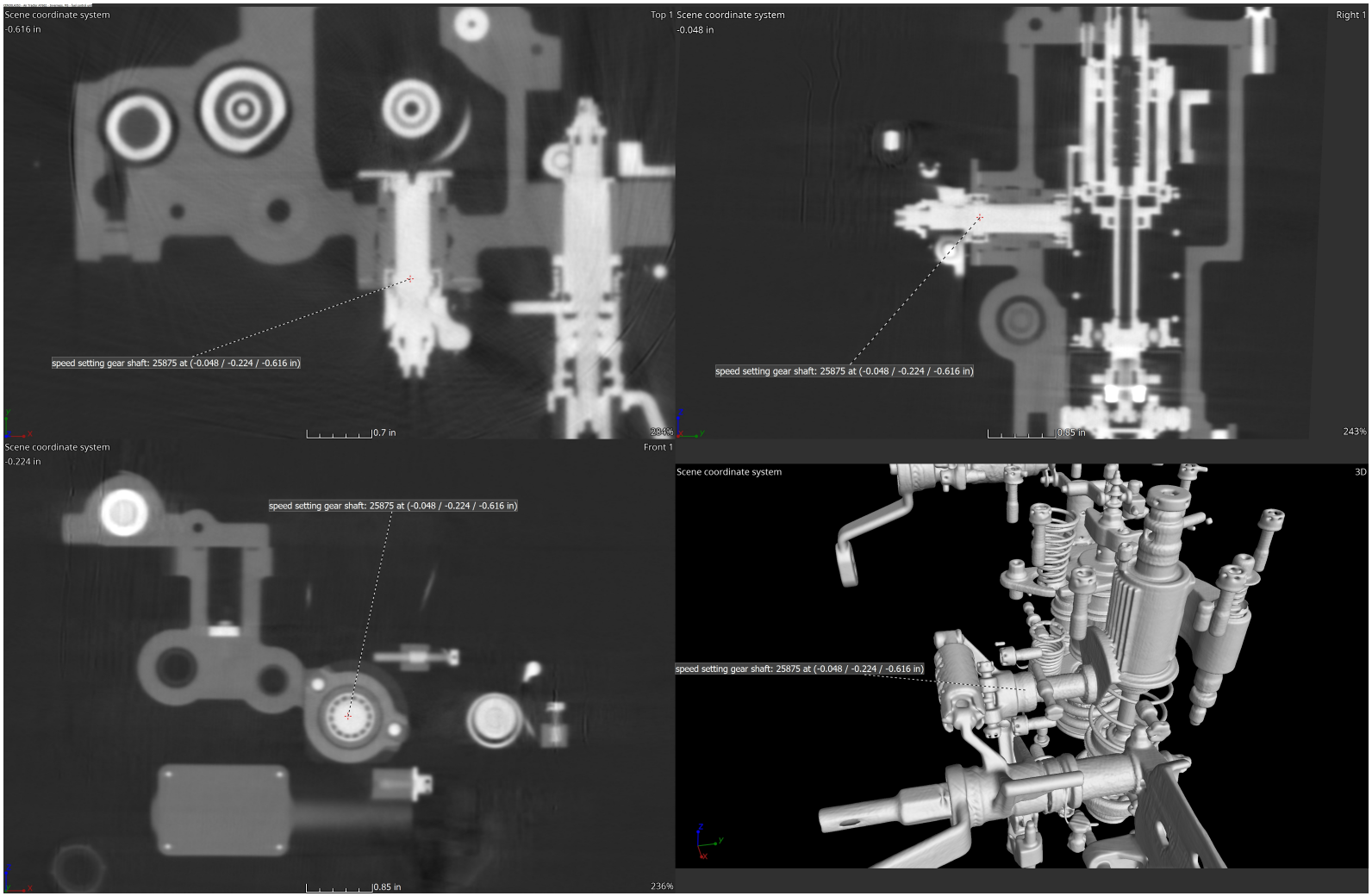


Figure 39
Fuel control unit – speed setting gear shaft

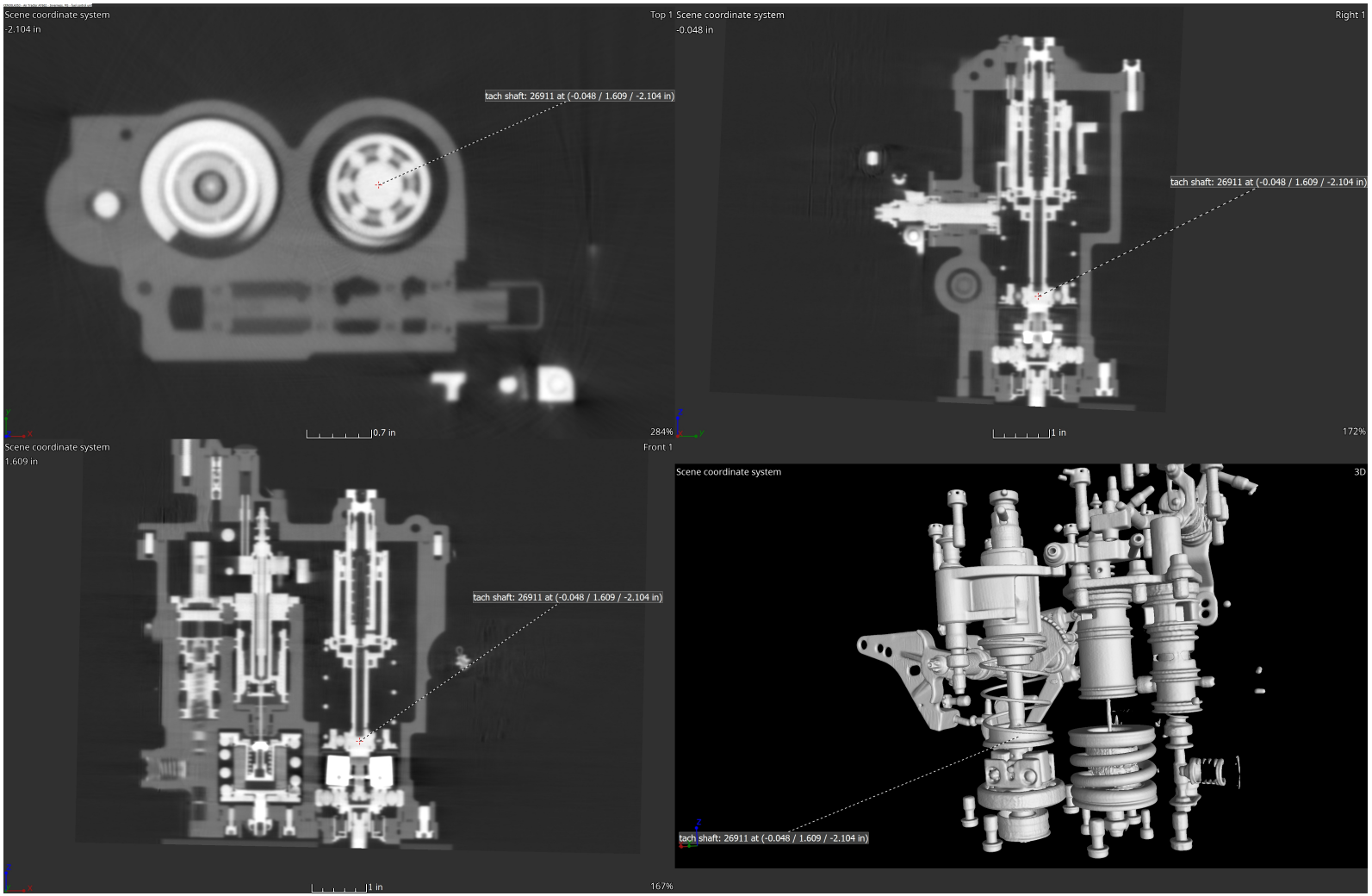


Figure 40
Fuel control unit – tach shaft

Scott Warren
Lead Aerospace Engineer
(Computed Tomography Specialist)