

National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



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COMPUTED TOMOGRAPHY

Specialist's Factual Report

March 31, 2025

TABLE OF CONTENTS

A	ACCIDENT.....	3
B	COMPUTED TOMOGRAPHY SPECIALIST.....	3
C	SUMMARY.....	3
D	DETAILS OF THE EXAMINATION.....	5
1.0	GENERAL.....	5
2.0	COMPUTED TOMOGRAPHY RESULTS.....	6

A ACCIDENT

Location: Summerville, SC
Date: May 18, 2023
Time: 0018 eastern daylight time
 0418 universal coordinated time (UTC)
Airplane: Honda Jet HA-420 N255HJ, SN 42000055

B COMPUTED TOMOGRAPHY SPECIALIST

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 Washington D.C.

C SUMMARY

On May 18, 2023, about 0018 eastern daylight time, a Honda Aircraft Company HA-420 APMG, N225HJ, was destroyed when it was involved in an accident at the Summerville Airport (DYB), Summerville, South Carolina. The commercial pilot, and the five passengers were not injured. The airplane was being operated as a Title 14 Code of Federal Regulations Part 91 personal flight.

The power brake and antiskid valve assembly (see Figure 1) was recovered from the wreckage and tested. Functional testing of the valve assembly was performed at the Honda Aircraft Company and at Crane Aerospace. The test results in one area were inconsistent leading to further examination of the valve assembly. The valve was sent to Varex Imaging for computed tomography (CT) scanning to document its internal condition and look for any indications of contamination or debris inside the valve. A figure of the valve with its ports and components labeled is provided in Figure 2.

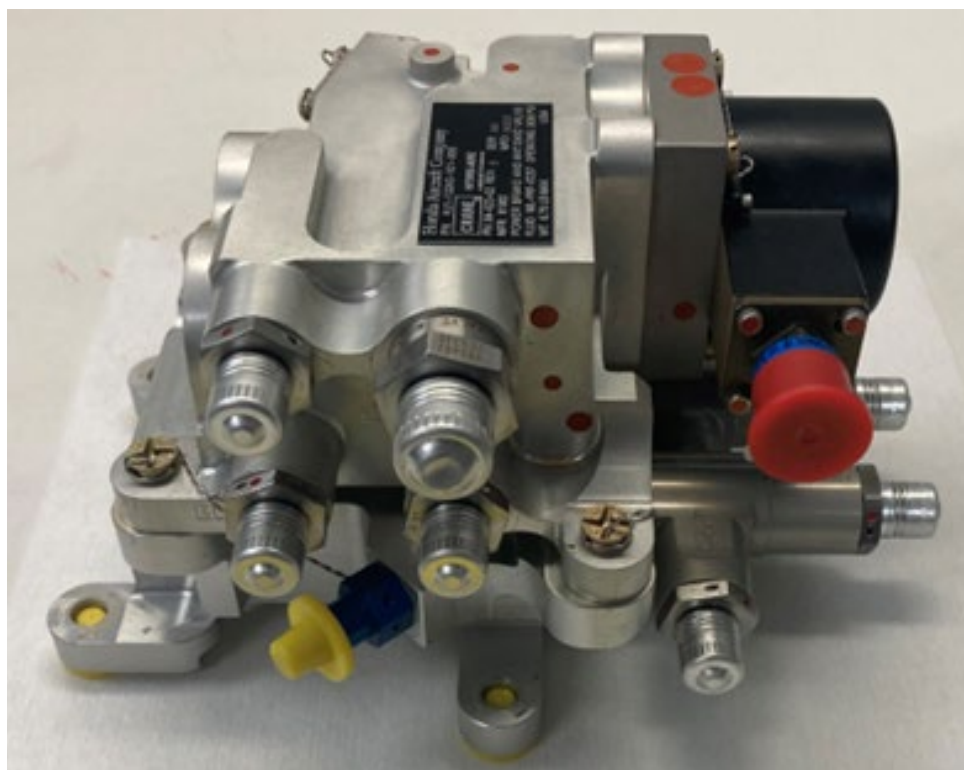


Figure 1. Photo of an exemplar power brake and antiskid valve assembly.

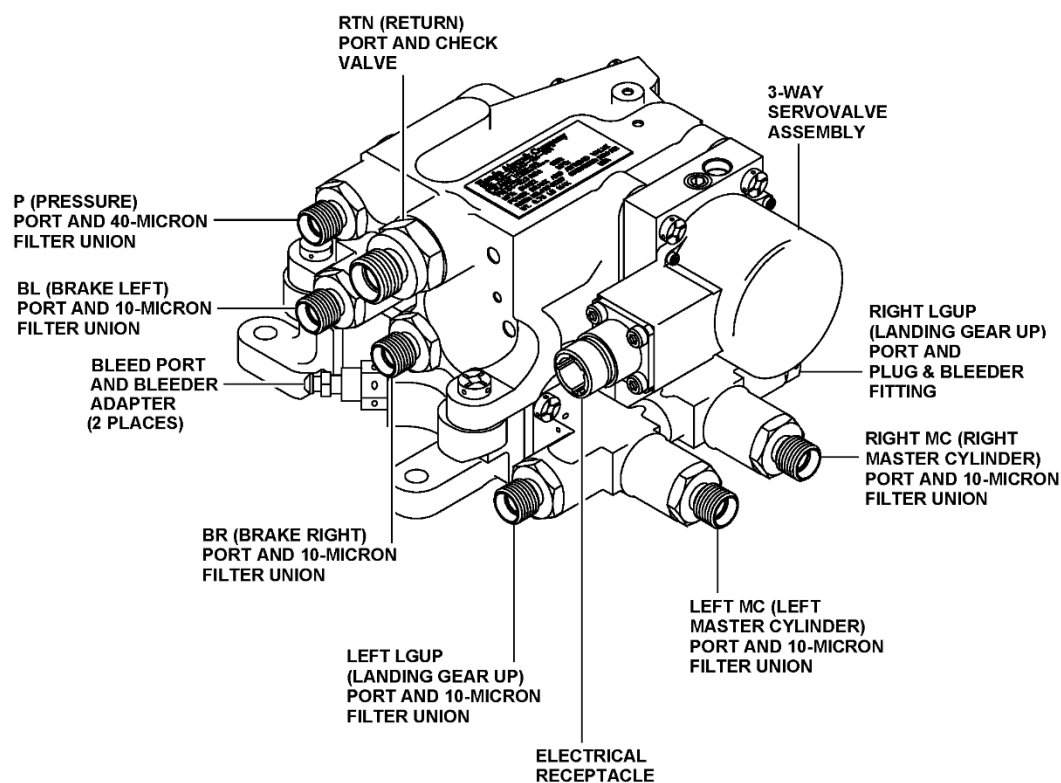


Figure 2. Figure of the power brake and antiskid valve assembly with the ports and components labeled. (Courtesy of Crane Aerospace & Electronics)

D DETAILS OF THE EXAMINATION

1.0 General

The power brake and antiskid valve assembly was subjected to computed tomography (CT) scanning to document its internal condition and look for any indications of contamination or debris inside the valve. The scanning was conducted on December 18, 2024, in Chicago, Illinois by Varex Imaging, Inc under the direction of the NTSB using the 6 MV Linatron with 4343 high energy (HE) detector CT system.

For the CT scan, 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 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 using a total of 750 slices, and the total size of the combined data sets was approximately 804 MB. The complete scan protocols are given in Table 1.

Table 1. Scan Protocol

CT System	6 MV Linatron with 4343 HE detector
Component/Area	Entire power brake anti-skid valve
Number of Slices	750
Voxel ¹ Size - X Direction (millimeter(mm))	0.3
Voxel Size - Y Direction (mm)	0.3
Voxel Size - Z Direction (mm)	0.3
Image Projections per Revolution	3600
Exposure Time (milliseconds)	1000
Frames to Avg (frames per projection)	1
X-ray Source Voltage (kilovolts)	6000
X-ray Source Current (Hz)	315
Source Filter Thickness (mm)	10.34
Source Filter Material	copper
Image Matrix Size (pixels)	750 x 750
Reconstruction Software	Conebeam Software Toolkit 2.5.0.22

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

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 component were digitally removed or rendered transparent to allow closer observation of interior parts. In all the images, the higher density areas were shown as brighter shades of gray and lower density areas were shown as darker shades of gray. Each 2-D quadrant within the images shows a scale at the bottom of that quadrant - note that the scales in each quadrant may be different. The pointers shown in some of the images denote specific areas of interest within that image. The numbers associated with the pointer are the gray value at the pointer location and the three positional coordinates of the pointer.

The valve structures were "virtually unrolled" using the CT image visualization software. This process required the identification of a path for the software to use when unrolling the data set, and it resulted in a cylindrical structure being "unrolled" to show a round surface as a flat planar image.

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 CT results for the power brake and antiskid valve assembly are shown in Figures 3 through 48. Review of the images indicated that when the scans were conducted the following items were observed. There were no indications of damaged or missing parts.

- 1) Figures 3 through 9 show the exterior of the valve assembly, the ports and the nomenclature of the ports.
- 2) Figures 10 through 13 show the pressure port and pressure passages.
- 3) Figures 14 through 16 show the servo valve and its filter screen.
- 4) Figures 17 through 22 show the left and right brake control valves.
- 5) Figures 22 through 35 show the left and right master cylinder metering valves and components. There were some indications of low-density material near the left master cylinder (MC) metering valve (see Figure 23)
- 6) Figures 36 through 39 show the exterior of the valve assembly, the ports and the nomenclature of the ports.
- 7) Figures 40 through 46 show the exterior of the valve assembly, the ports and the nomenclature of the ports.
- 8) Figure 47 shows the return port.
- 9) Figure 48 shows the servo valve electrical connector.

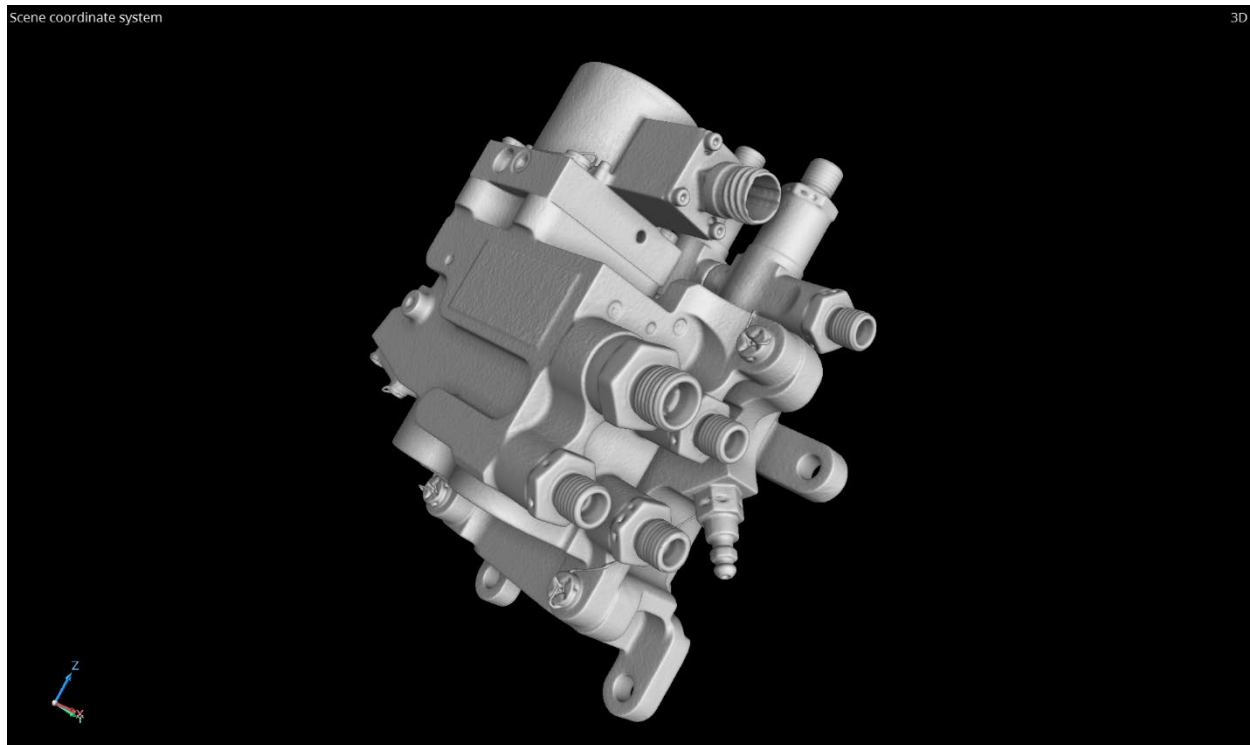


Figure 3. Power brake and antiskid valve assembly - isometric view.

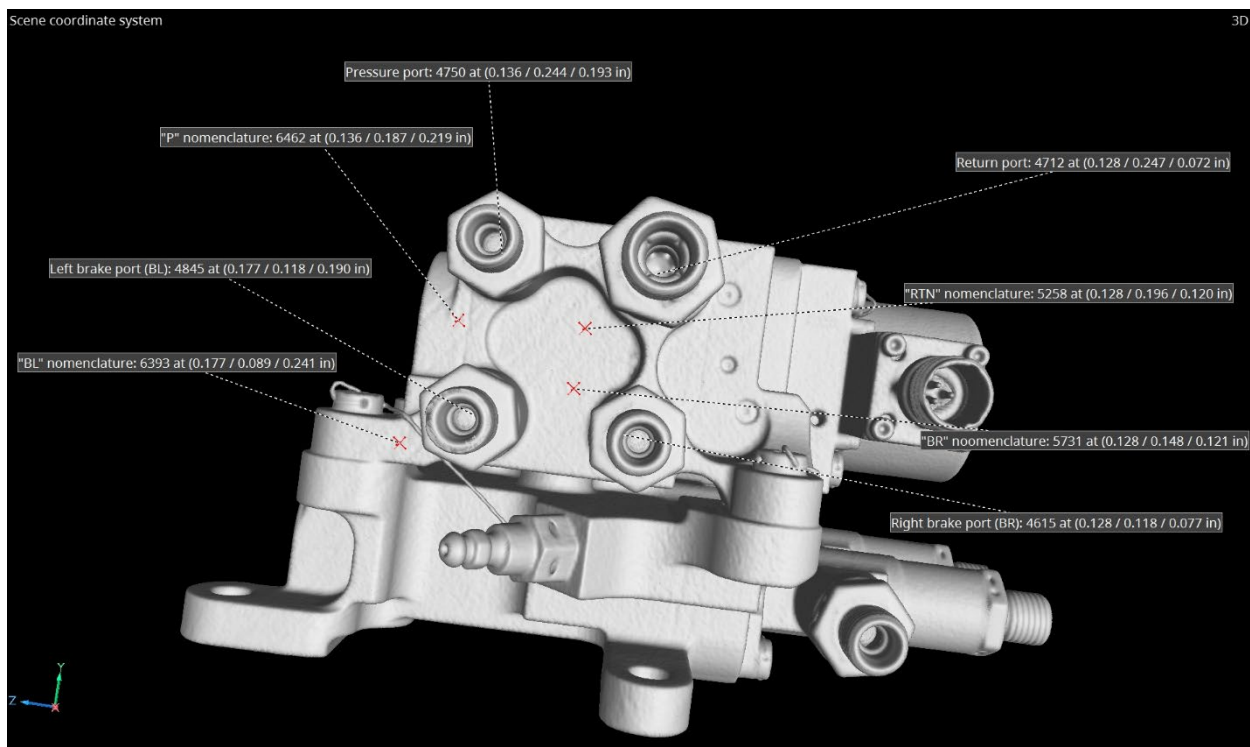


Figure 4. Power brake and antiskid valve assembly with the pressure, return, brake left, and brake right ports labeled.

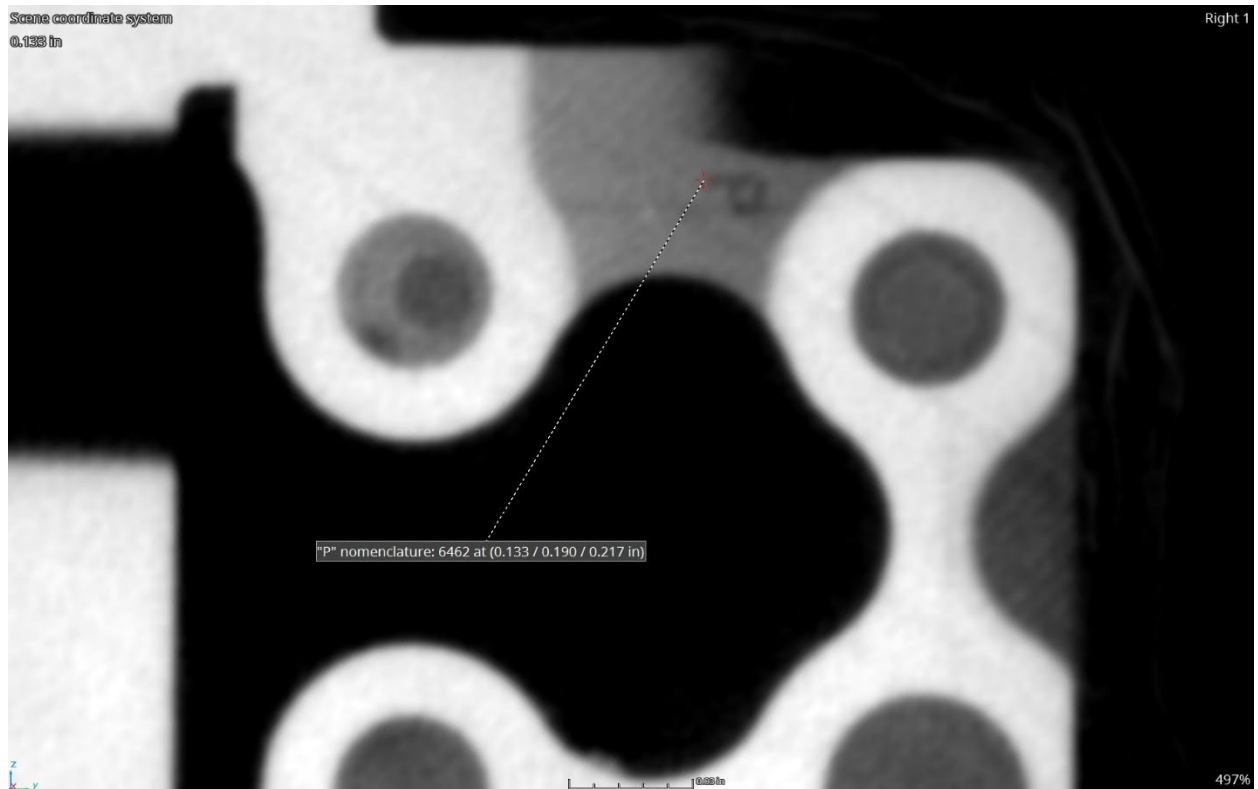


Figure 5. Power brake and antiskid valve assembly - pressure (P) port nomenclature.

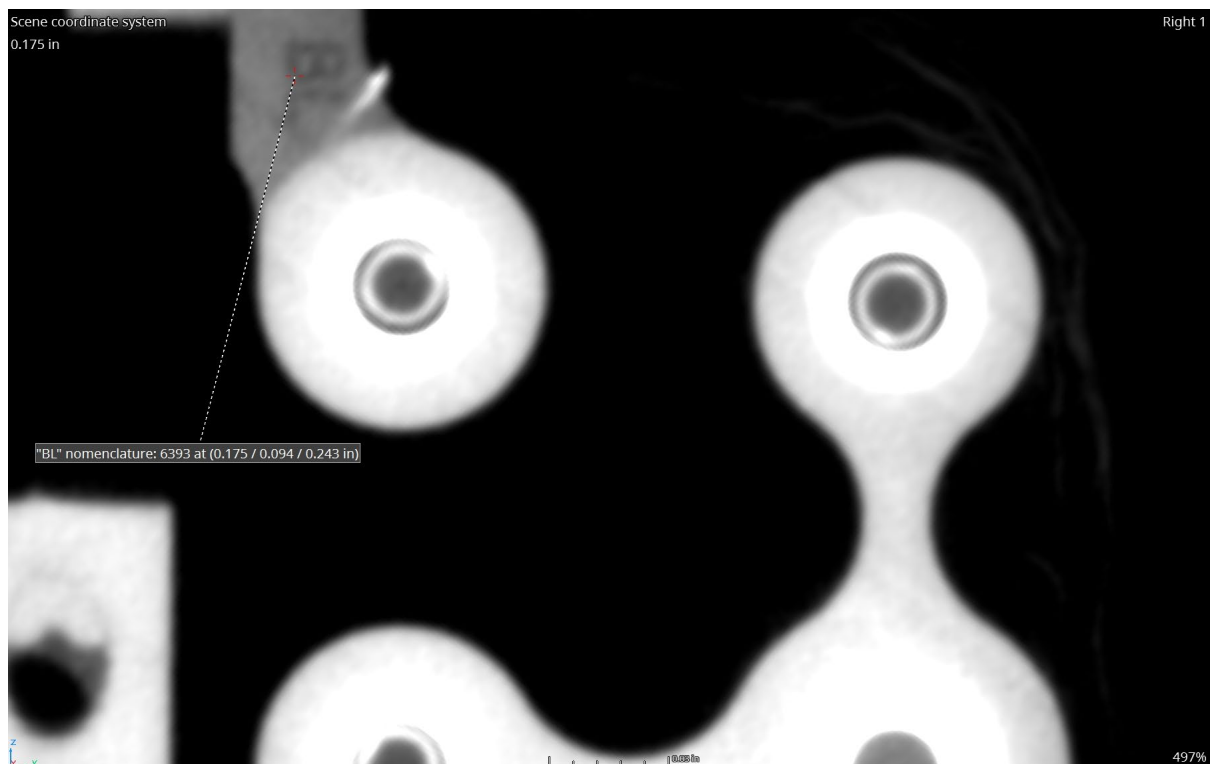


Figure 6. Power brake and antiskid valve assembly - brake left (BL) port nomenclature.

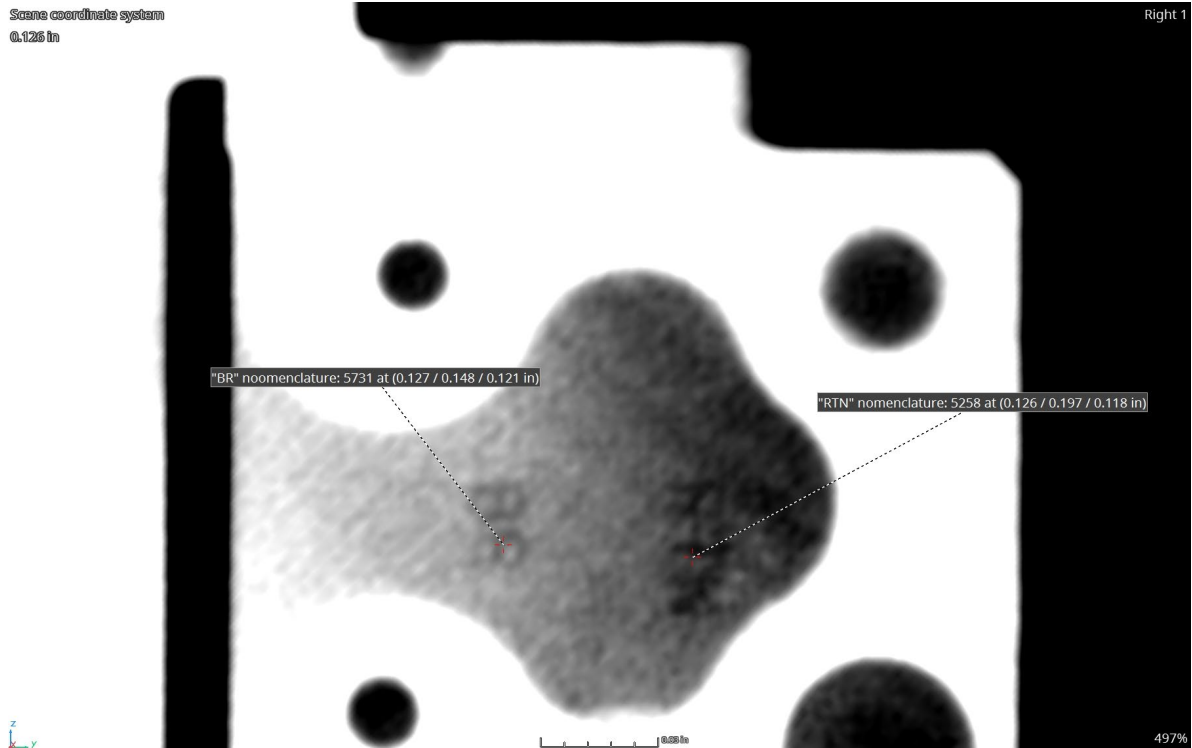


Figure 7. Power brake and antiskid valve assembly - brake right (BR) port and return (RTN) port nomenclature.

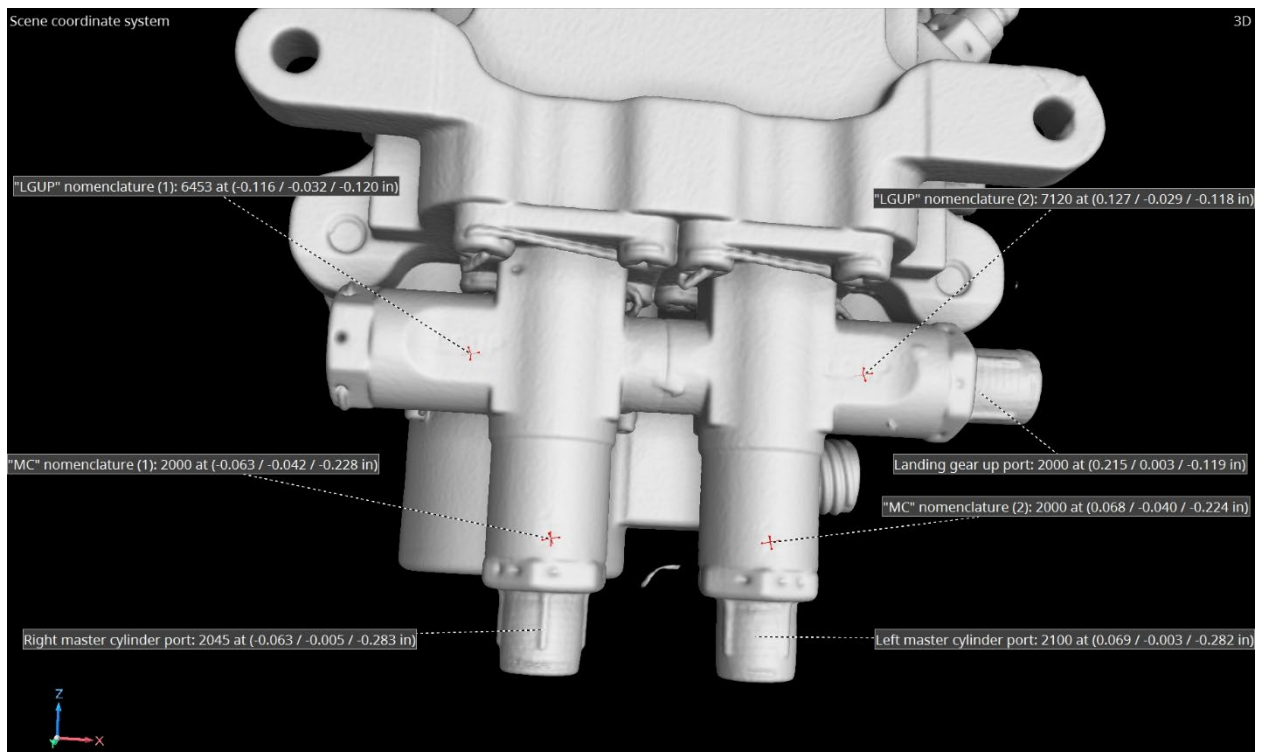


Figure 8. Power brake and antiskid valve assembly with the landing gear up, left master cylinder, and right mater cylinder ports labeled.

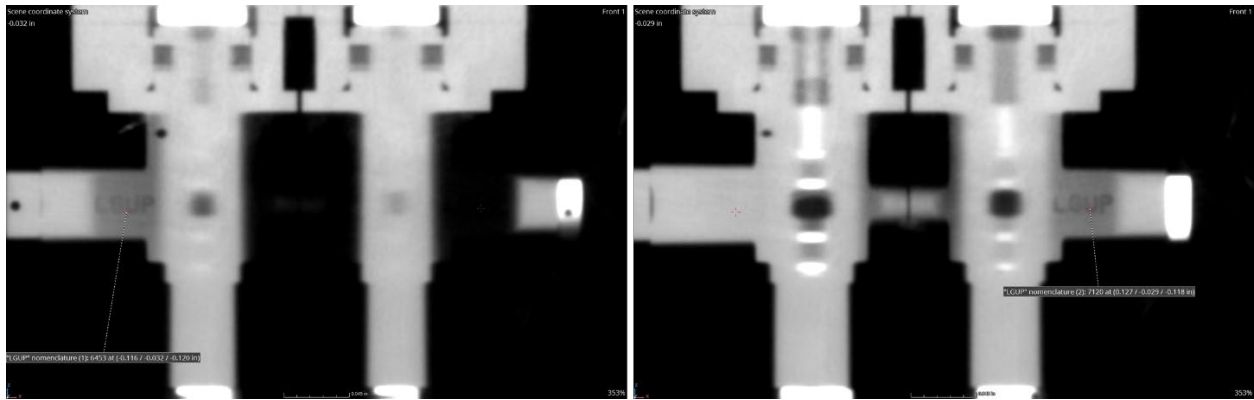


Figure 9. Power brake and antiskid valve assembly - "LGUP" port nomenclature.

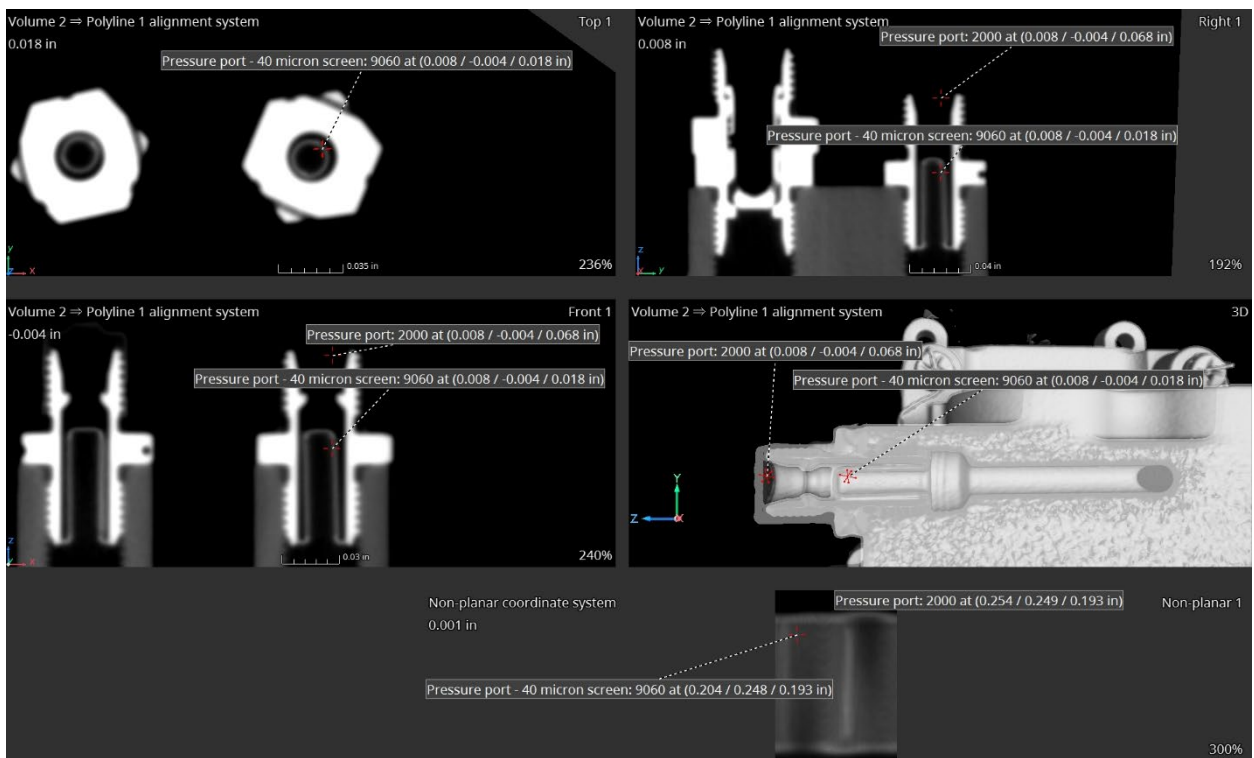


Figure 10. Power brake and antiskid valve assembly - pressure port and 40 micron screen.

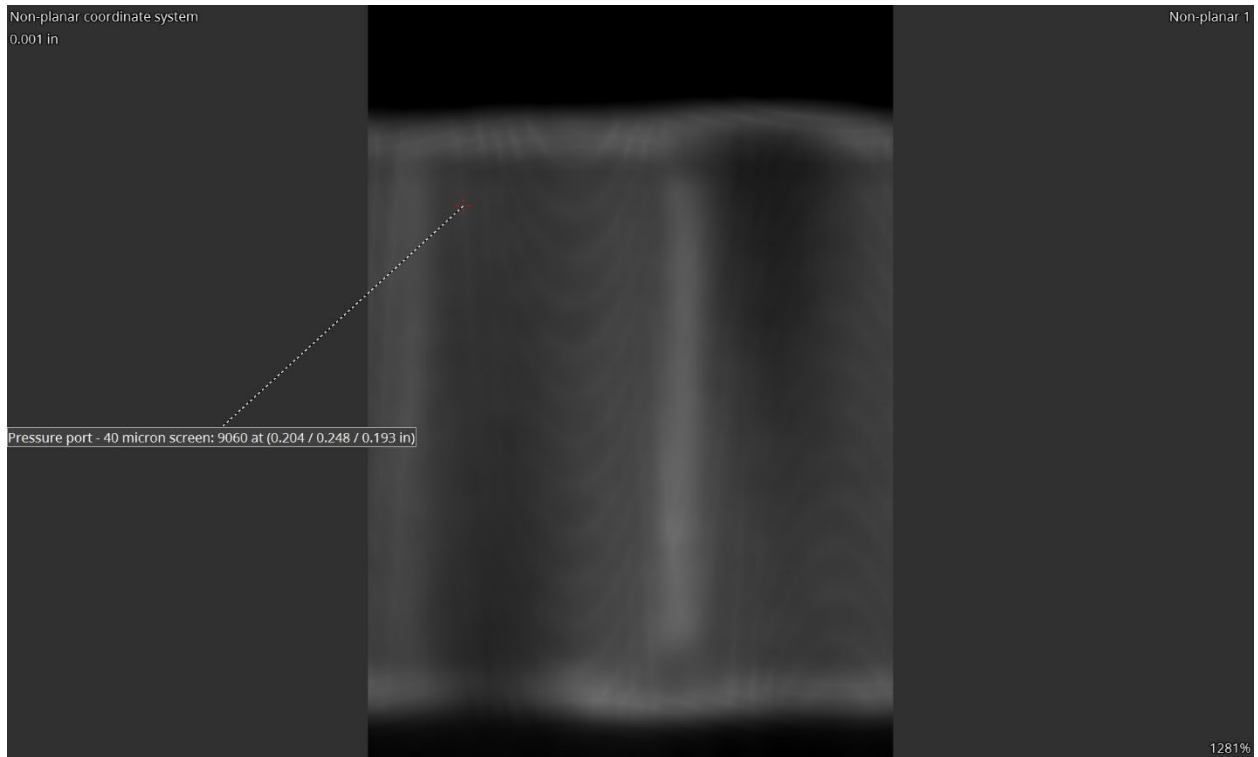


Figure 11. Power brake and antiskid valve assembly - pressure port 40 micron screen unrolled.



Figure 12. Power brake and antiskid valve assembly - pressure passages.

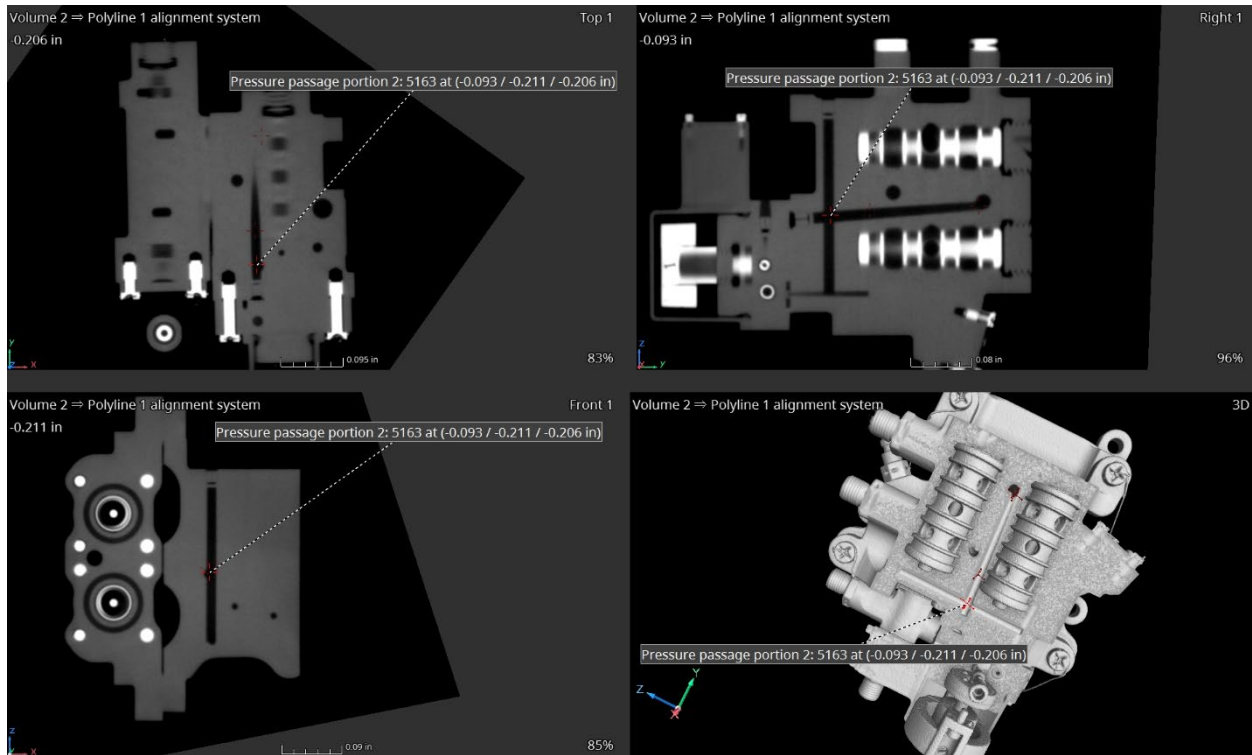


Figure 13. Power brake and antiskid valve assembly - additional pressure passages.

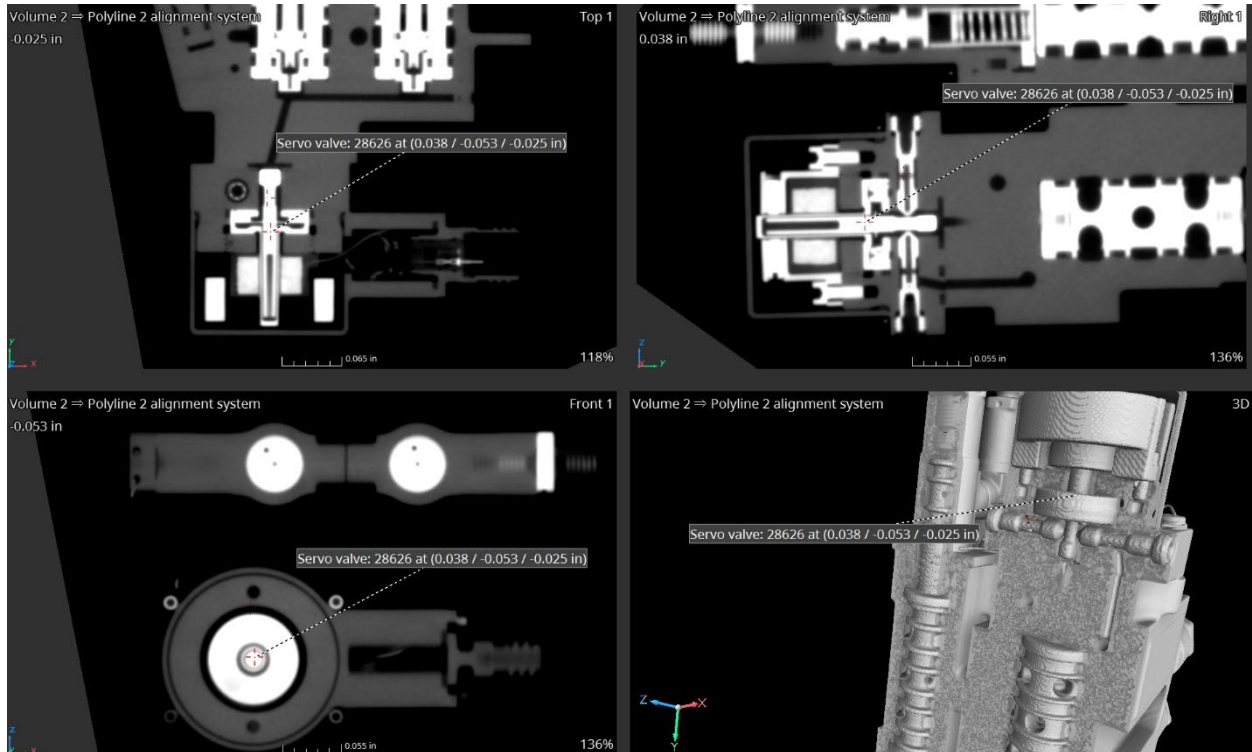


Figure 14. Power brake and antiskid valve assembly - servo valve.

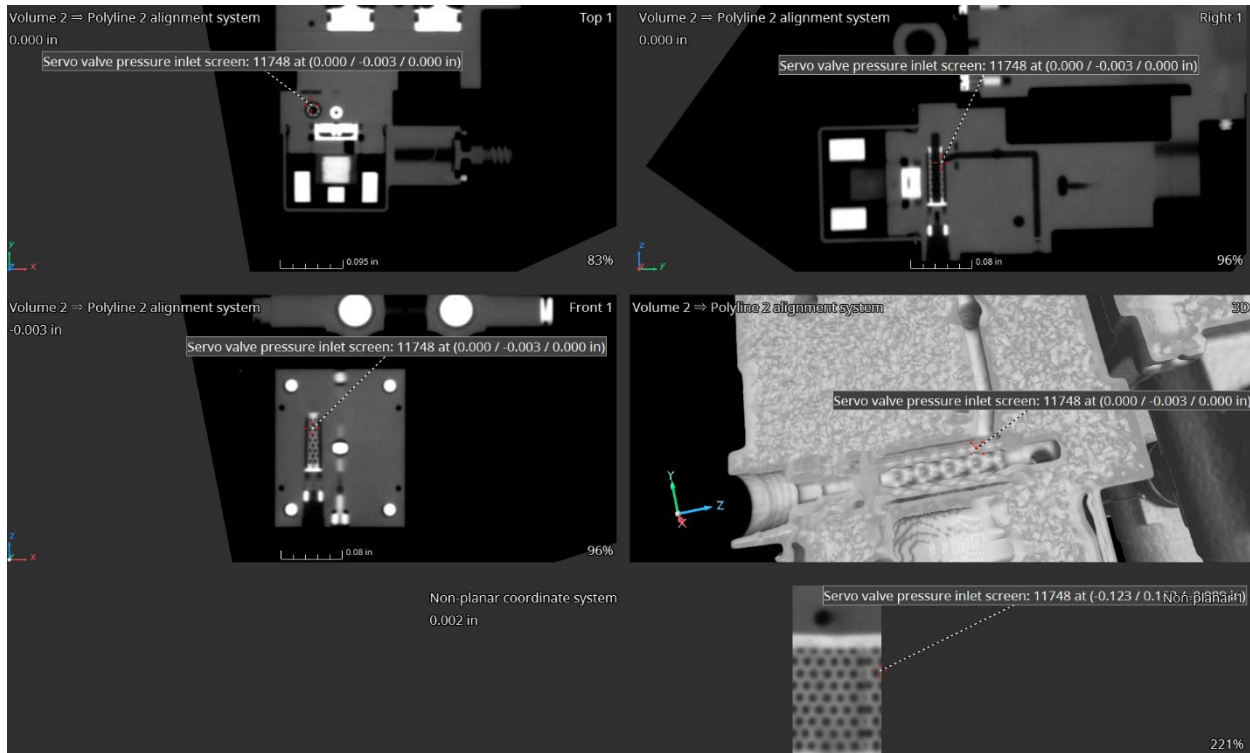


Figure 15. Power brake and antiskid valve assembly – servo valve inlet port and inlet screen.

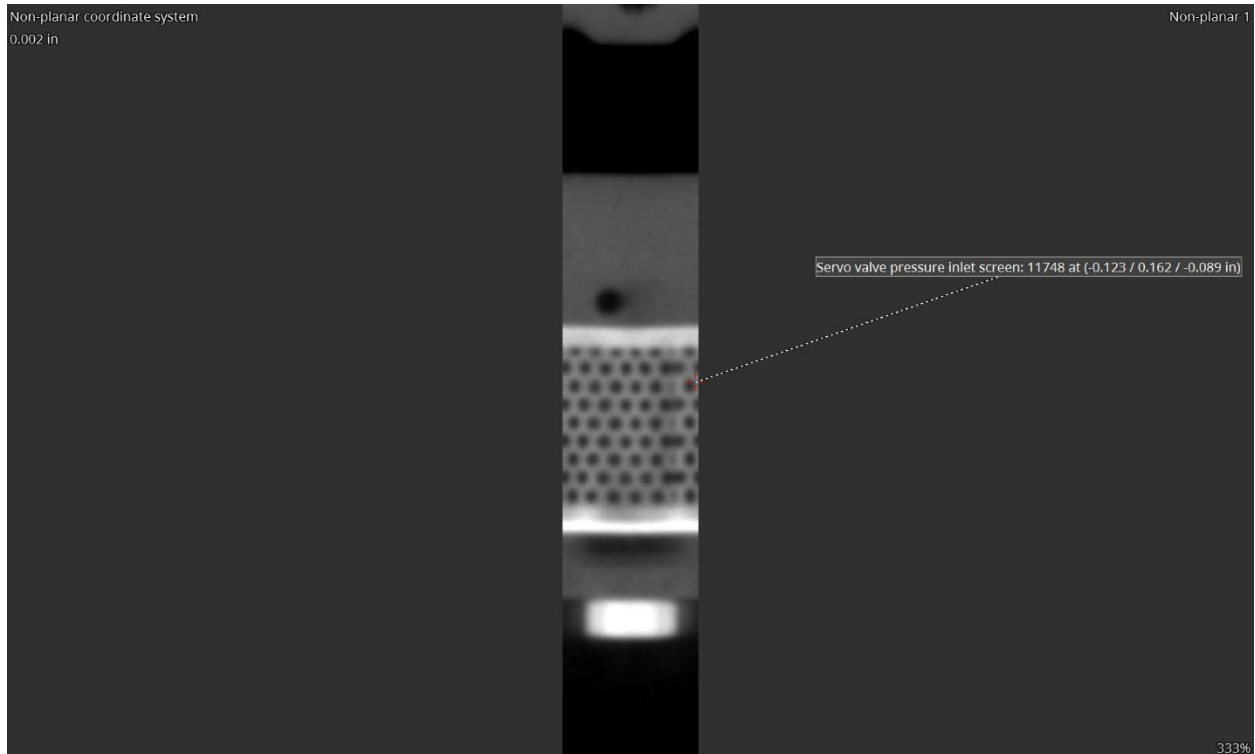


Figure 16. Power brake and antiskid valve assembly - servo valve inlet screen unrolled.

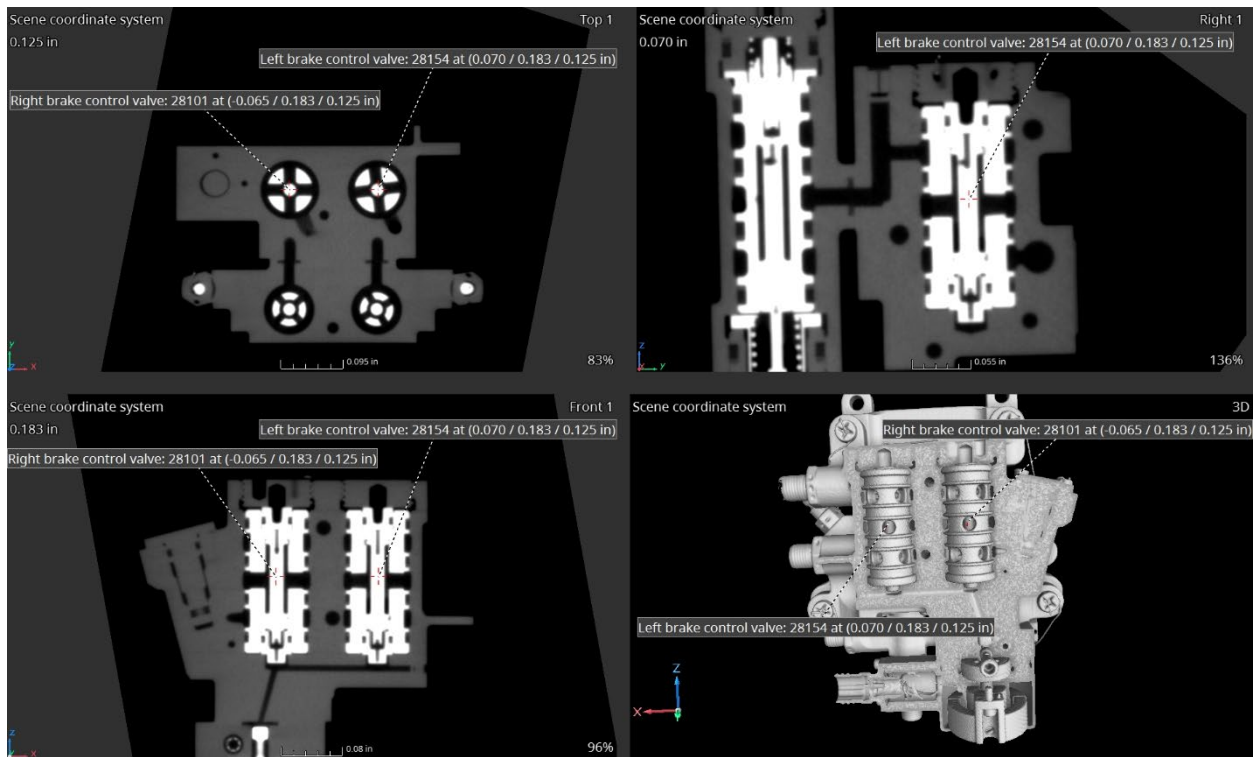


Figure 17. Power brake and antiskid valve assembly - brake control valve.

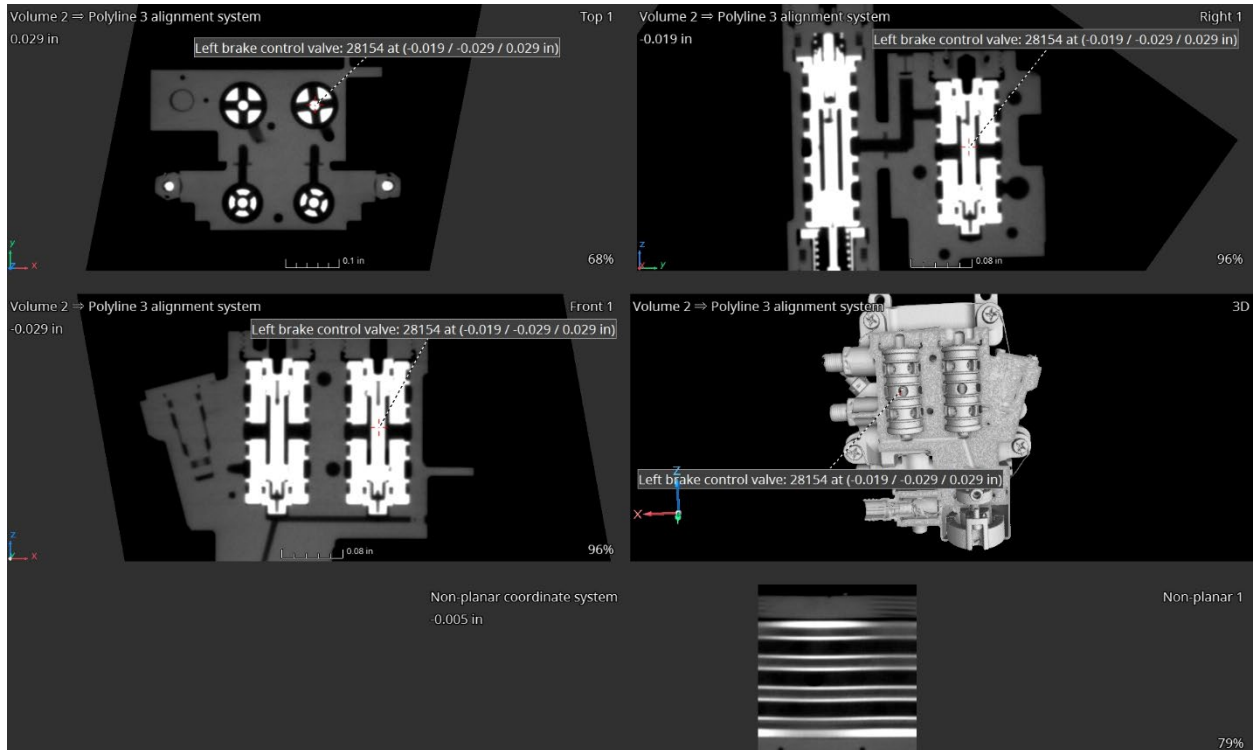


Figure 18. Power brake and antiskid valve assembly - left brake control valve spool.

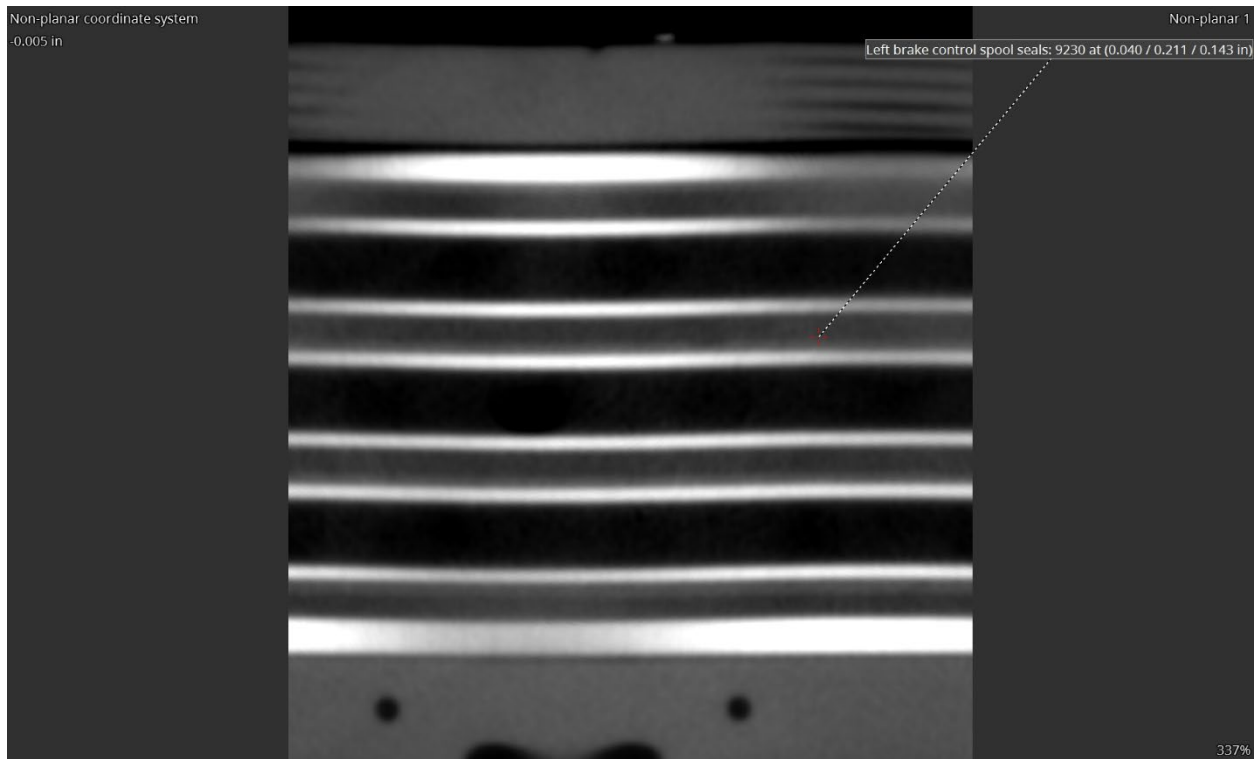


Figure 19. Power brake and antiskid valve assembly - left brake control valve spool unrolled.

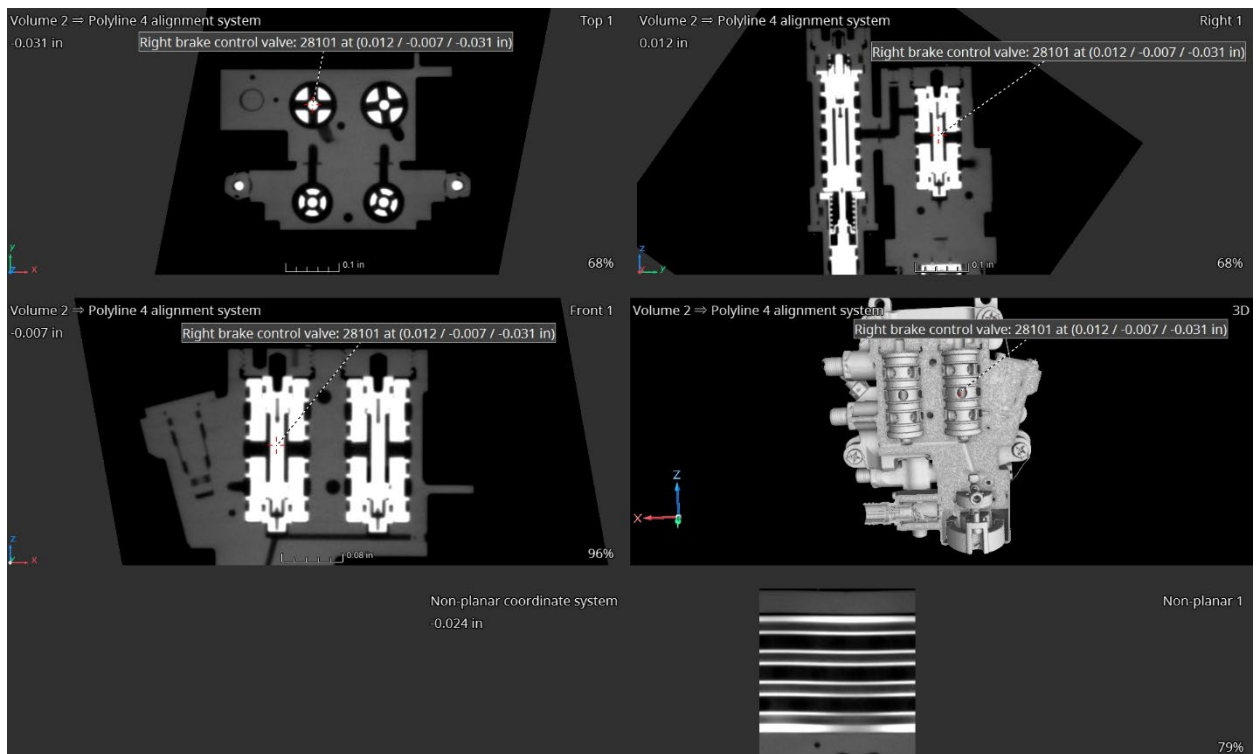


Figure 20. Power brake and antiskid valve assembly - right brake control valve spool.

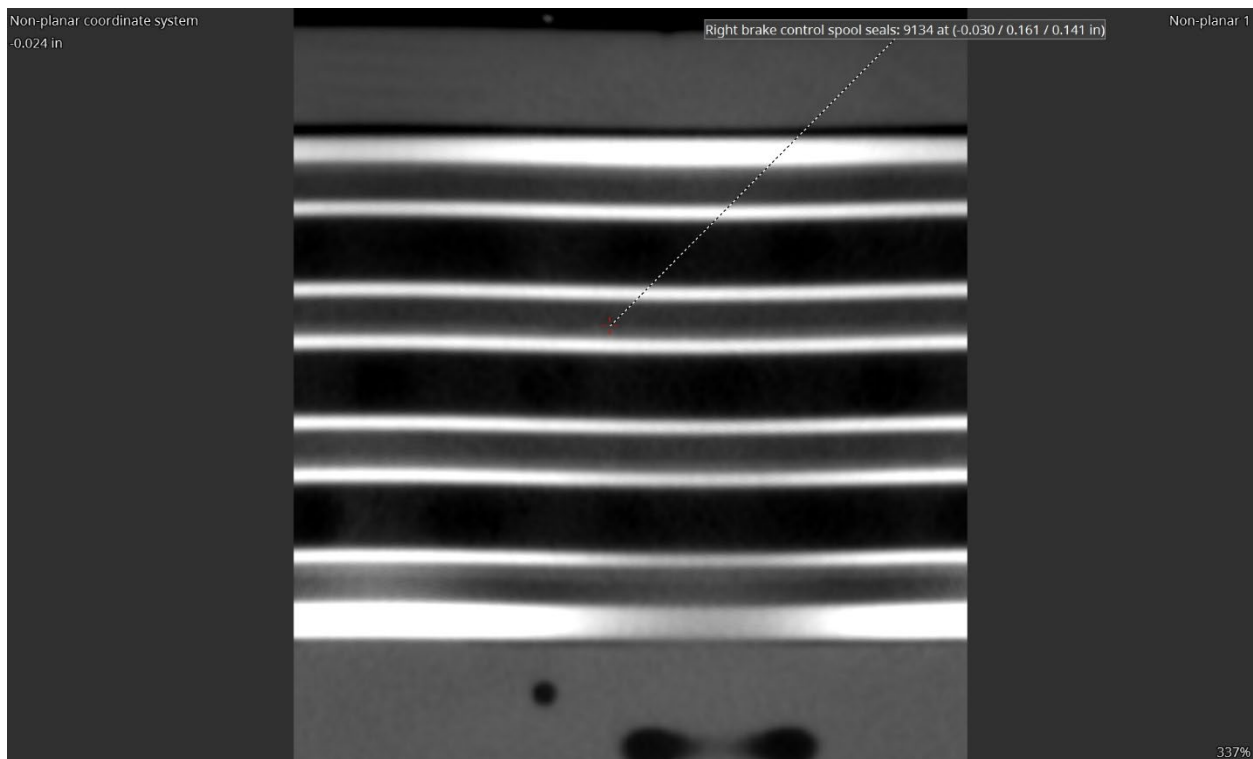


Figure 21. Power brake and antiskid valve assembly - right brake control valve spool unrolled.

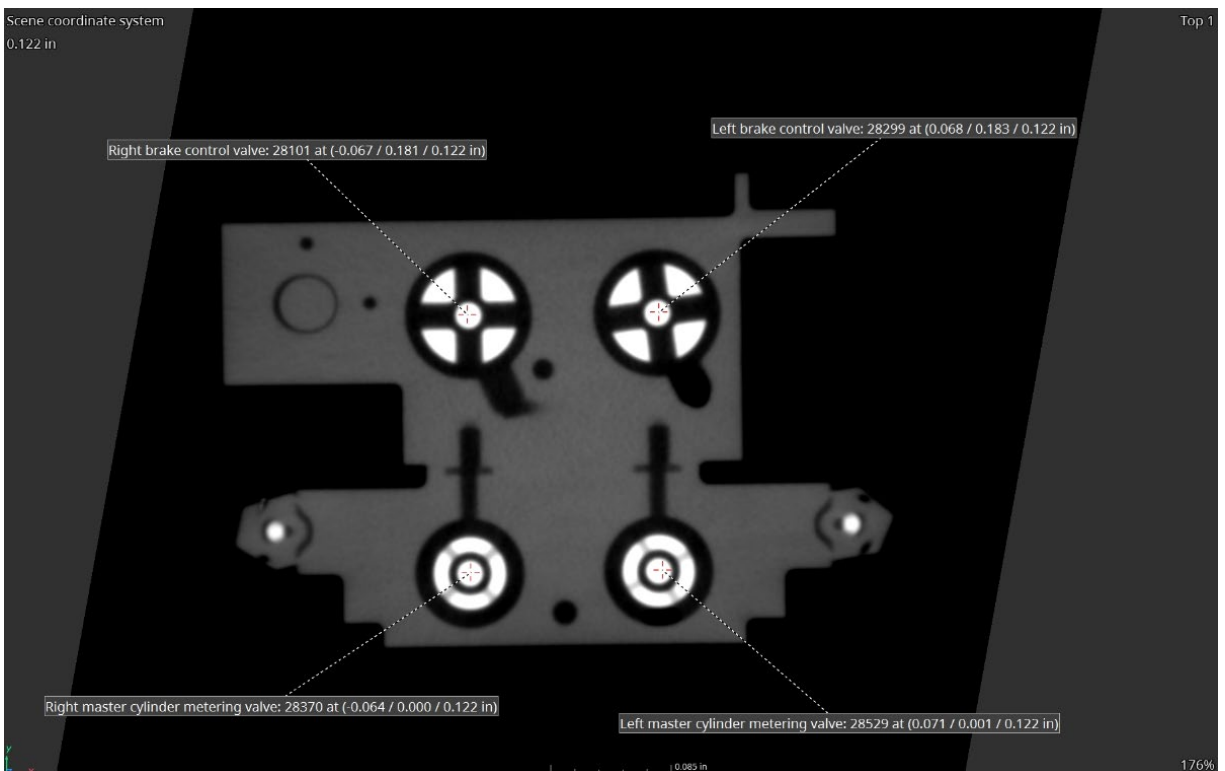


Figure 22. Power brake and antiskid valve assembly - brake control valves and master cylinder metering valves.

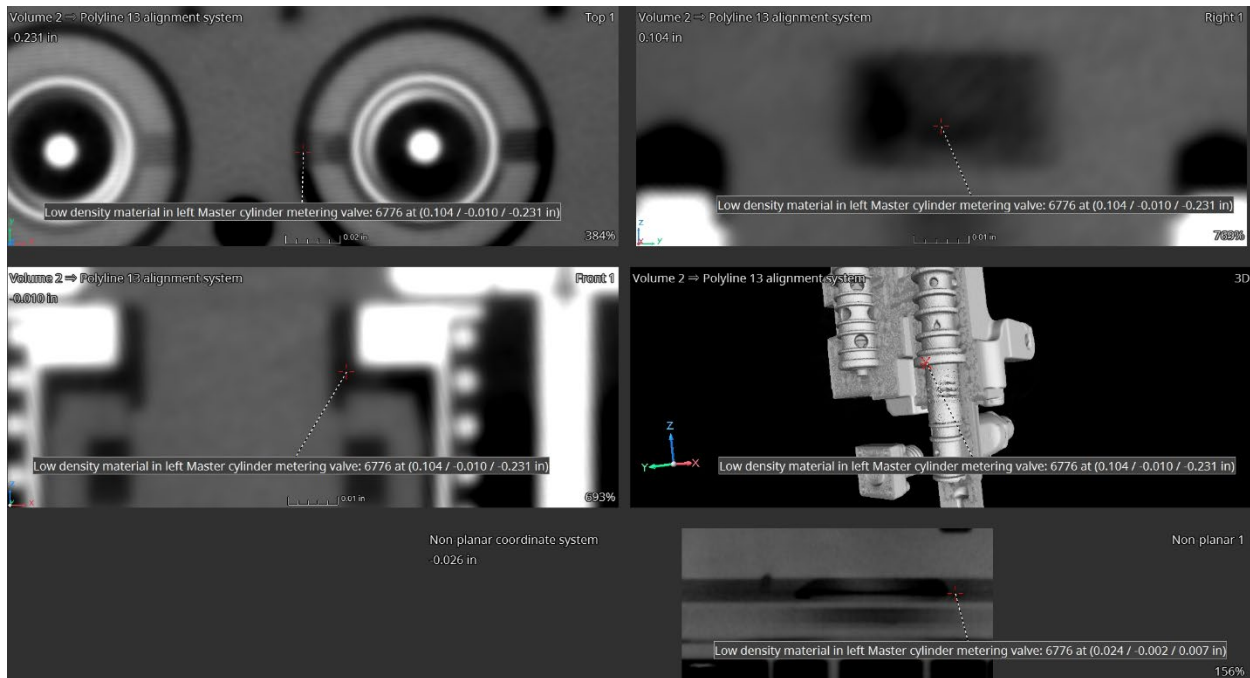


Figure 23. Power brake and antiskid valve assembly - left MC metering valve - low density material.

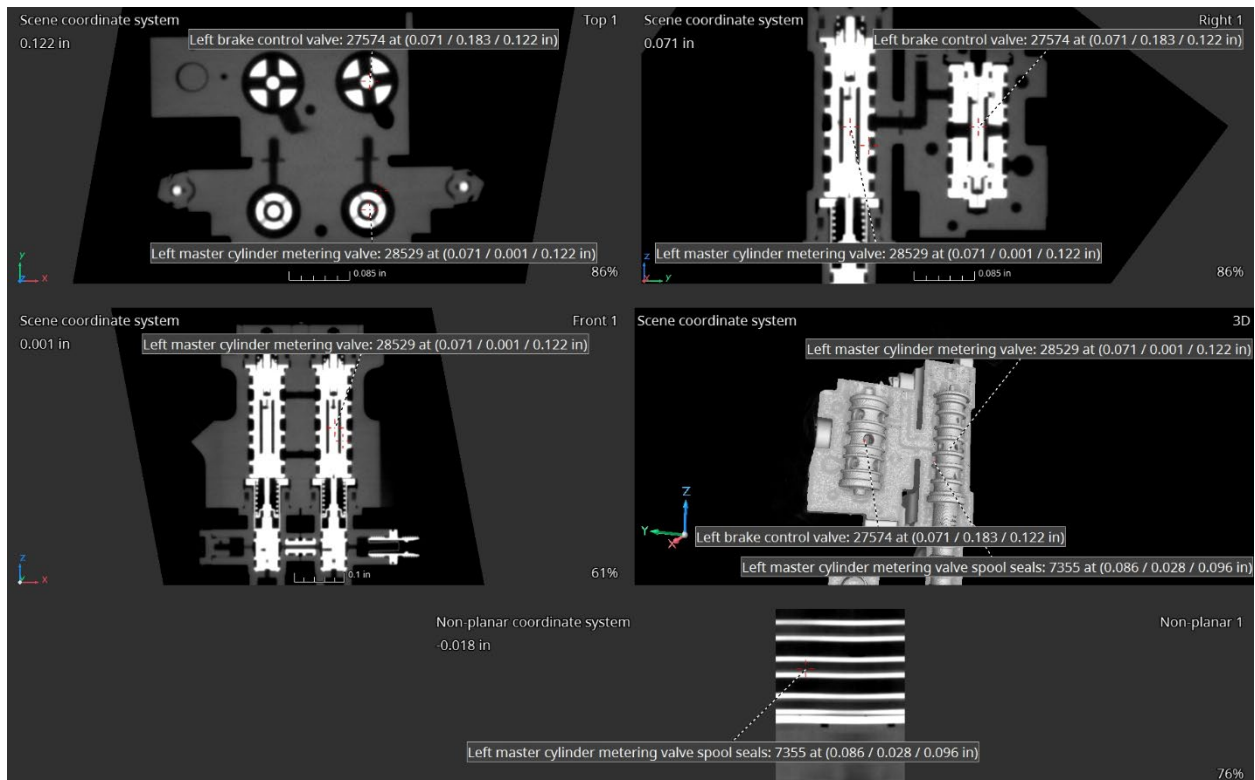


Figure 24. Power brake and antiskid valve assembly - left MC metering valve.

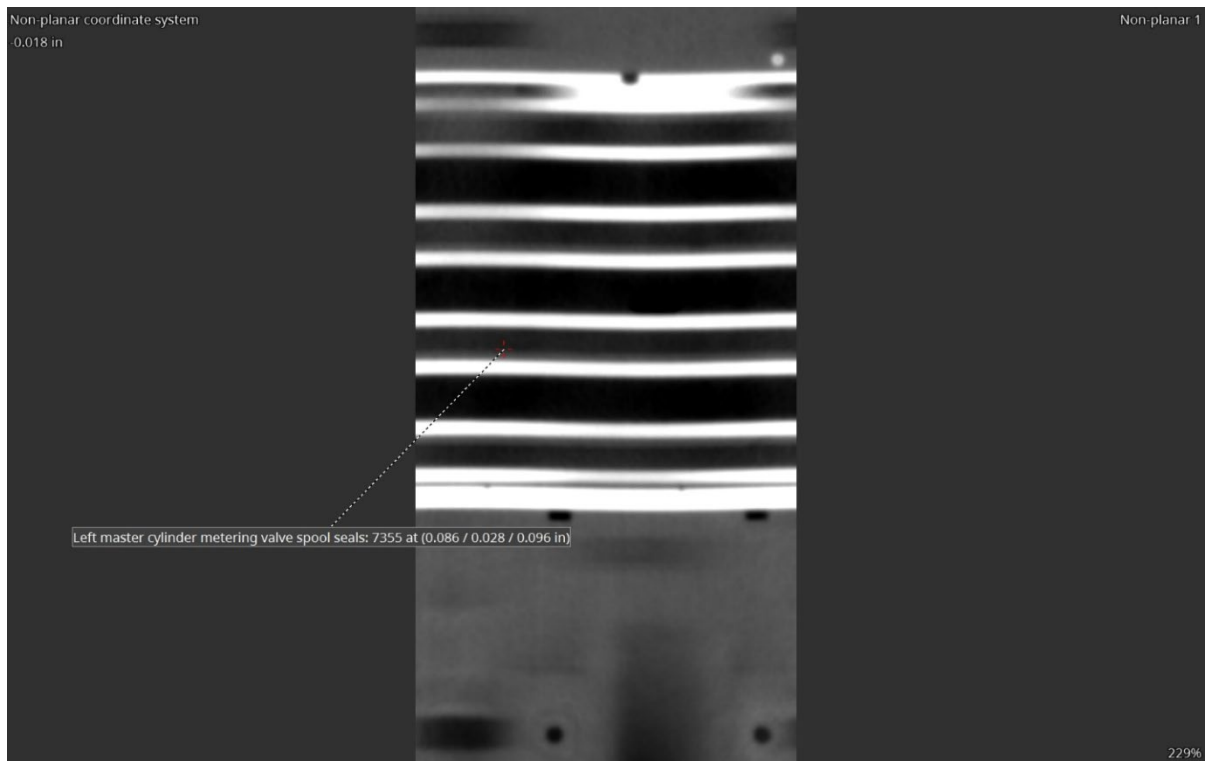


Figure 25. Power brake and antiskid valve assembly - left MC metering valve spool unrolled.

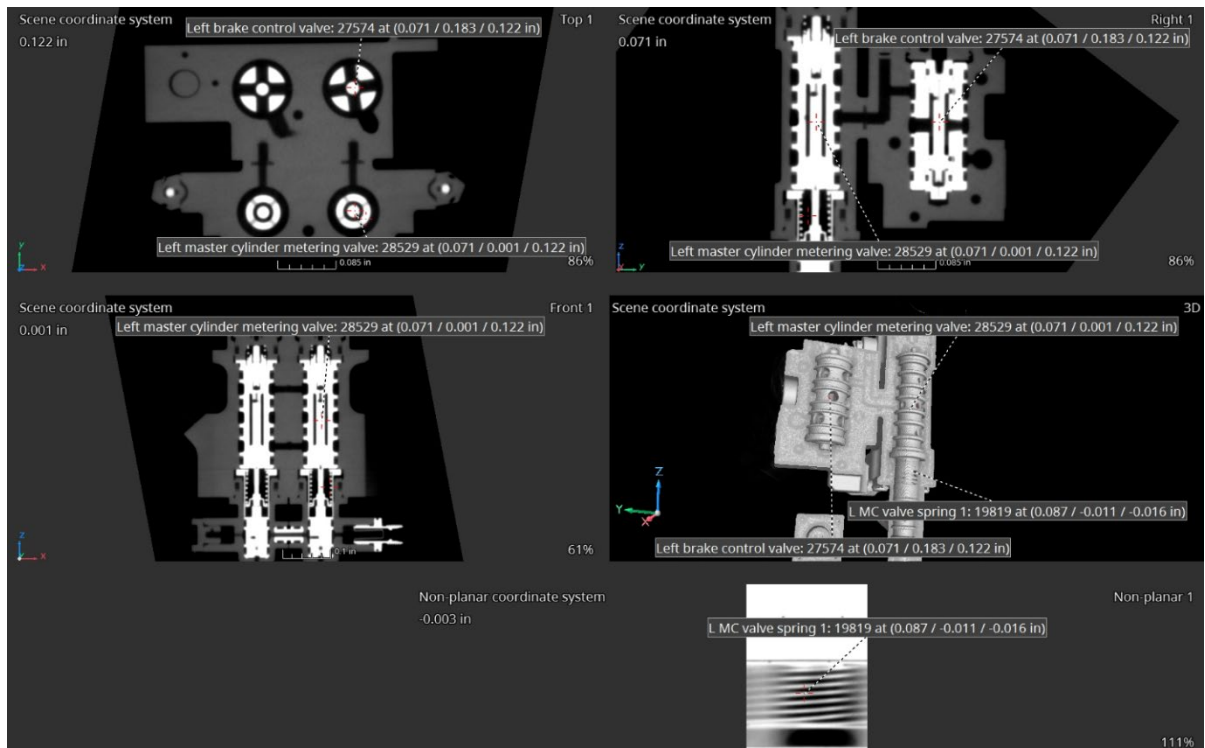


Figure 26. Power brake and antiskid valve assembly - left MC metering valve spring 1.

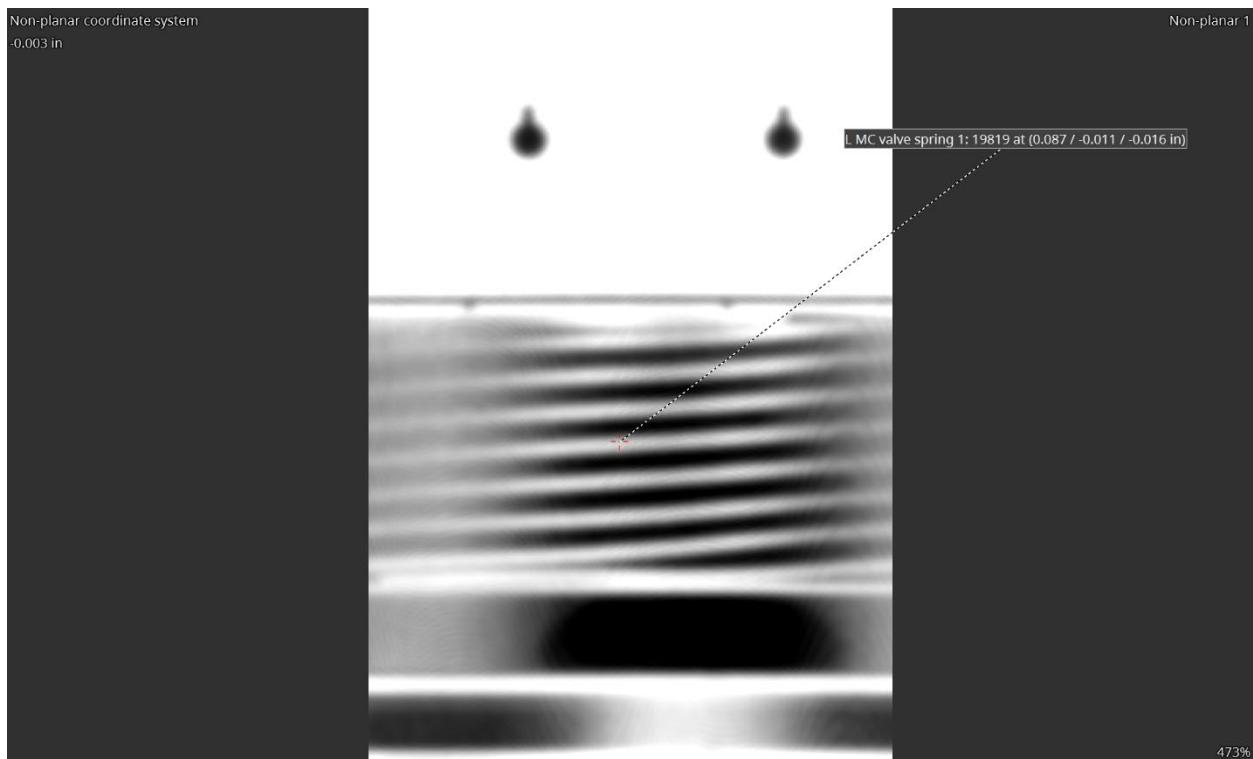


Figure 27. Power brake and antiskid valve assembly – left MC metering valve spring 1 unrolled.

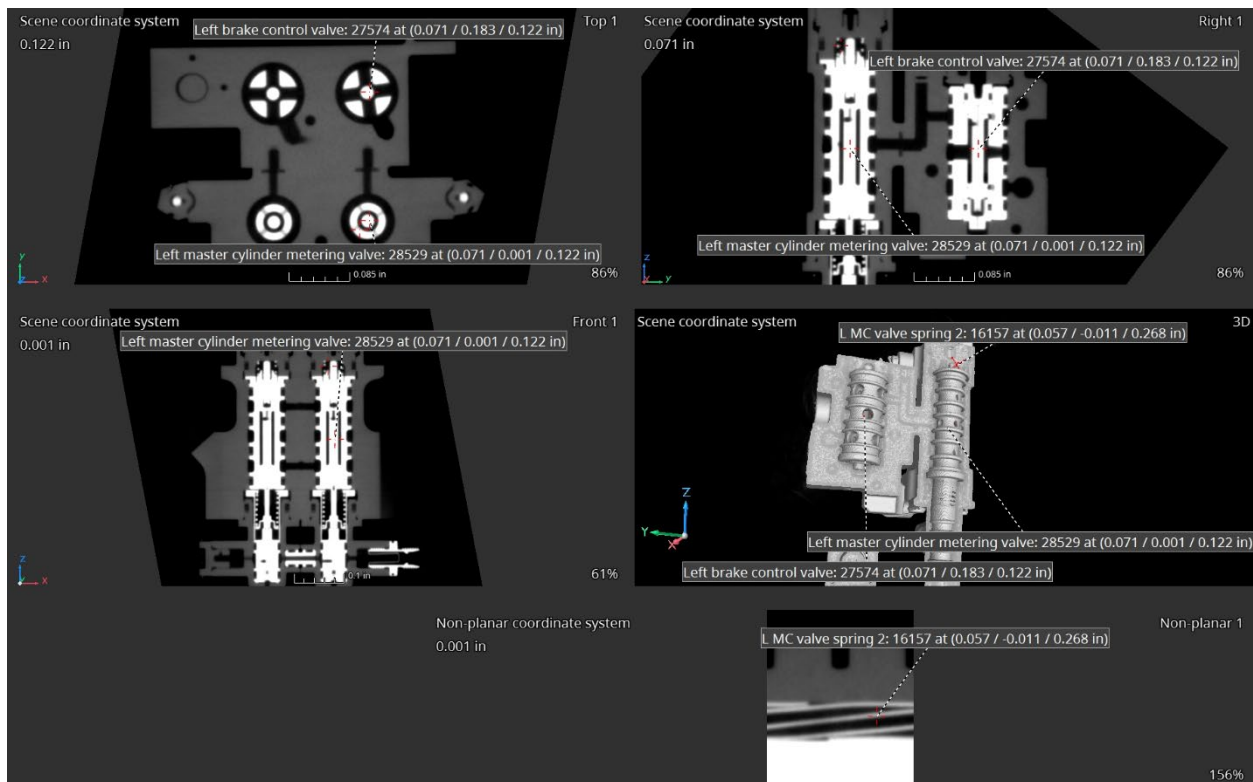


Figure 28. Power brake and antiskid valve assembly – left MC metering valve spring 2.

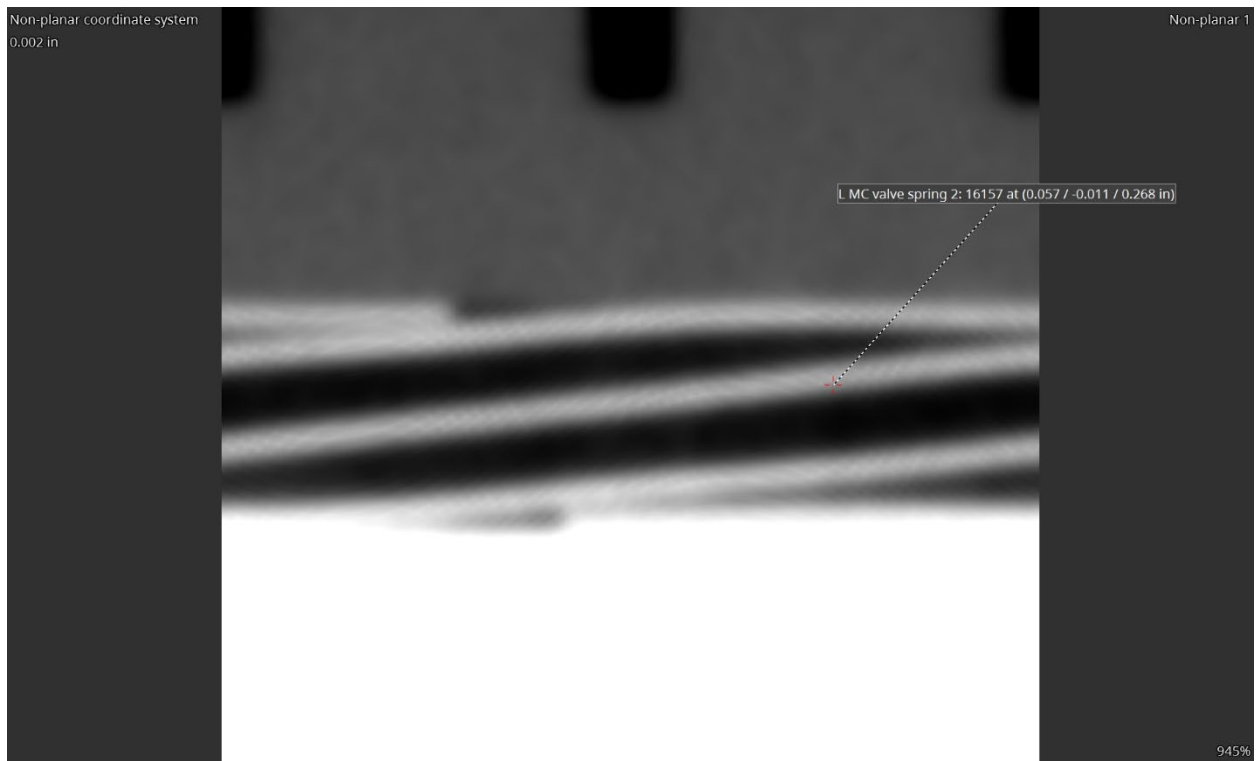


Figure 29. Power brake and antiskid valve assembly - left MC metering valve spring 2 unrolled.

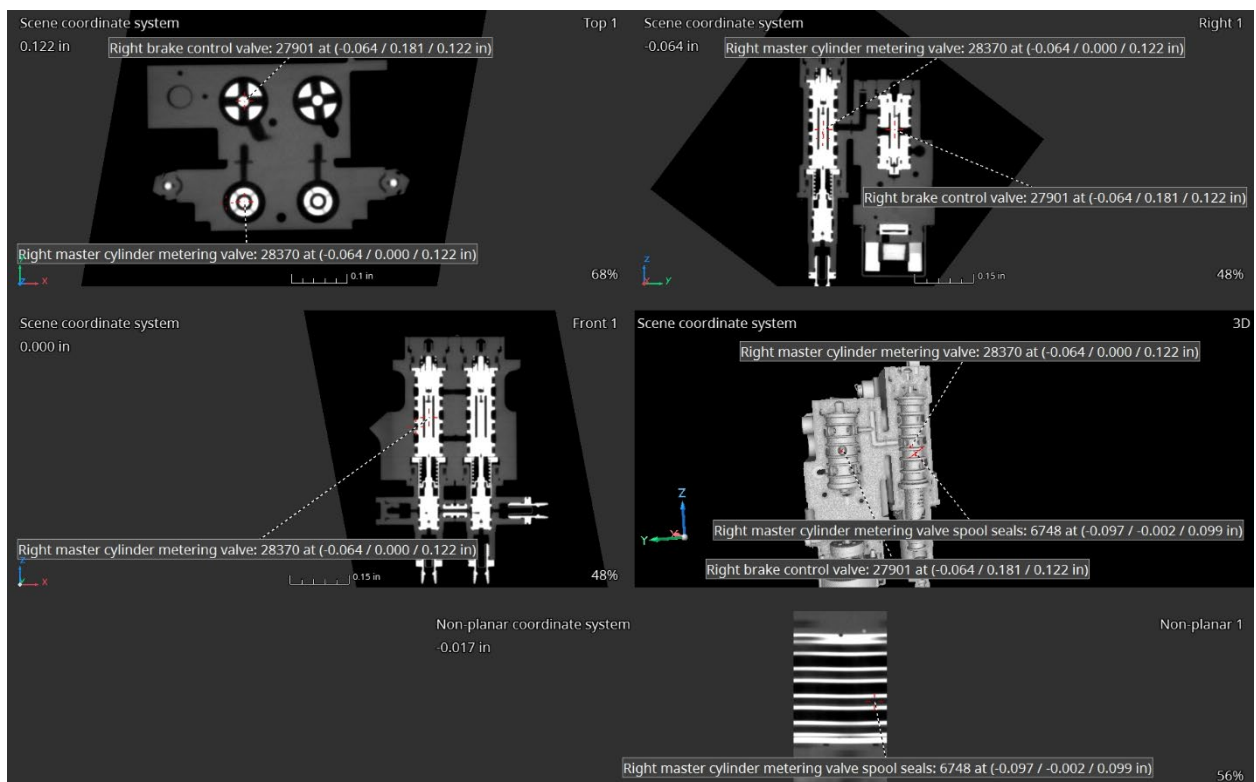


Figure 30. Power brake and antiskid valve assembly - right MC metering valve.

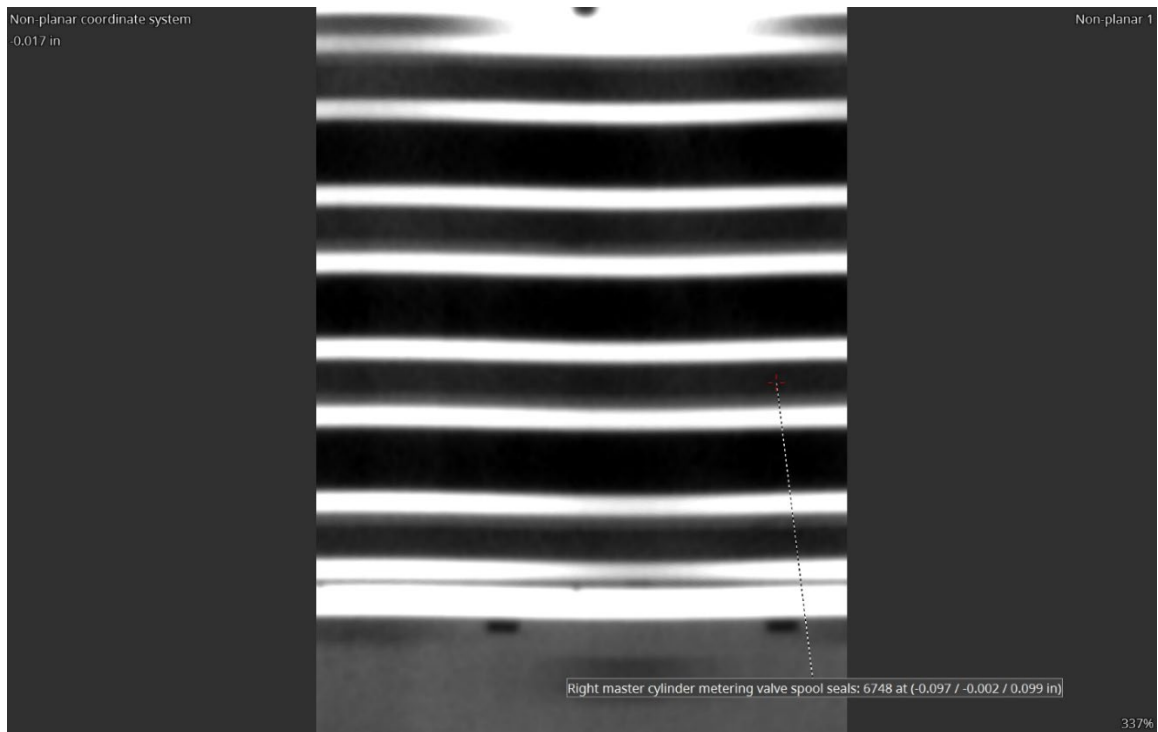


Figure 31. Power brake and antiskid valve assembly - right MC metering valve spool unrolled.

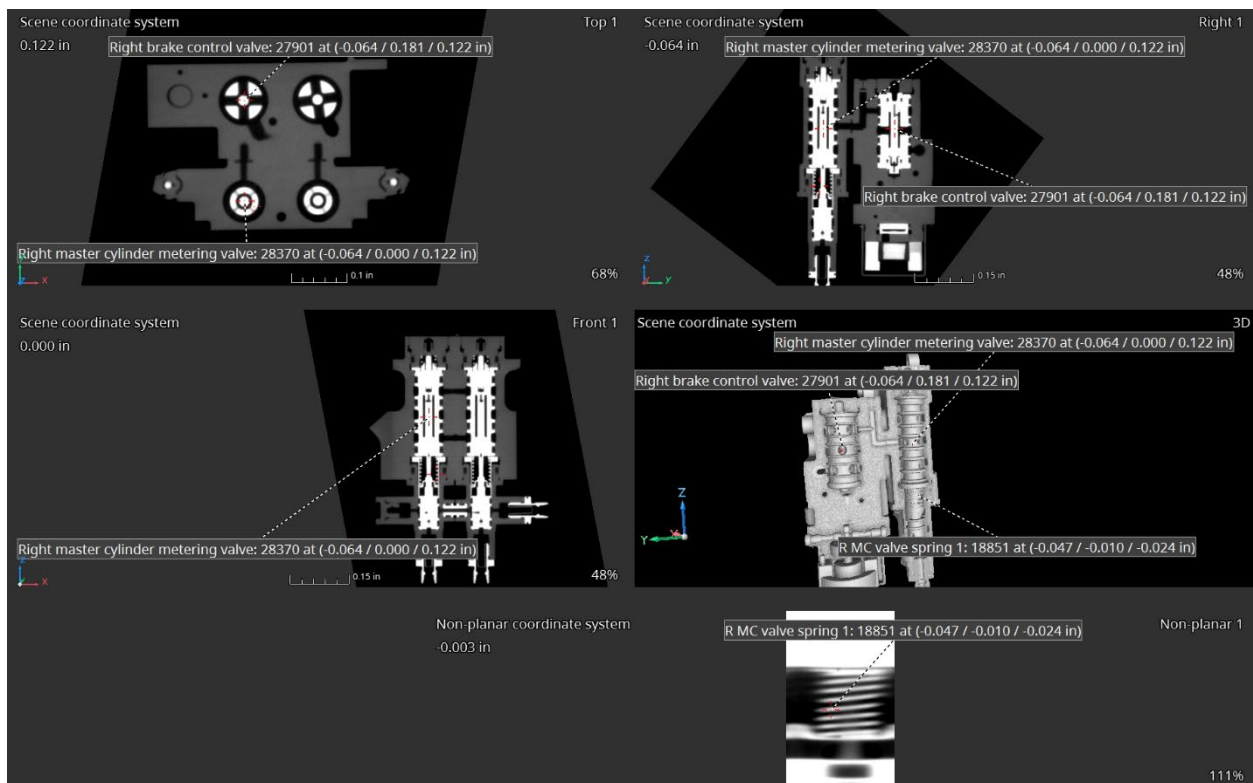


Figure 32. Power brake and antiskid valve assembly - right MC metering valve spring 1.

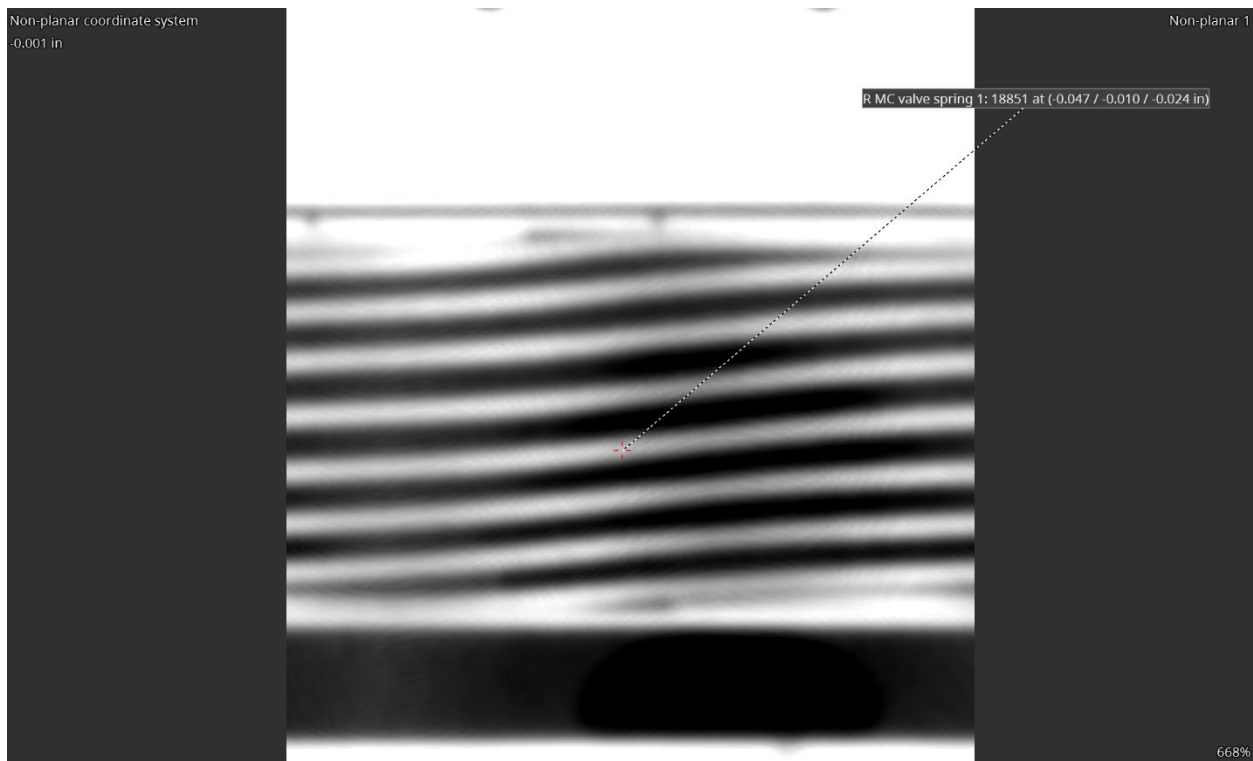


Figure 33. Power brake and antiskid valve assembly – right MC metering valve spring 1.

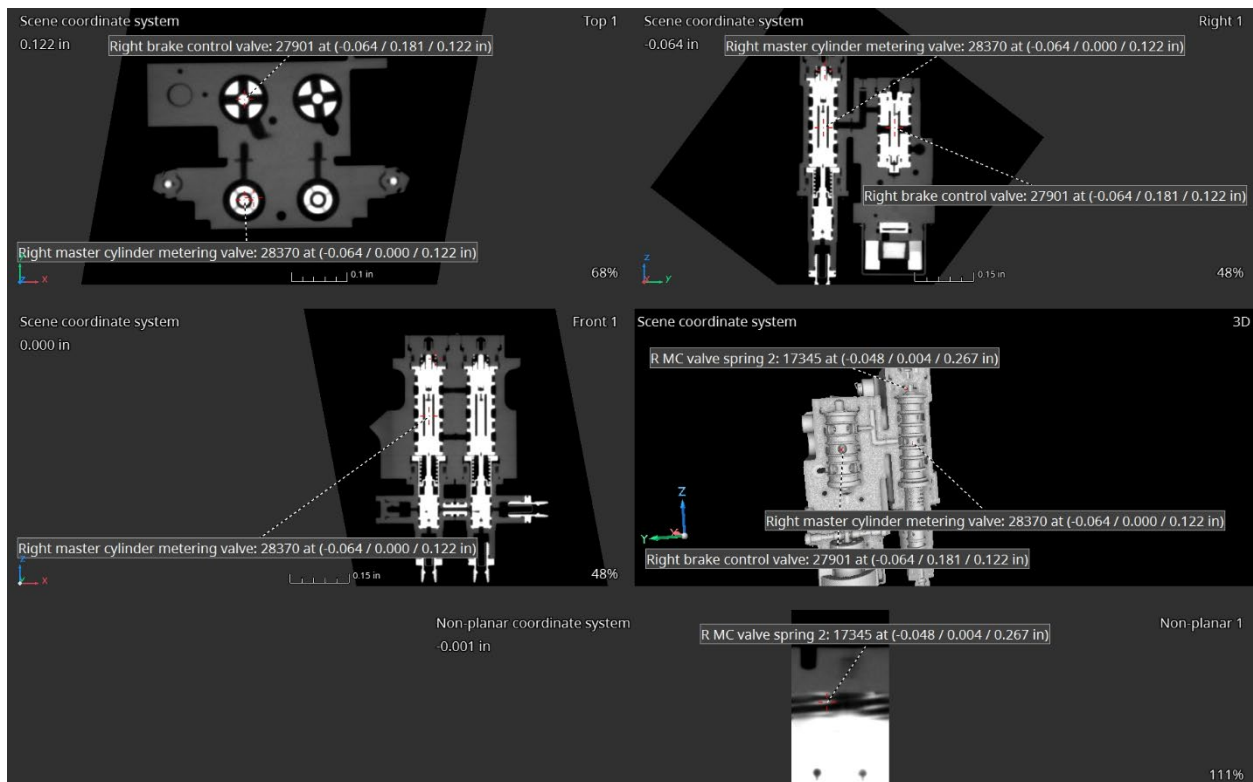


Figure 34. Power brake and antiskid valve assembly – right MC metering valve spring 2.

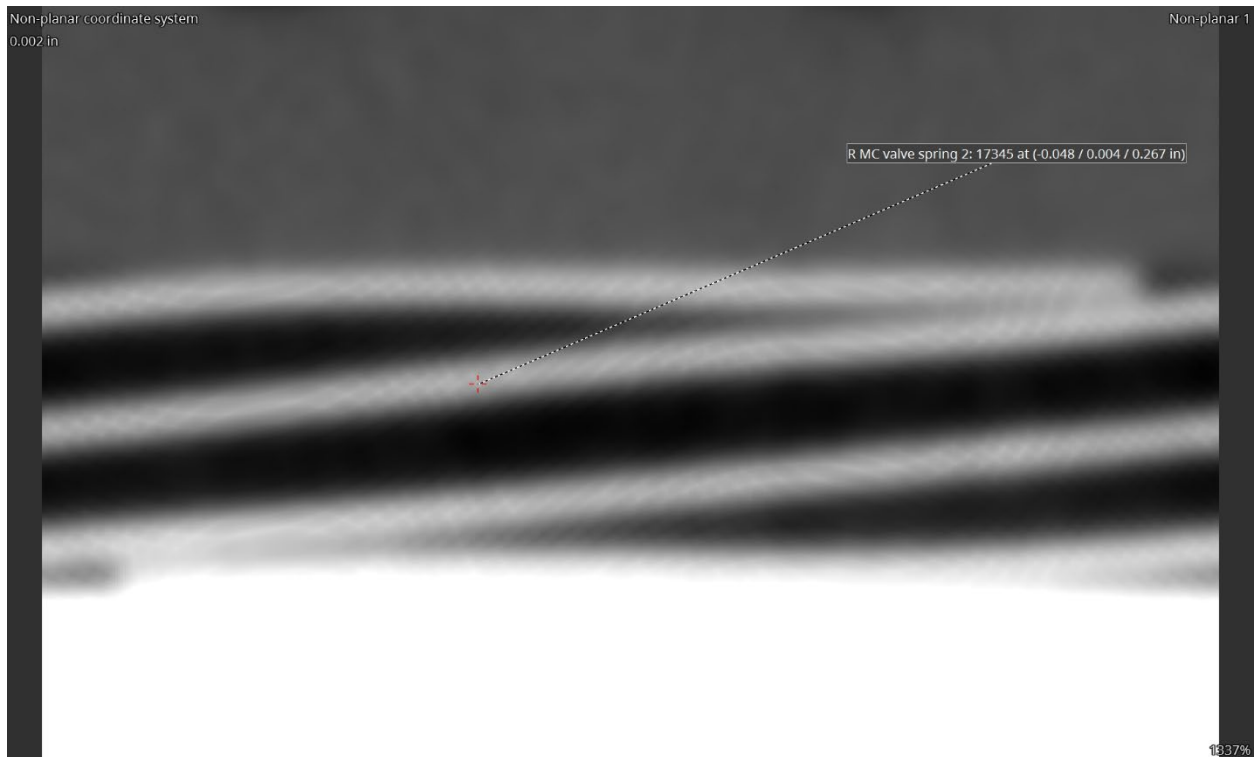


Figure 35. Power brake and antiskid valve assembly - right MC metering valve spring 2 unrolled.

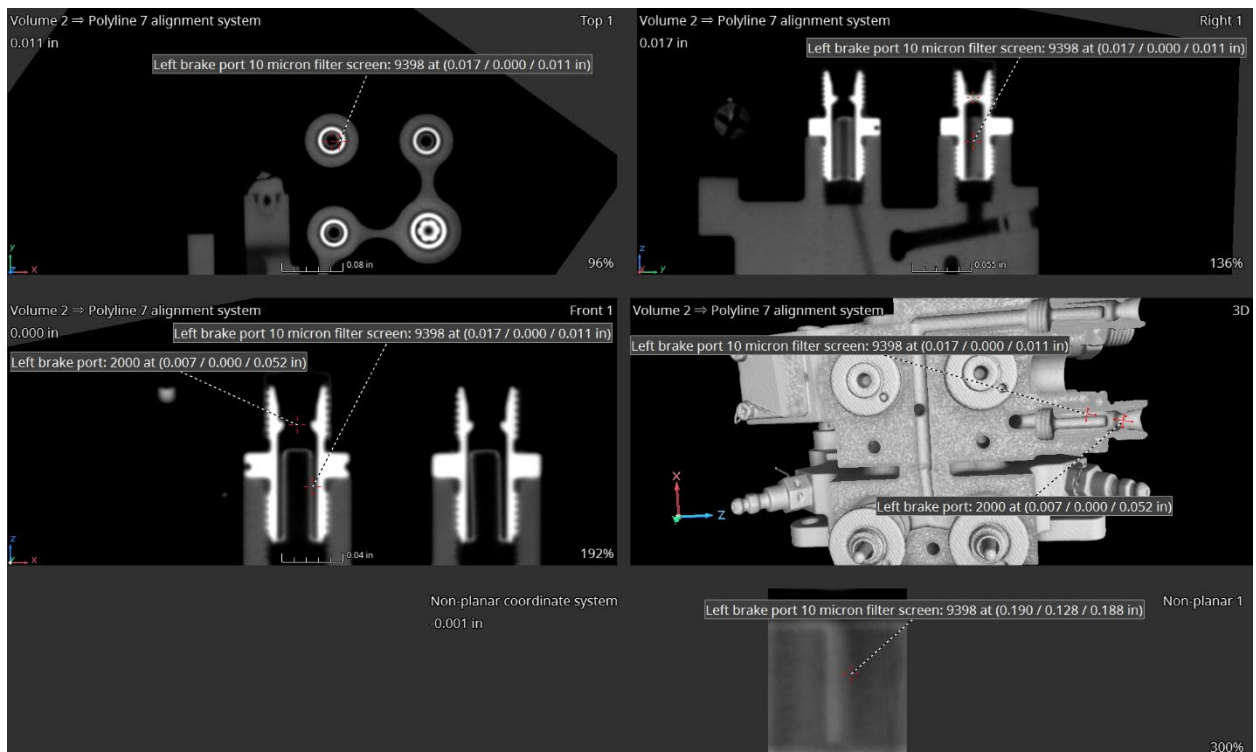


Figure 36. Power brake and antiskid valve assembly - left brake port and 10 micron filter screen.

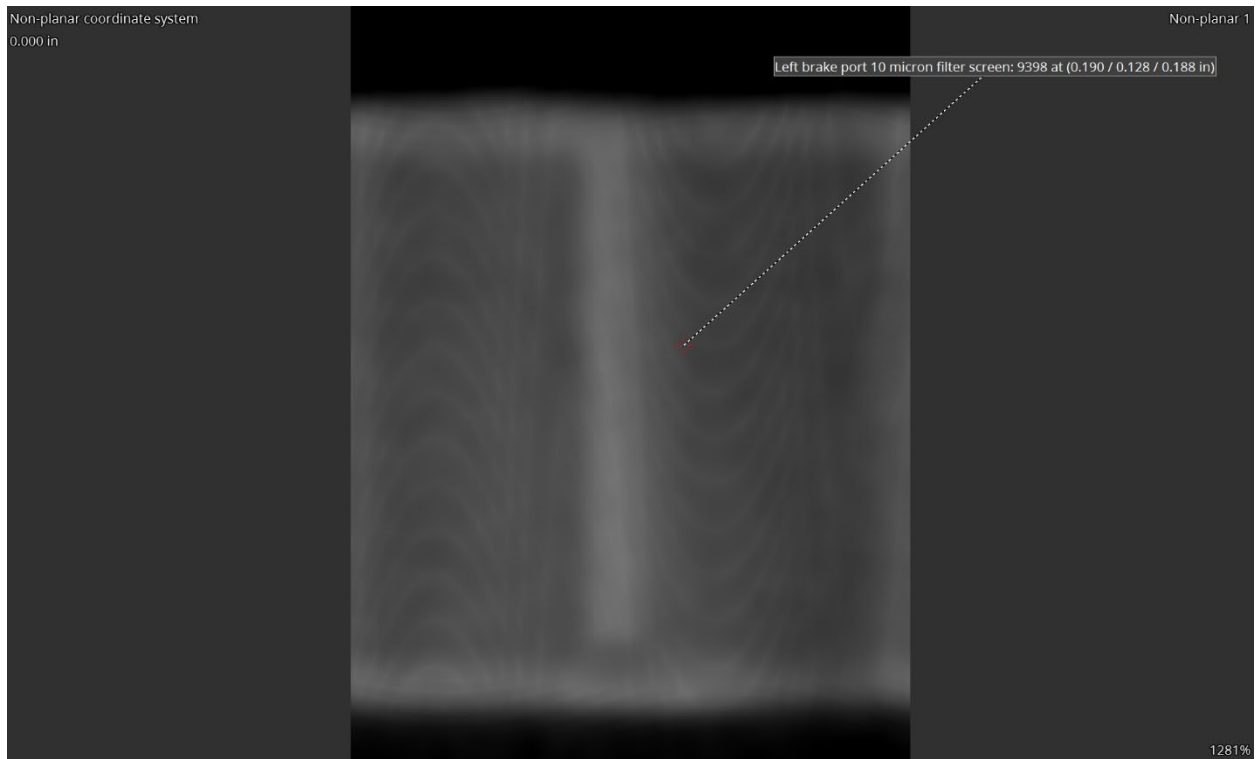


Figure 37. Power brake and antiskid valve assembly - left brake port 10 micron filter screen unrolled.

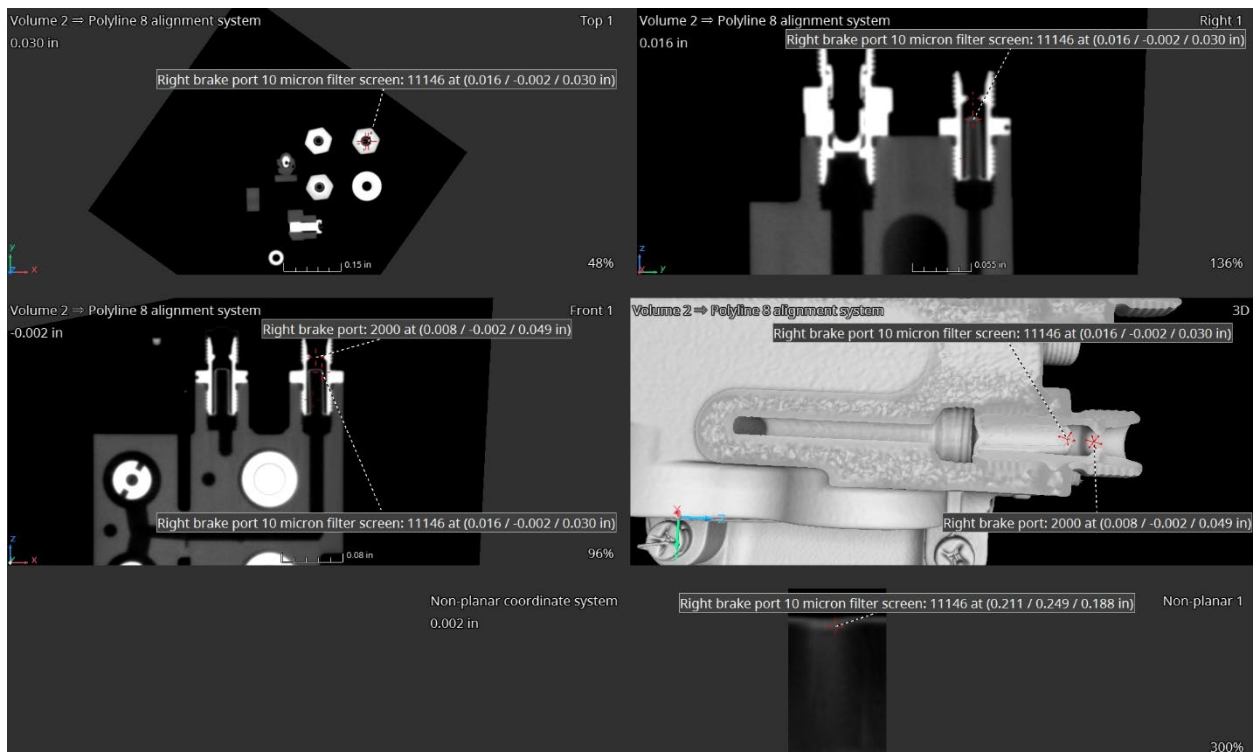


Figure 38. Power brake and antiskid valve assembly - right brake port and 10 micron filter screen.

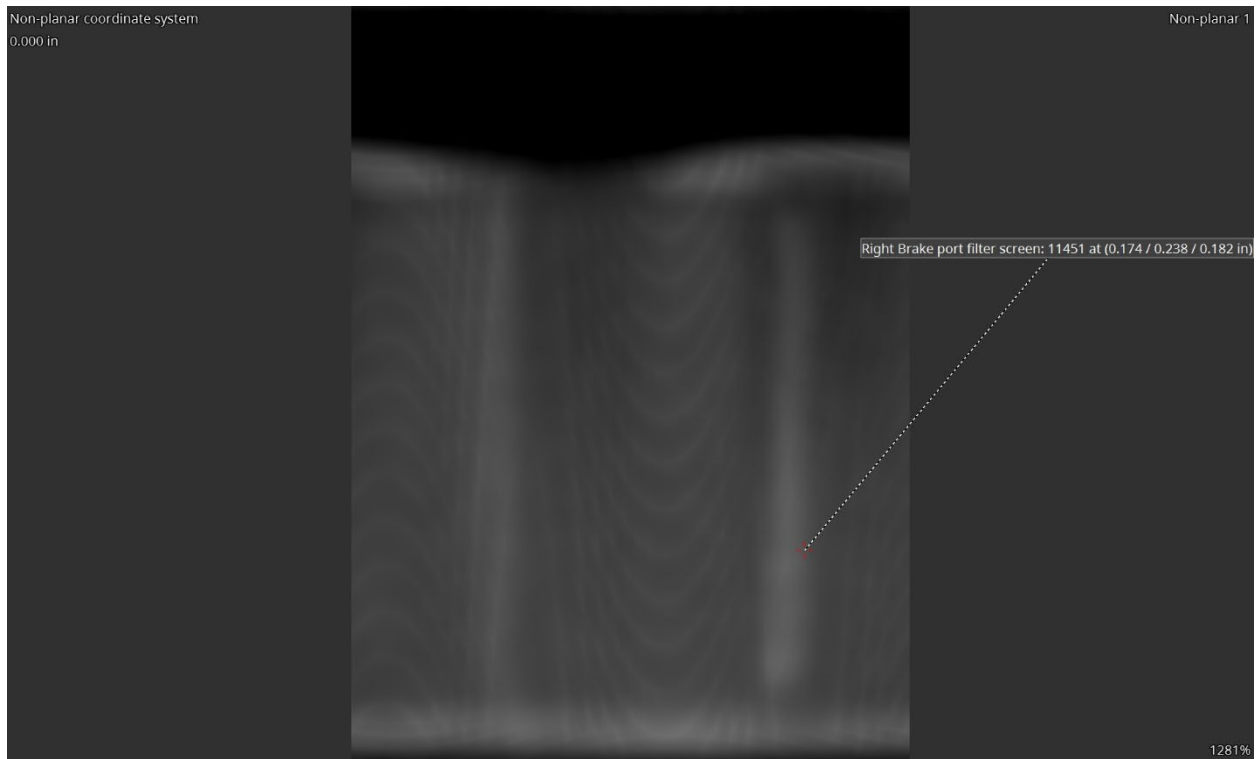


Figure 39. Power brake and antiskid valve assembly - right brake port 10 micron filter screen unrolled.

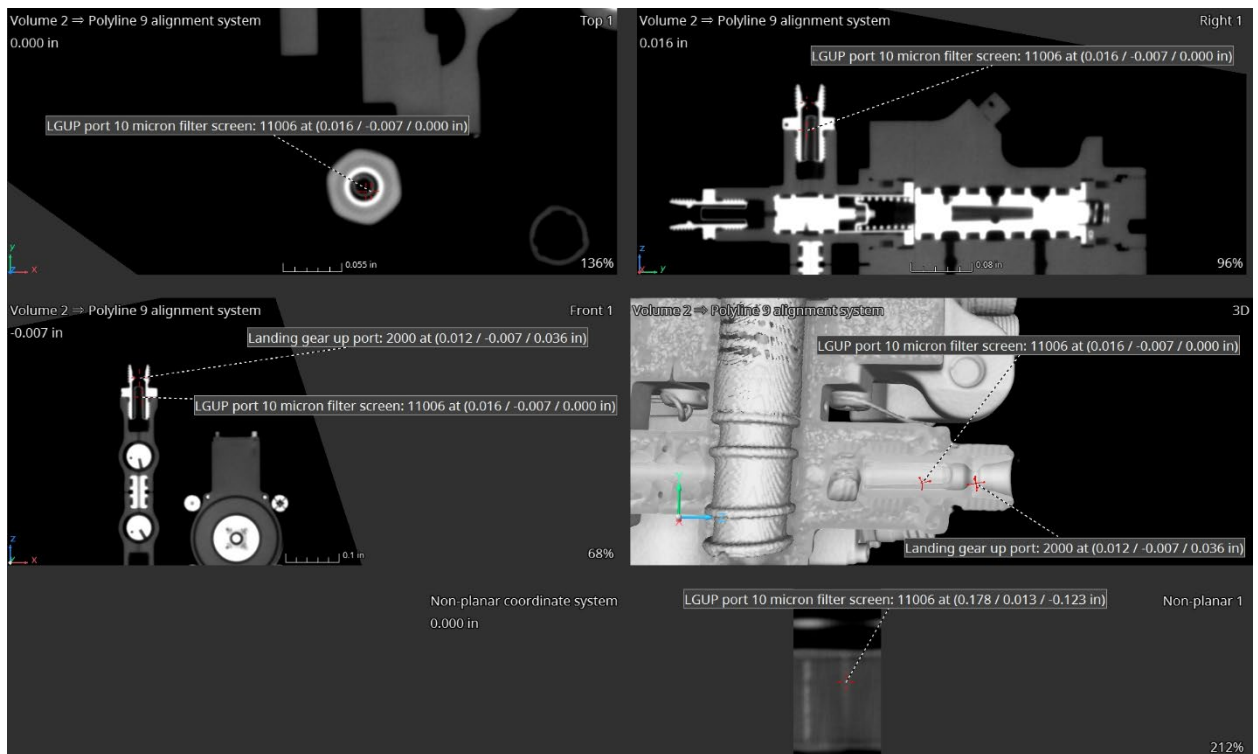


Figure 40. Power brake and antiskid valve assembly - landing gear up port and 10 micron filter screen.

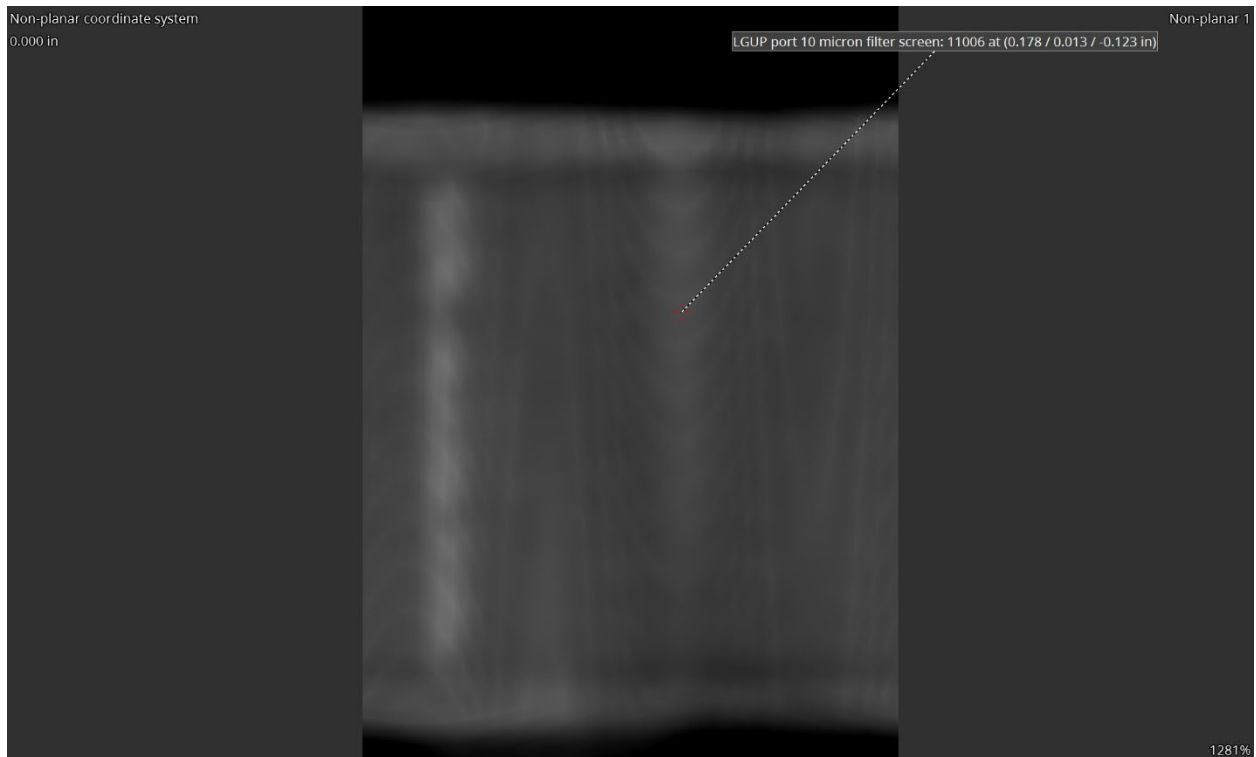


Figure 41. Power brake and antiskid valve assembly - landing gear up port 10 micron filter screen unrolled.

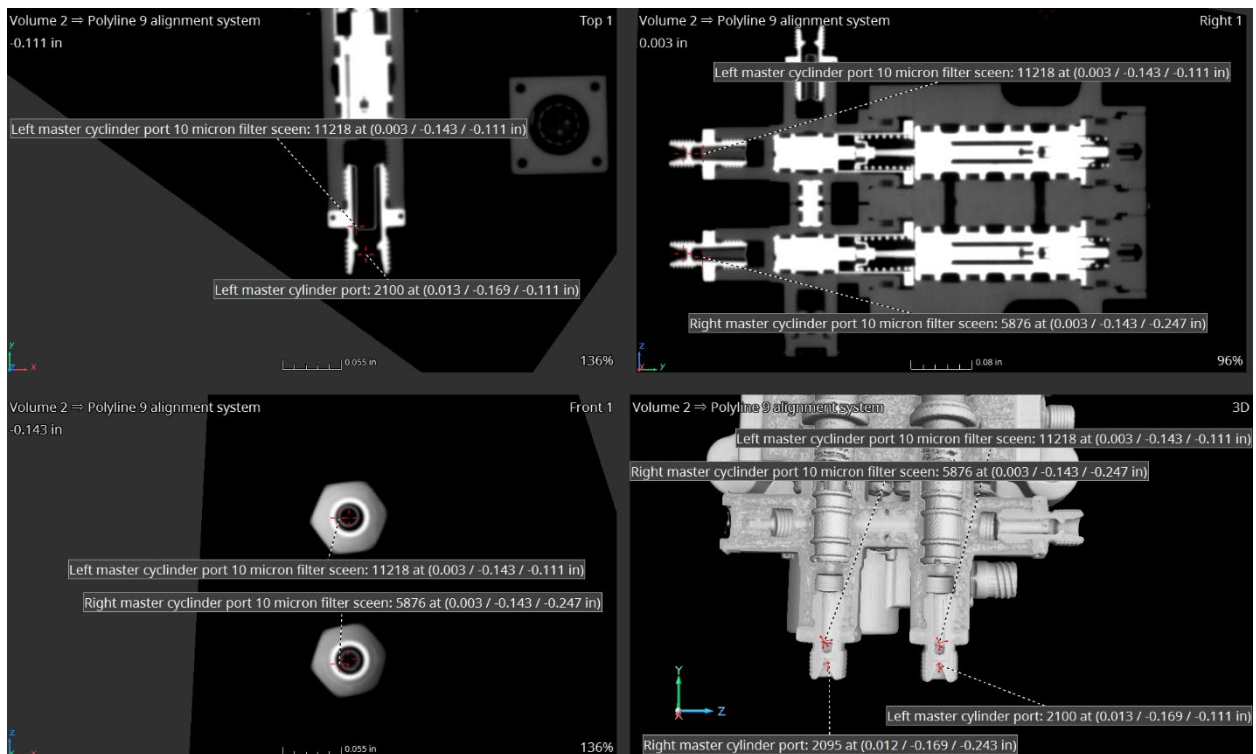


Figure 42. Power brake and antiskid valve assembly - left and right MC ports and filter screens.

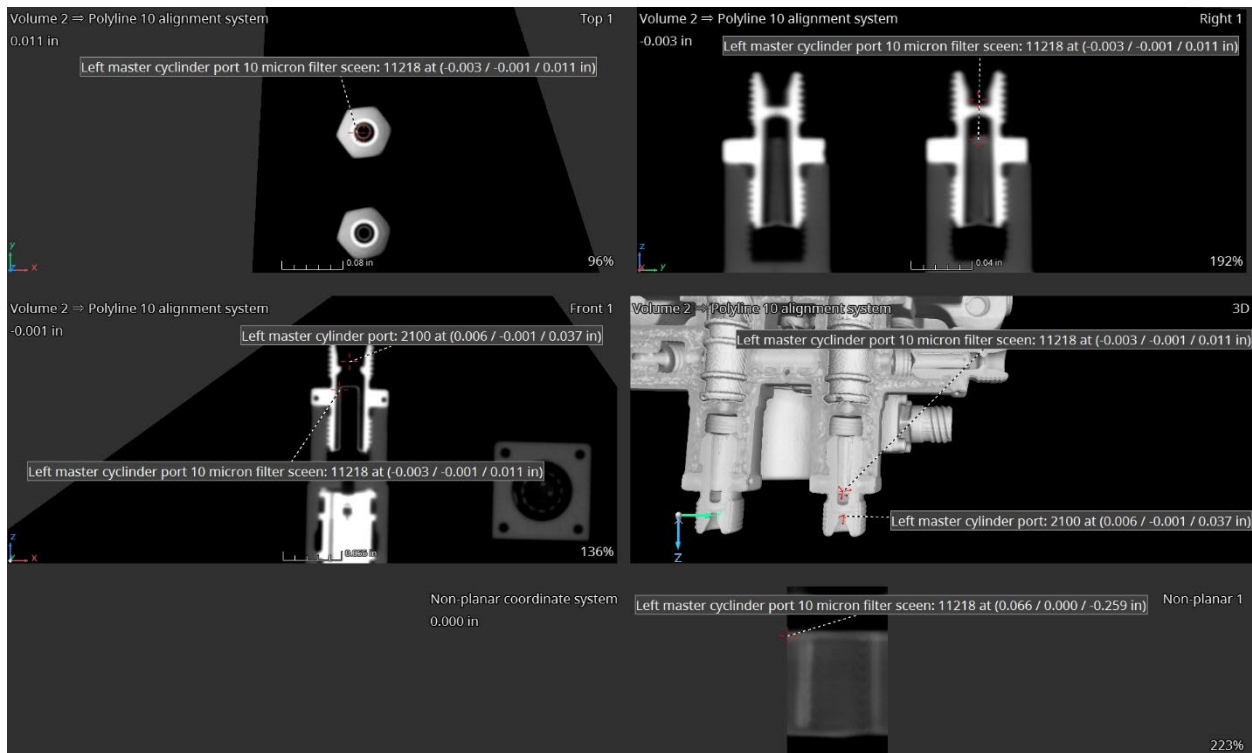


Figure 43. Power brake and antiskid valve assembly - left MC port and 10 micron filter screen.

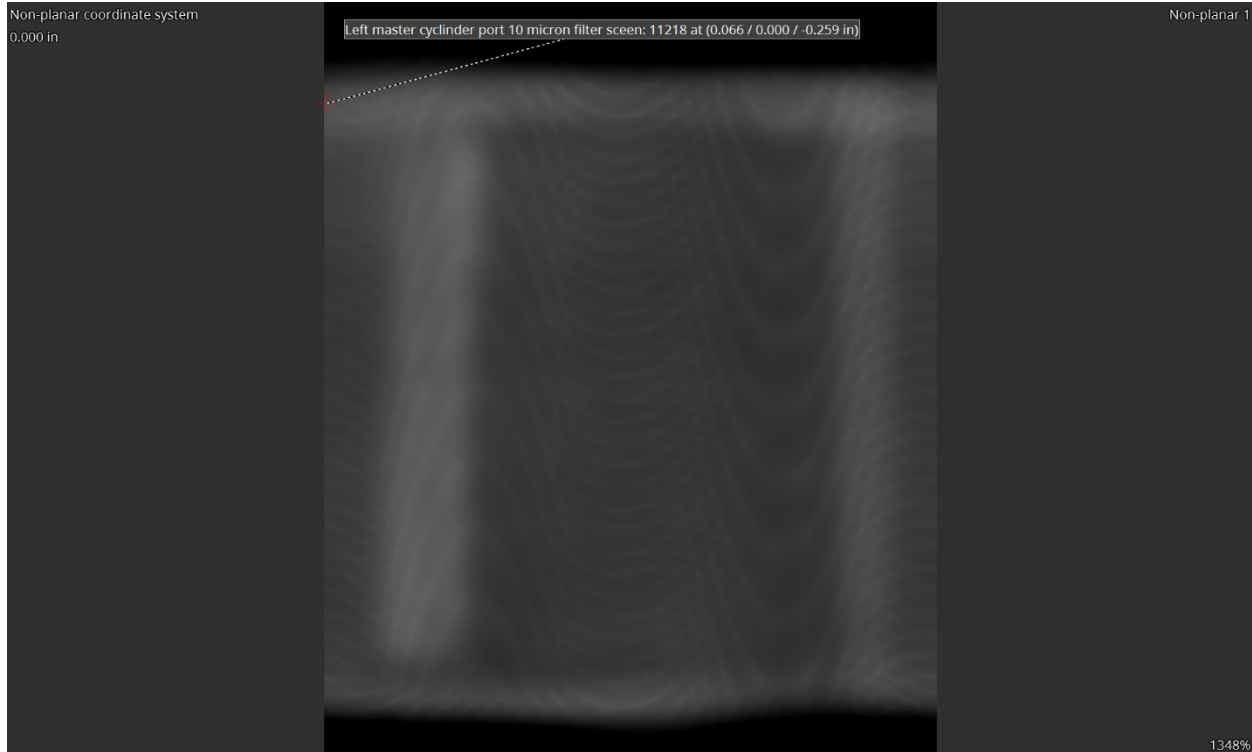


Figure 44. Power brake and antiskid valve assembly - left MC port 10 micron filter screen unrolled.

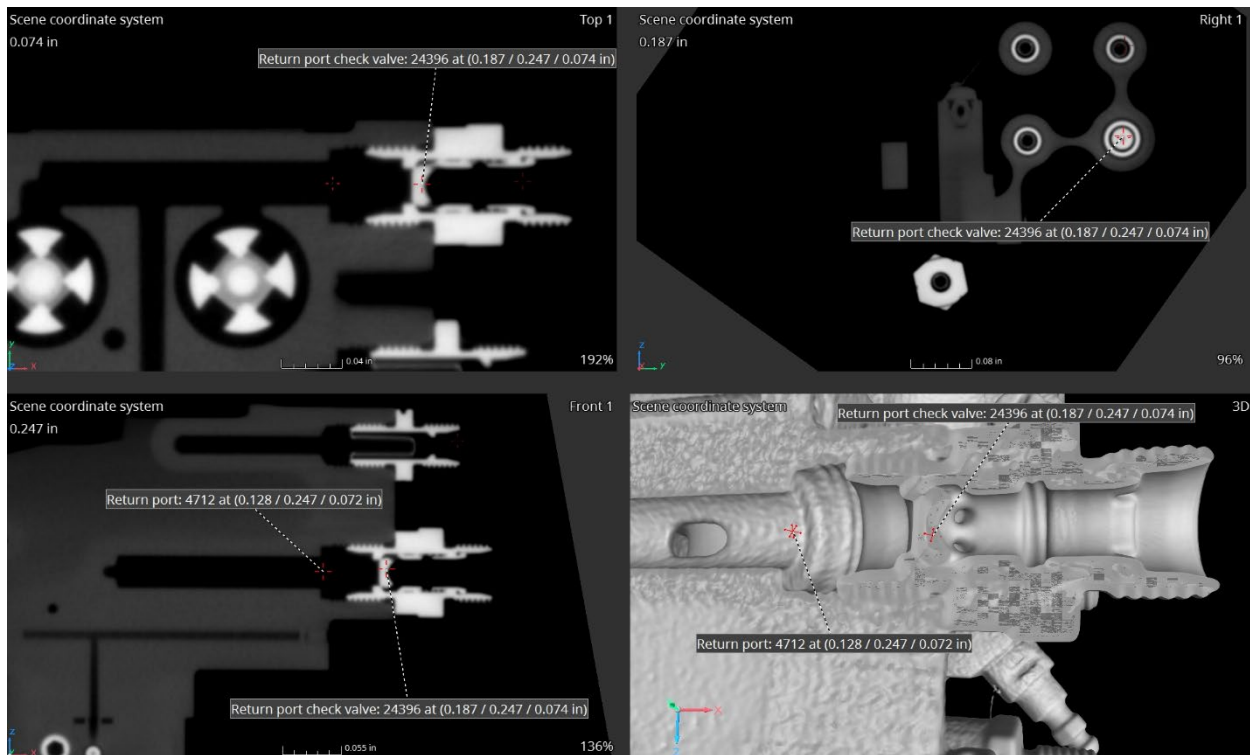


Figure 47. Power brake and antiskid valve assembly – return port and check valve.



Figure 48. Power brake and antiskid valve assembly – servo valve electrical connector.

Submitted by:

John Flynn
Computed Tomography Specialist