

**NATIONAL TRANSPORTATION SAFETY BOARD**

Office of Aviation Safety  
Washington, D.C. 20594

June 10, 2015

**Computed Tomography Specialist's Factual Report**

CEN-15-LA-146

**A. ACCIDENT**

Location: Haviland, Kansas  
Date: February 13, 2015  
Time: about 2330 central standard time  
Vehicle: Piper PA-28R-180 airplane, N3918T

**B. GROUP**

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

## **C. SUMMARY**

On February 13, 2015, about 2330 central standard time, a Piper PA-28R-180 airplane, N3918T, impacted terrain during a forced landing following an in-flight loss of engine power near Haviland, Kansas. The private pilot and passenger were uninjured. The airplane sustained substantial wing damage. The airplane was purchased by and operated by the pilot under the provisions of 14 Code of Federal Regulations Part 91 as a personal flight. Night visual flight rules (VFR) conditions prevailed for the flight, which did not operate on a flight plan. The flight originated about 2118 from the East Kansas City Airport (3GV), near Grain Valley, Missouri, and was destined for the Dalhart Municipal Airport (DHT), near Dalhart, Texas.

The internal configuration of an engine cylinder head was documented using radiographic images that were collected on March 31, 2015 in Chicago, Illinois. A total of 985 computed tomography (CT) slice images were examined, processed, and analyzed by the NTSB to evaluate the component.

Review of the cylinder head images determined that there were no indications of any damage to the valves, rocker arm, spark plug (only one was present) or piston rings and that there were indications of three cracked areas within the remaining portion of the piston head.

## **D. DETAILS OF THE INVESTIGATION**

### **1.0 General**

The cylinder head was subjected to x-ray computed tomography (CT) scanning to document its internal condition. The scanning was conducted on March 31, 2015. The scans were performed by Varian Medical Systems, Inc (formerly Bio-Imaging Research, Inc. (BIR)) under the direction of the NTSB using the BIR-500/1000-CT/DR 1 MV High-energy CT system.

For the CT scans, the component was loaded into the imaging unit and placed on a turntable. It 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 fan 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 captured by the detector were recorded at several thousand different points during each rotation, and this information was converted into axial slice images using reconstruction algorithms.

The cylinder head was scanned using a total of 985 axial slices. The total size of the data set was 7.71 Gb. The complete scan protocols are given in table 1. The CT axial slice images were provided to the NTSB where they were examined, processed, and analyzed to evaluate the components.

Table 1  
Scan Protocol

|                                       | 1 MV scan         |
|---------------------------------------|-------------------|
| Number of slices                      | 985               |
| Voxel Size - X Direction (mm)         | 0.273             |
| Voxel Size - Y Direction (mm)         | 0.273             |
| Voxel Size - Z Direction (mm)         | 0.4               |
| Image Projections per Revolution      | 1400              |
| Exposure time (ms)                    | 10                |
| Frames to Avg (frames per projection) | 2                 |
| X-ray Source Voltage (kV)             | 1000              |
| X-ray Source Characteristics          | 4 ppv, 2.5 period |
| Source Filter Material                | steel             |
| Source Filter Thickness (mm)          | 3.3               |
| Image Matrix Size (pixels)            | 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 components were digitally removed or rendered transparent to allow closer observation of interior parts. In the images, the high density areas are shown as brighter shades of gray and lower density areas are shown as darker shades of gray. Some areas within the images were digitally colored to help highlight specific areas within the part. The pointers shown in some of the images denote specific areas of interest within that image.

The images of the cylinder head were examined for any signs of missing or damaged parts, contamination, cracks 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 oil system component are shown in figures 1 through 37. Review of the images indicated:

1. There were no indications of any damage to the valves, rocker arm, spark plug (only one was present) or piston rings;
2. There were indications of a high density material at the cylinder barrel edge closest to the valves;
3. There were indications of three cracked areas within the remaining portion of the piston head. The locations of these cracks were documented;
4. There were indications of indentations on the cylinder head wall.

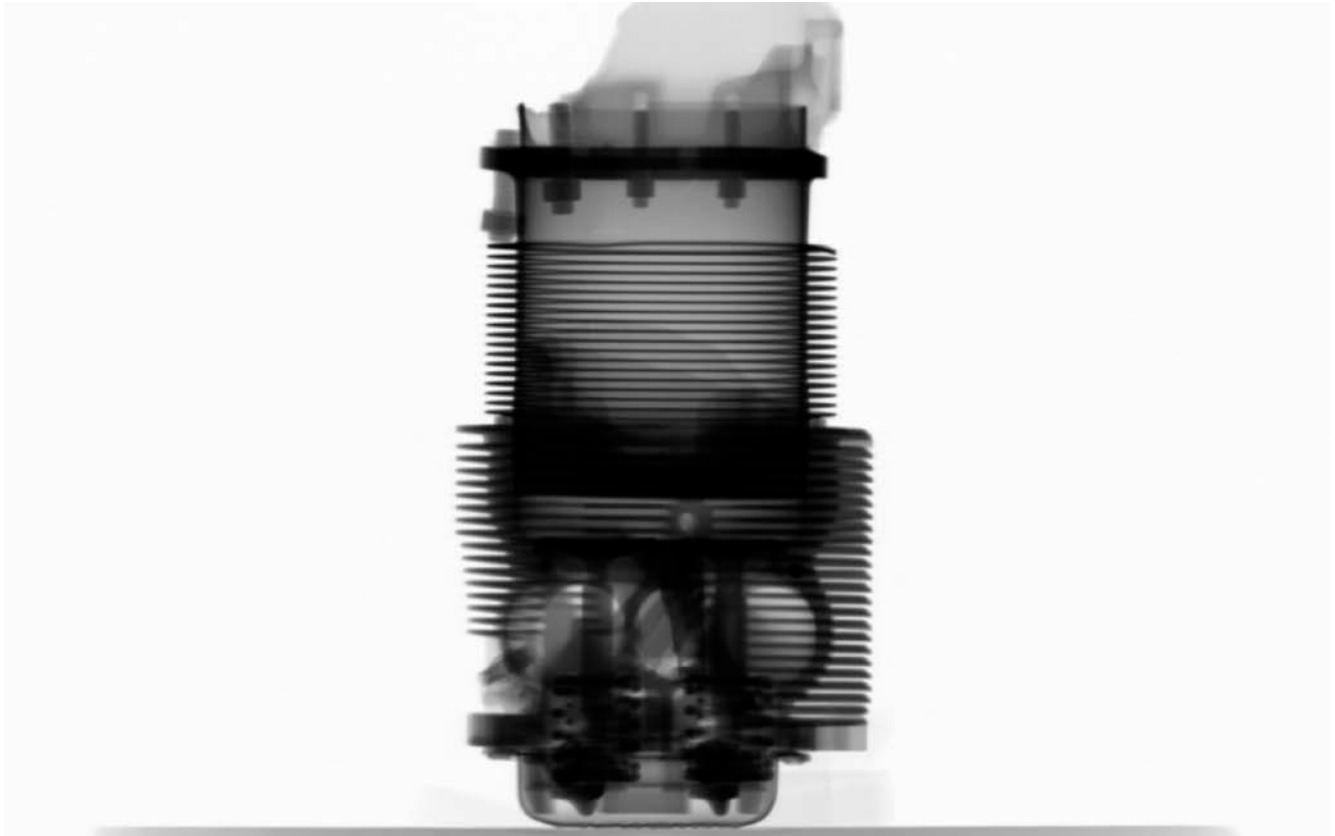


Figure 1  
Cylinder head – digital radiograph

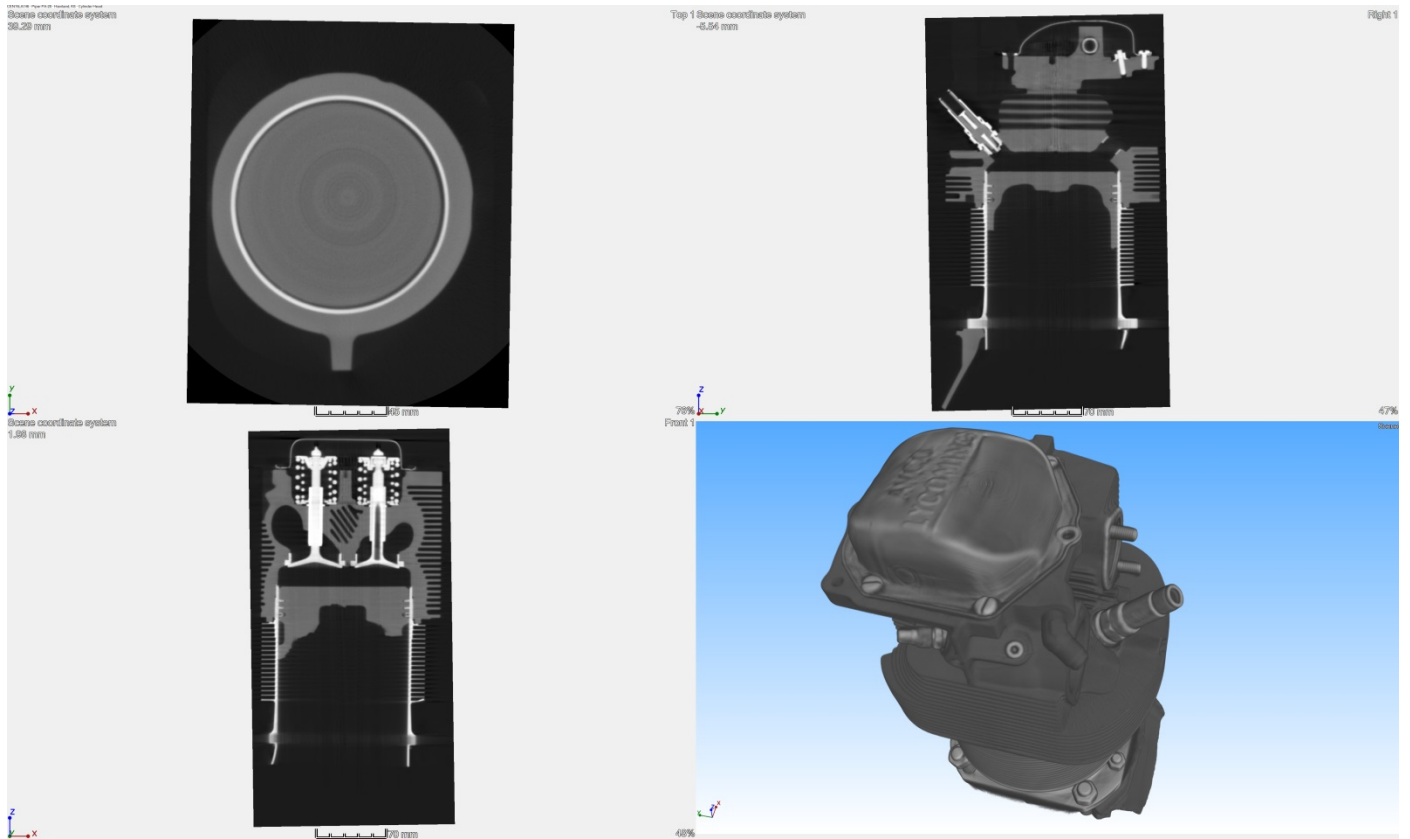


Figure 2  
Cylinder head – Overall cross section – view 1

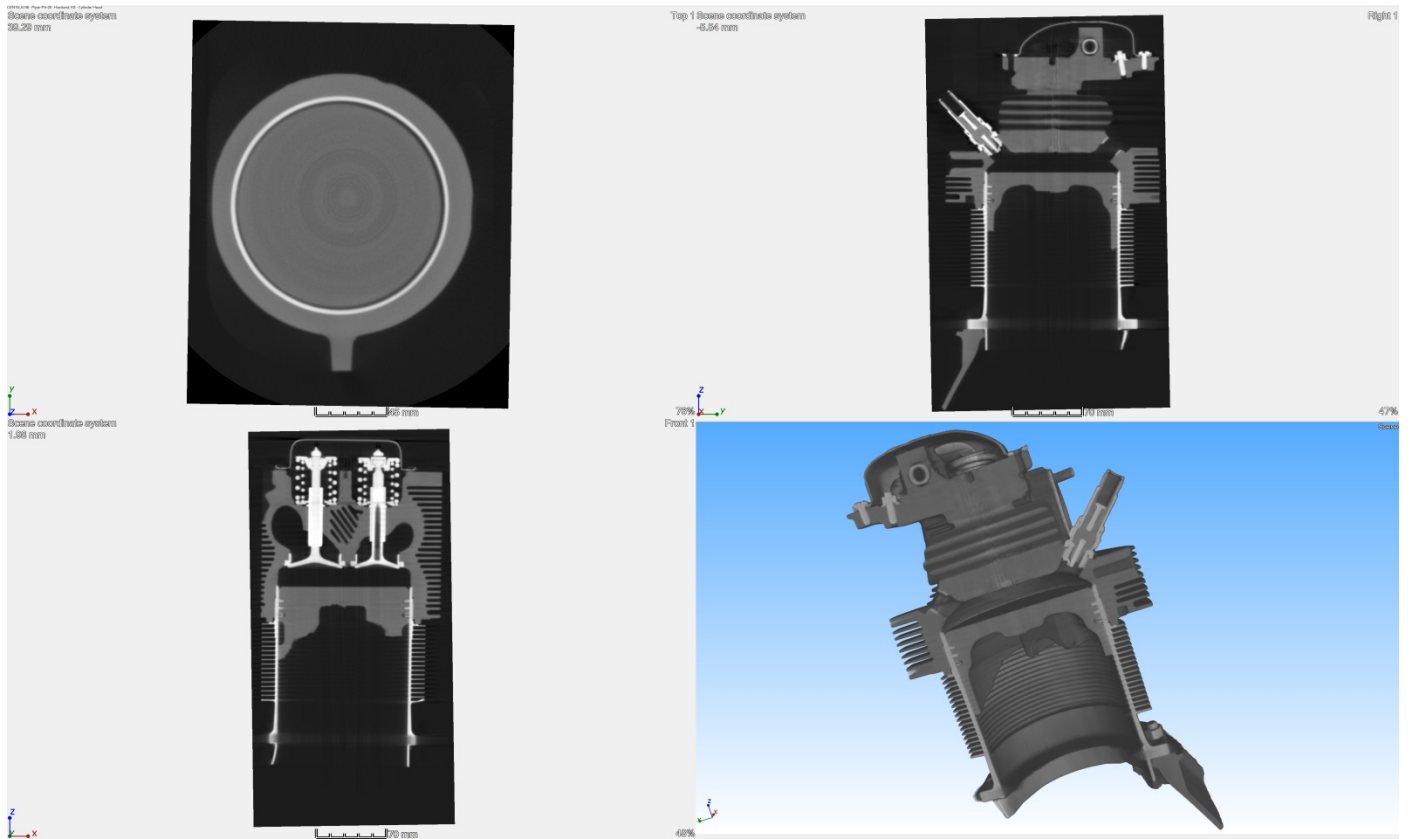


Figure 3  
Cylinder head – Overall cross section – view 2

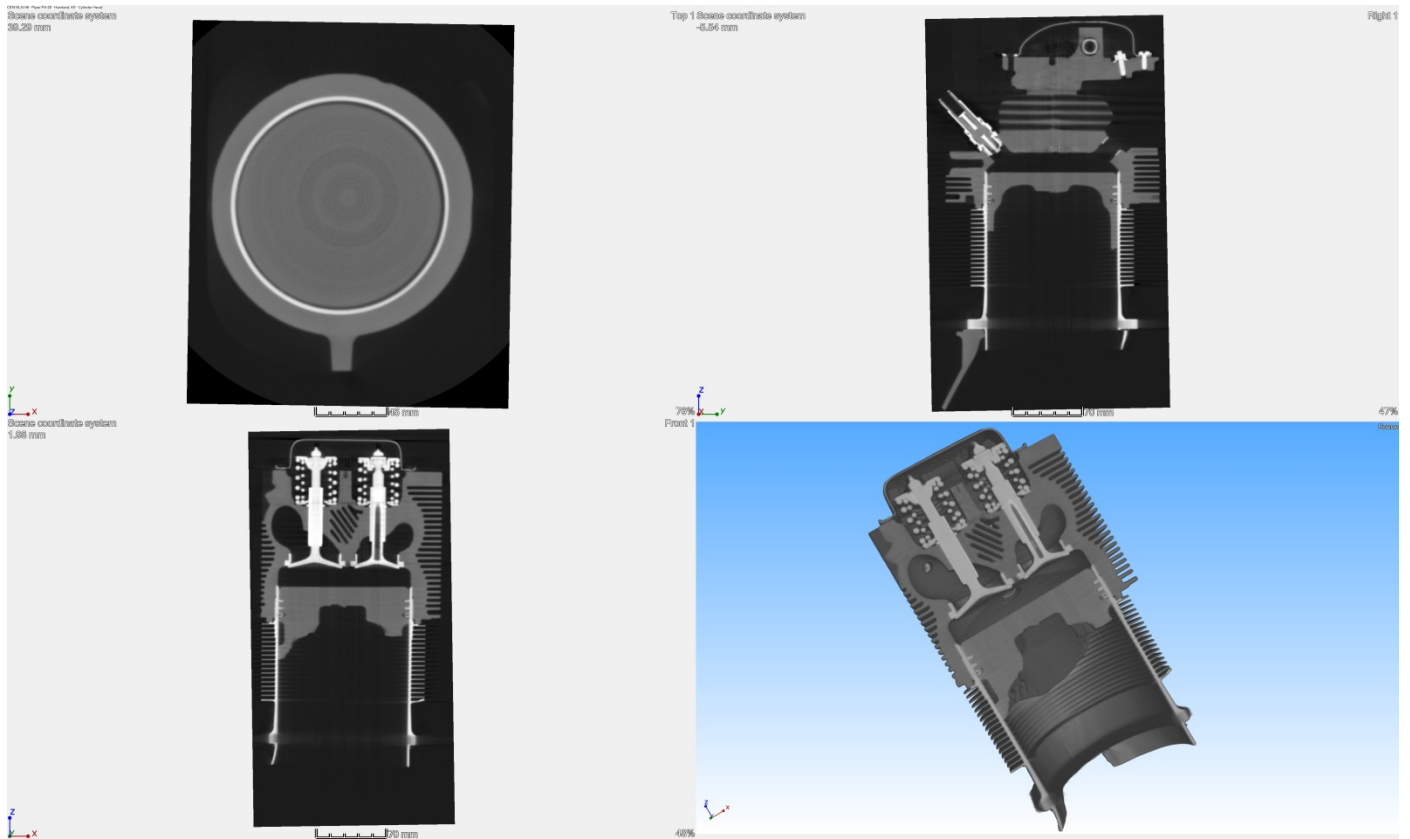


Figure 4  
Cylinder head – Overall cross section – view 3

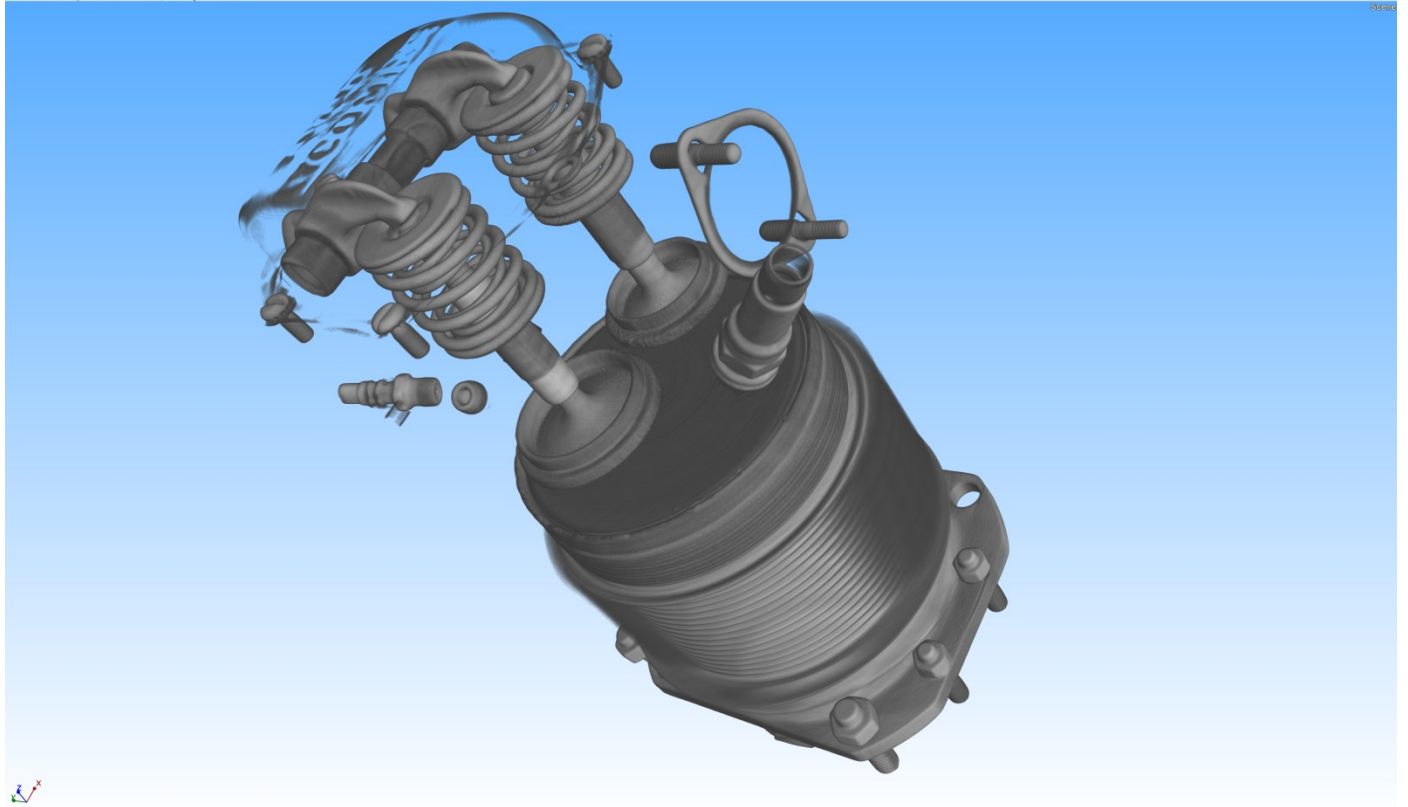


Figure 5  
Cylinder head – High density items

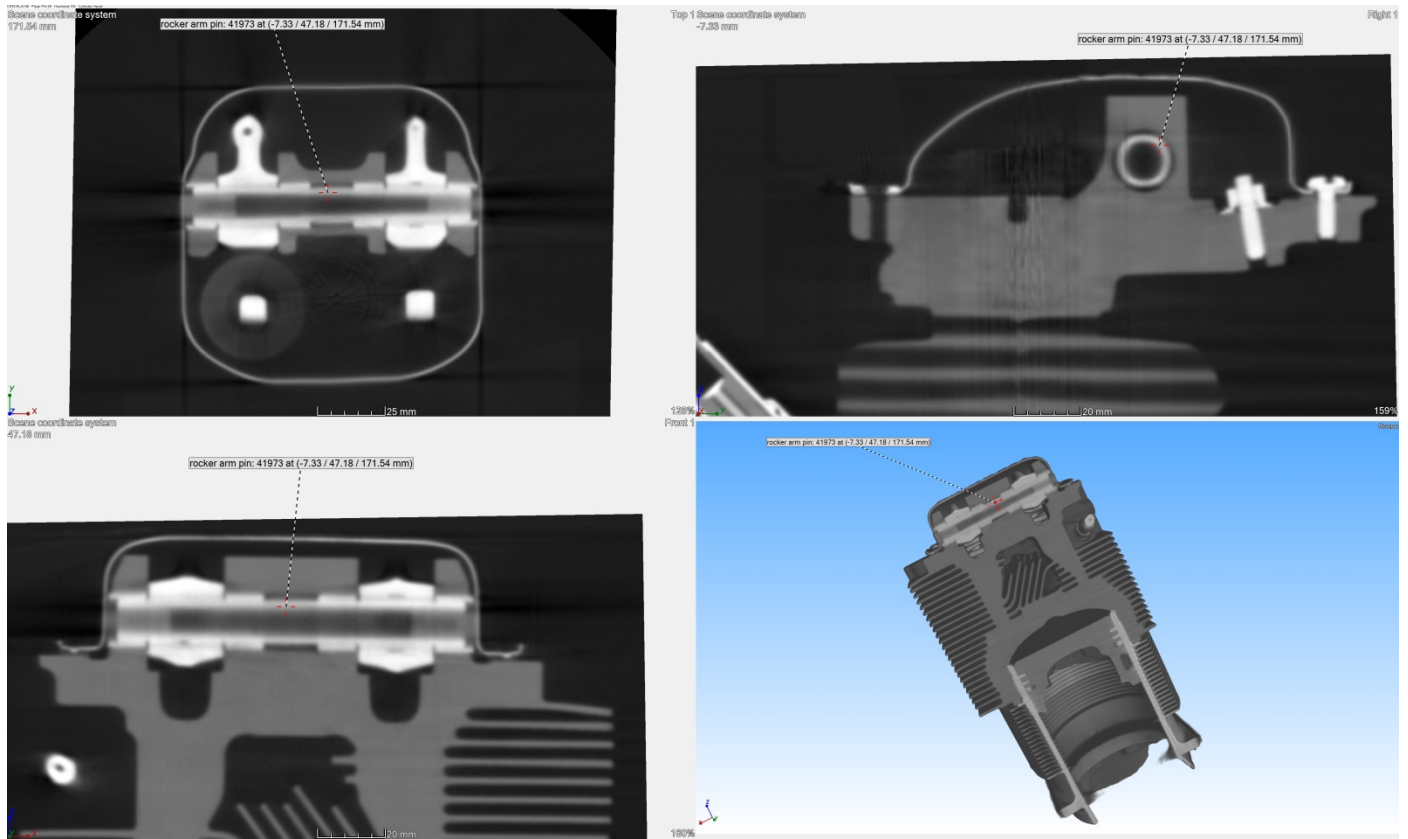


Figure 6  
Cylinder head – Rocker arm pin

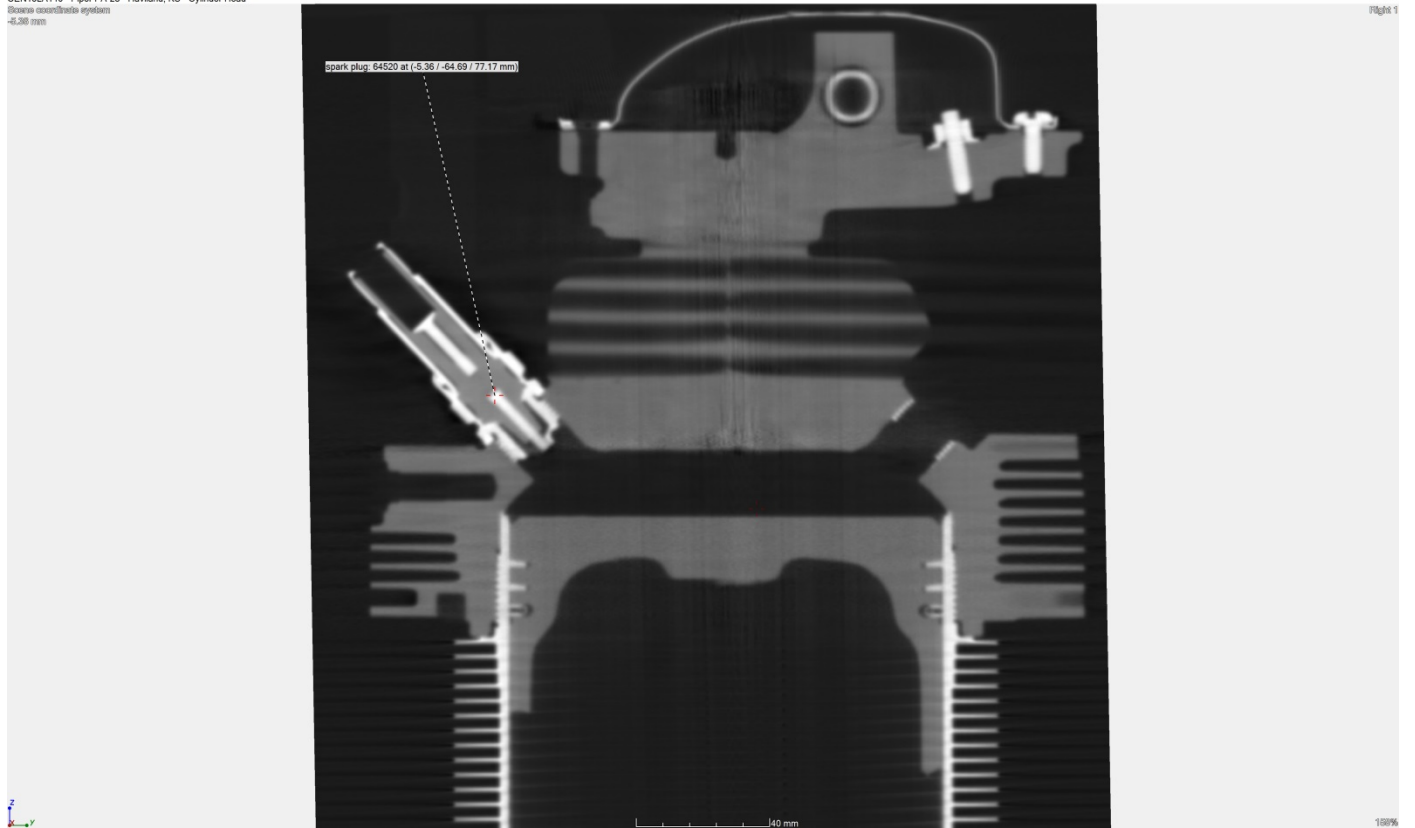


Figure 7  
Cylinder head – Spark plug

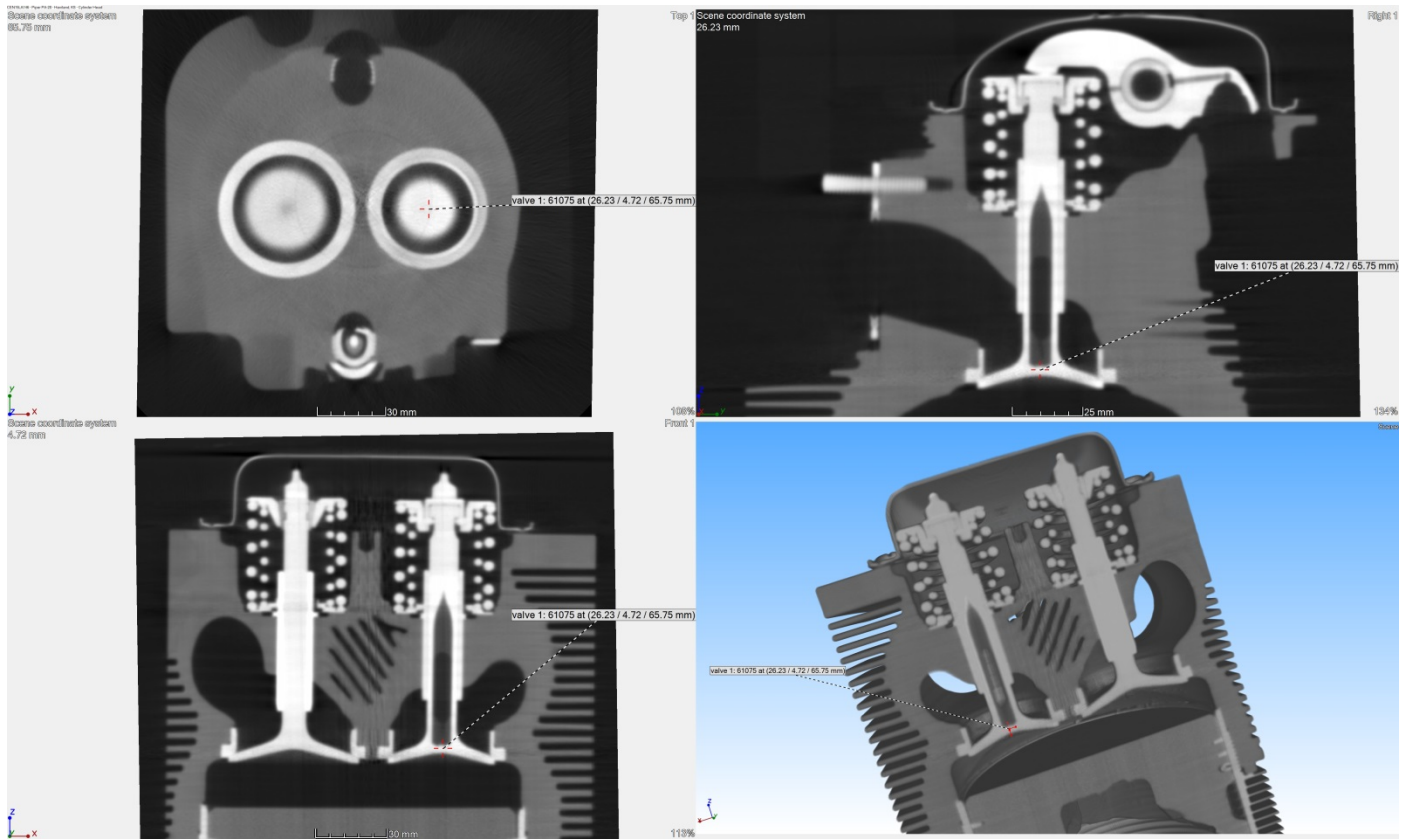


Figure 8  
Cylinder head – Valve 1

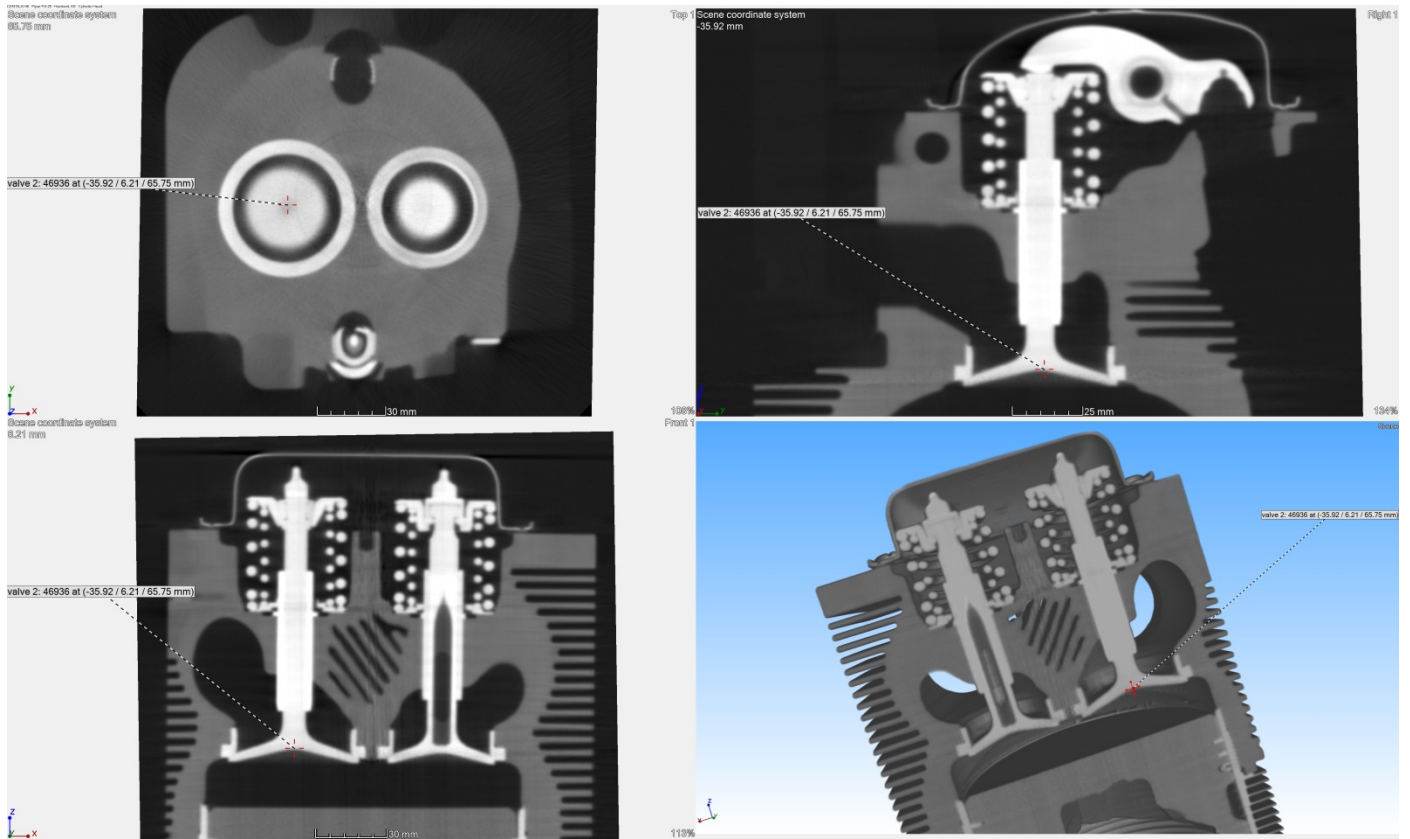


Figure 9  
Cylinder head – Valve 2

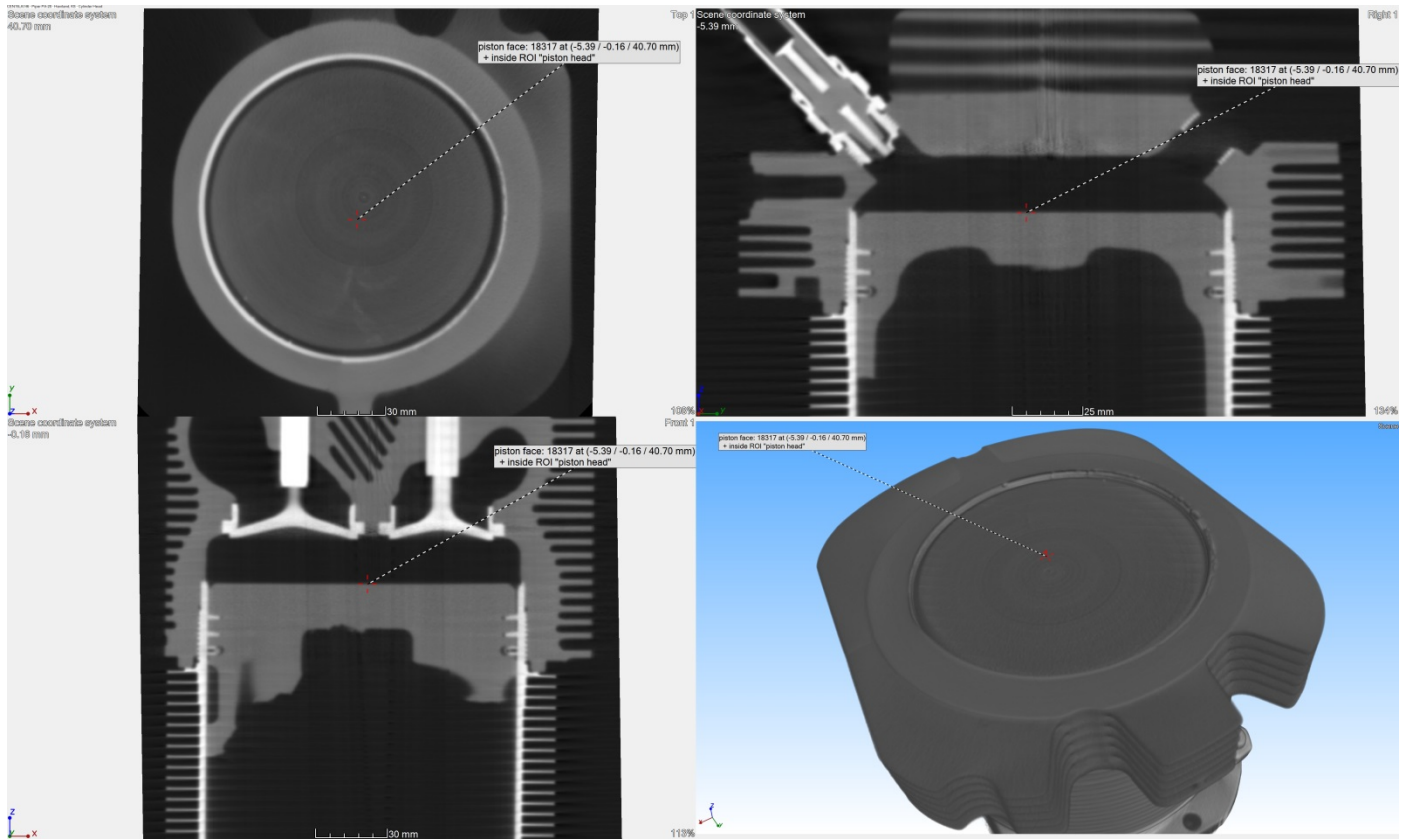


Figure 10  
Cylinder head – Piston head face

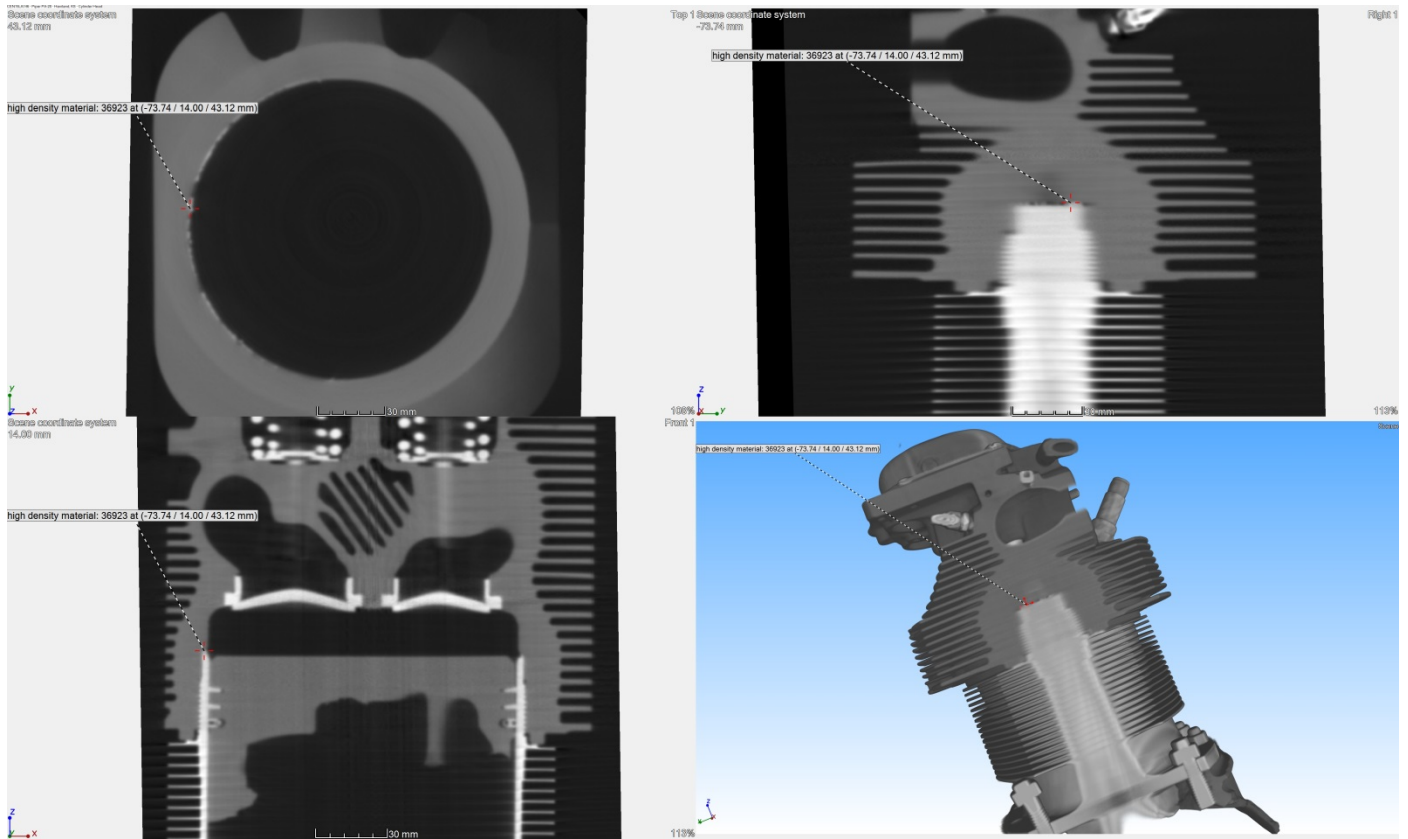


Figure 11  
Cylinder head – High density material

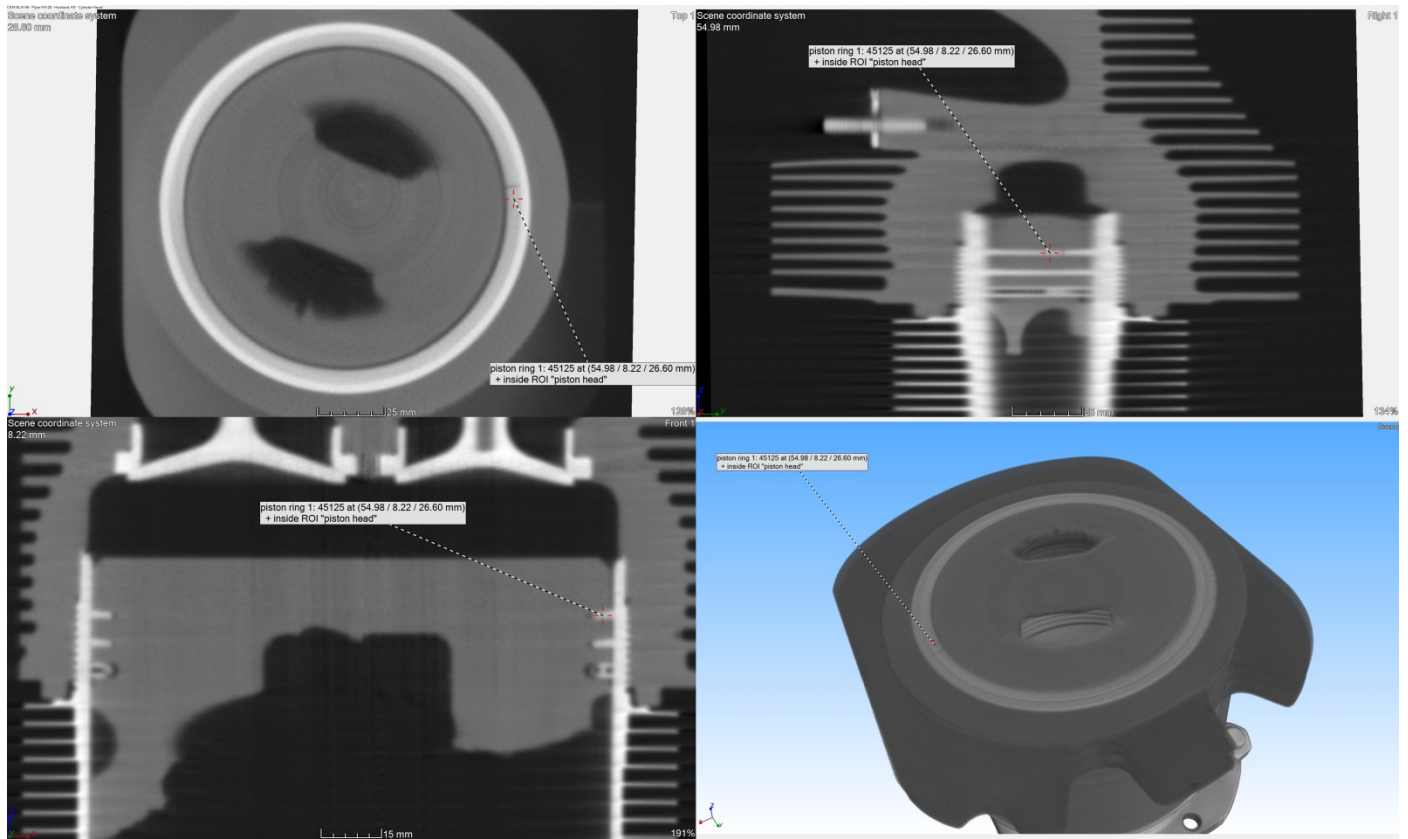


Figure 12  
Cylinder head – Piston ring 1

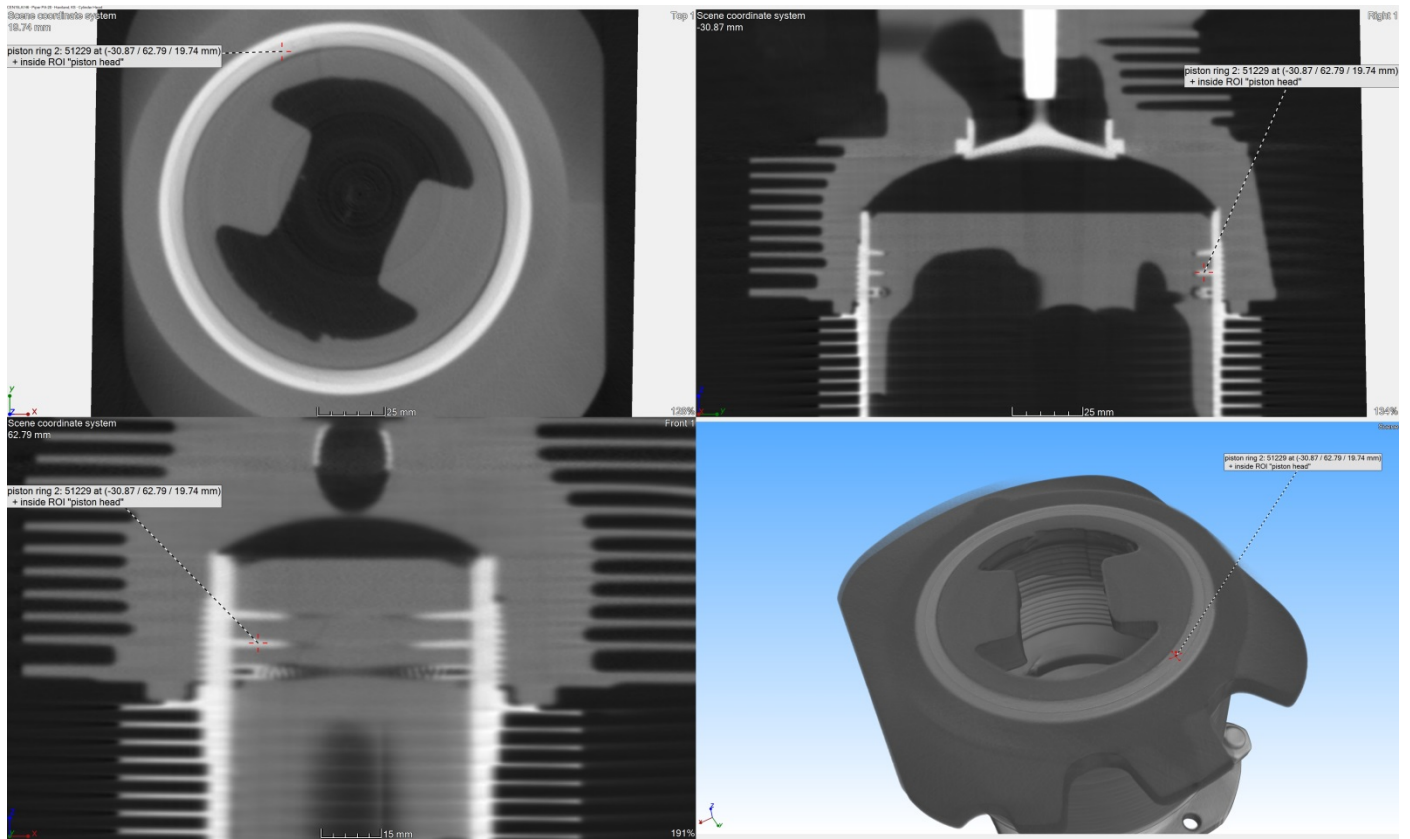


Figure 13  
Cylinder head – Piston ring 2

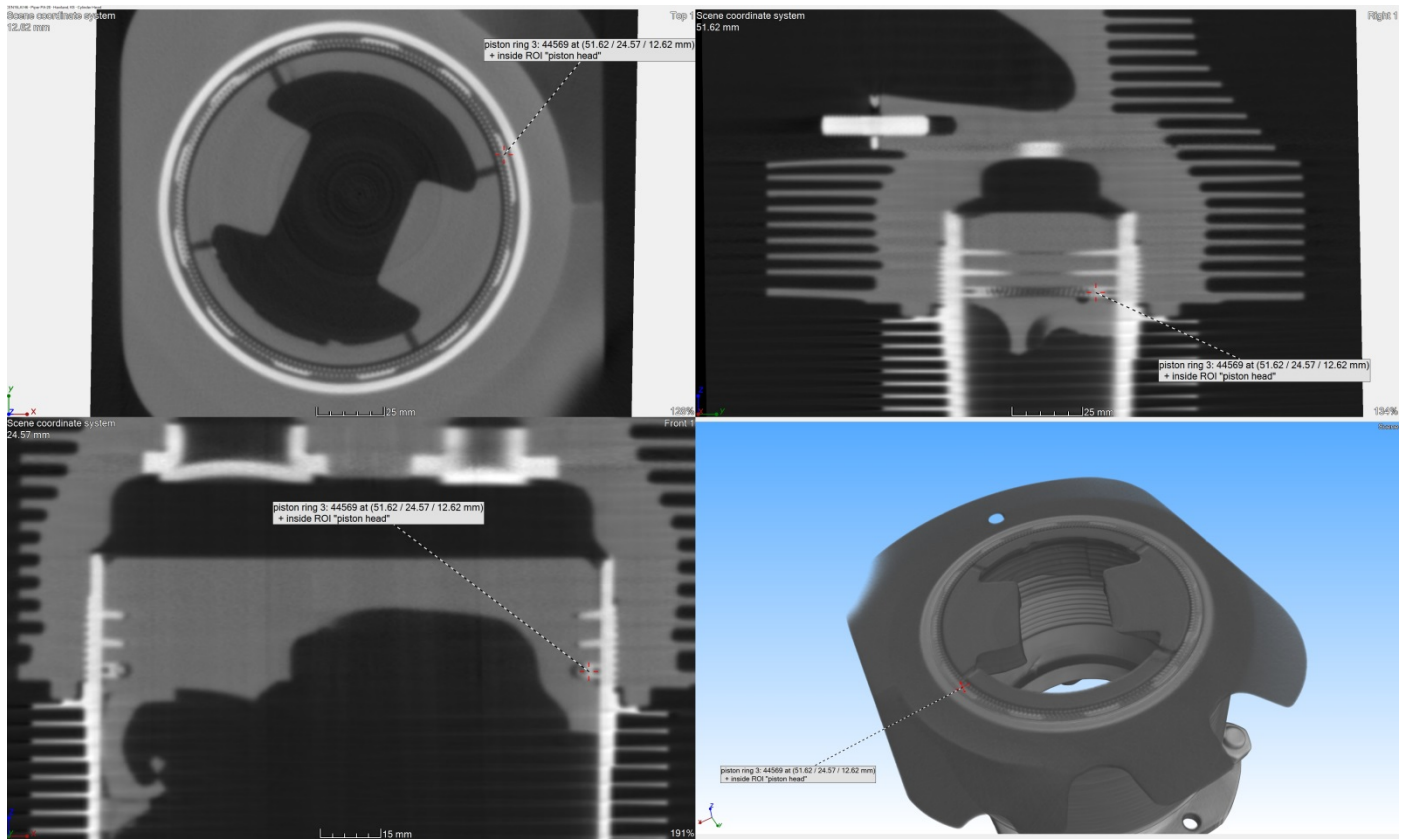


Figure 14  
Cylinder head – Piston ring 3 – view 1

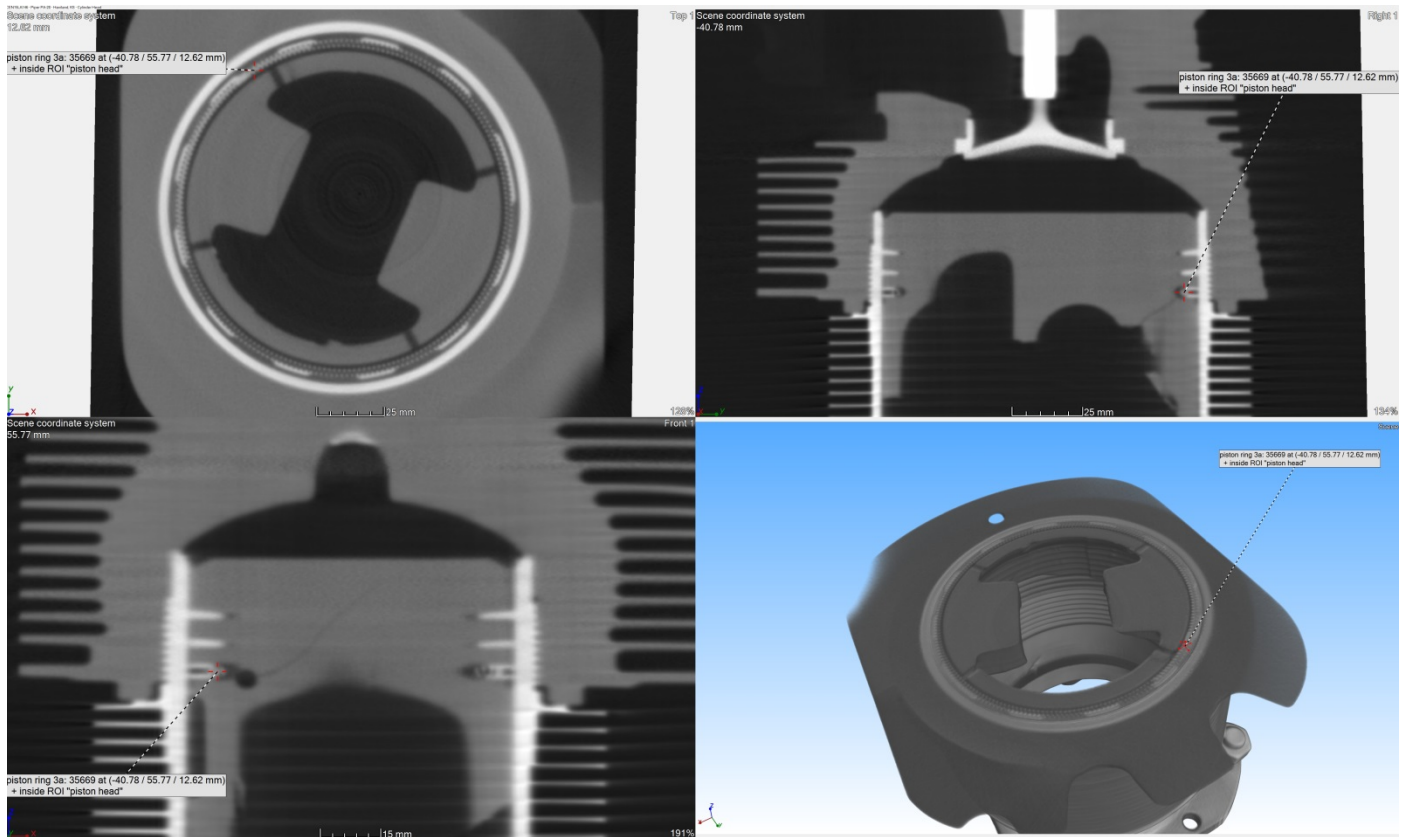


Figure 15  
Cylinder head – Piston ring 3 – crack indications

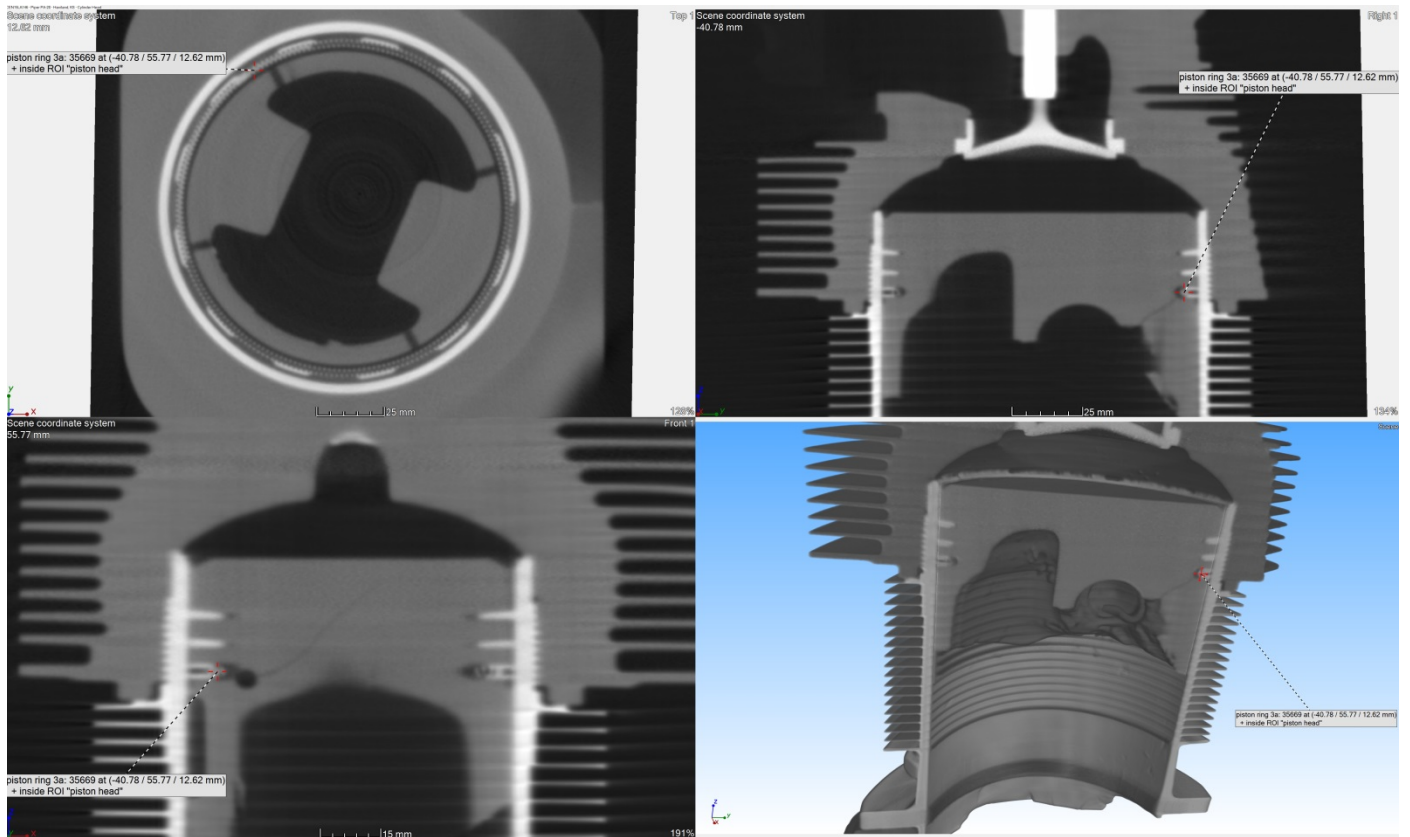


Figure 16  
Cylinder head – Piston ring 3 – view 2

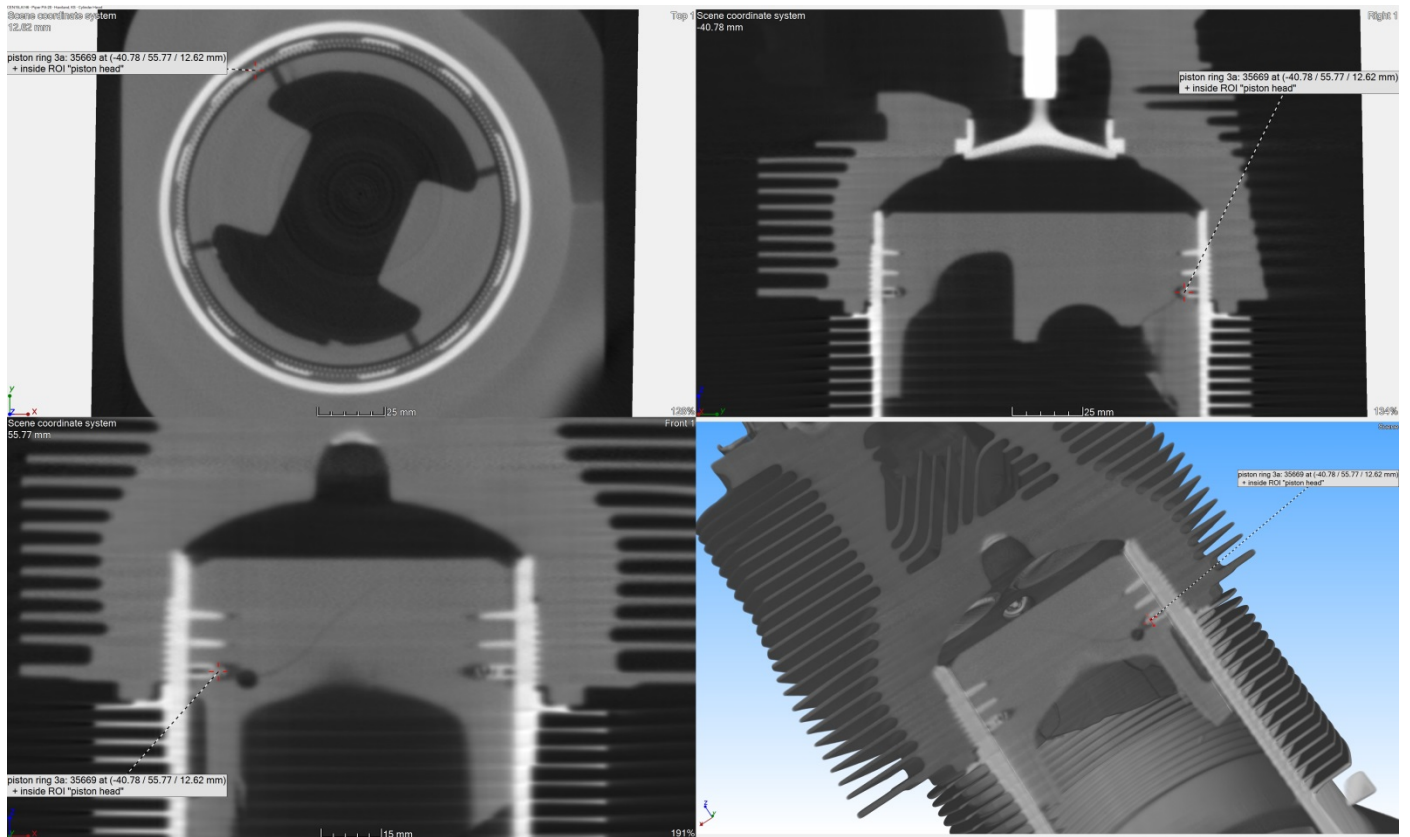


Figure 17  
Cylinder head – Piston ring 3 – view 3

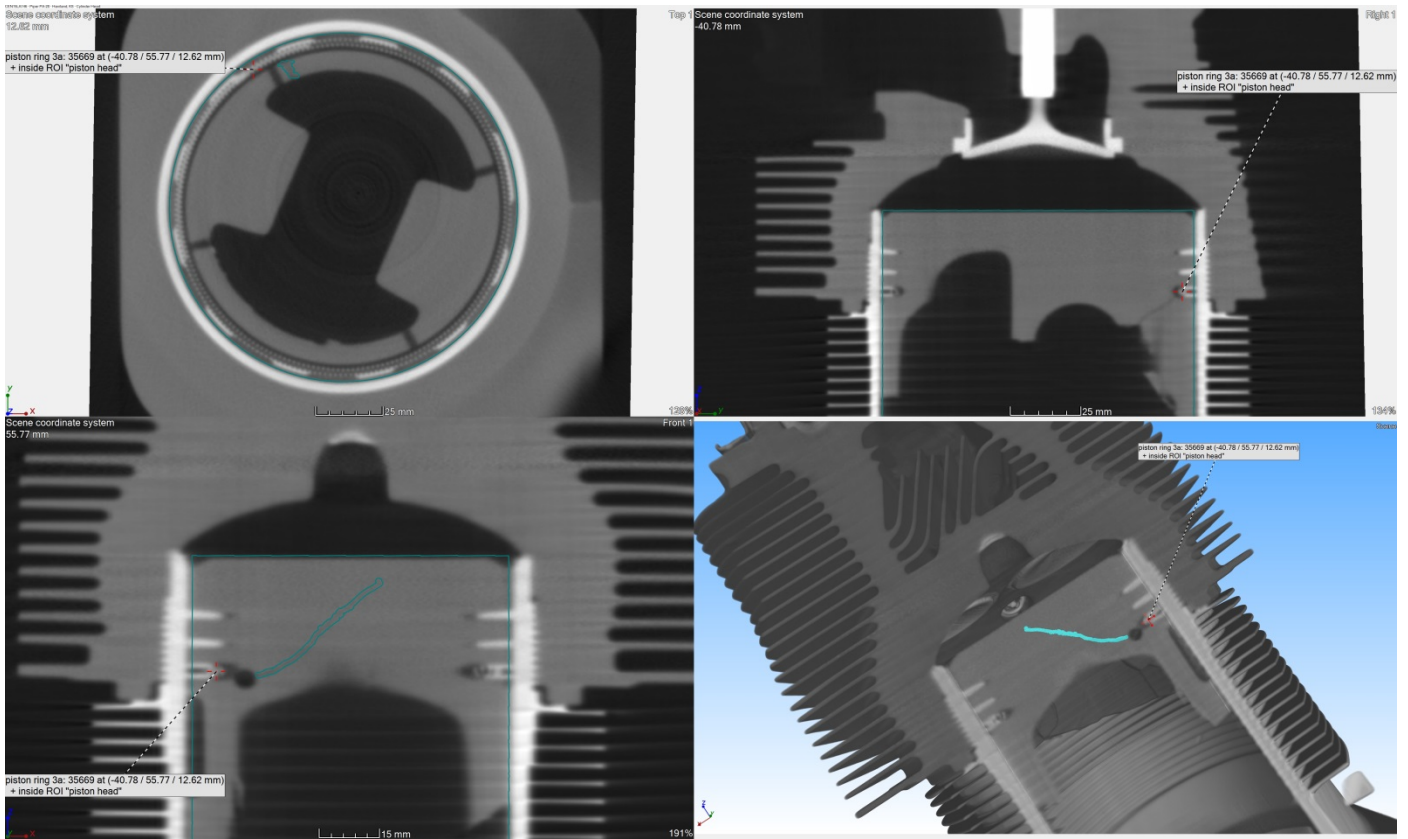


Figure 18  
Cylinder head – Piston ring 3 – view 3 with highlighted crack indication

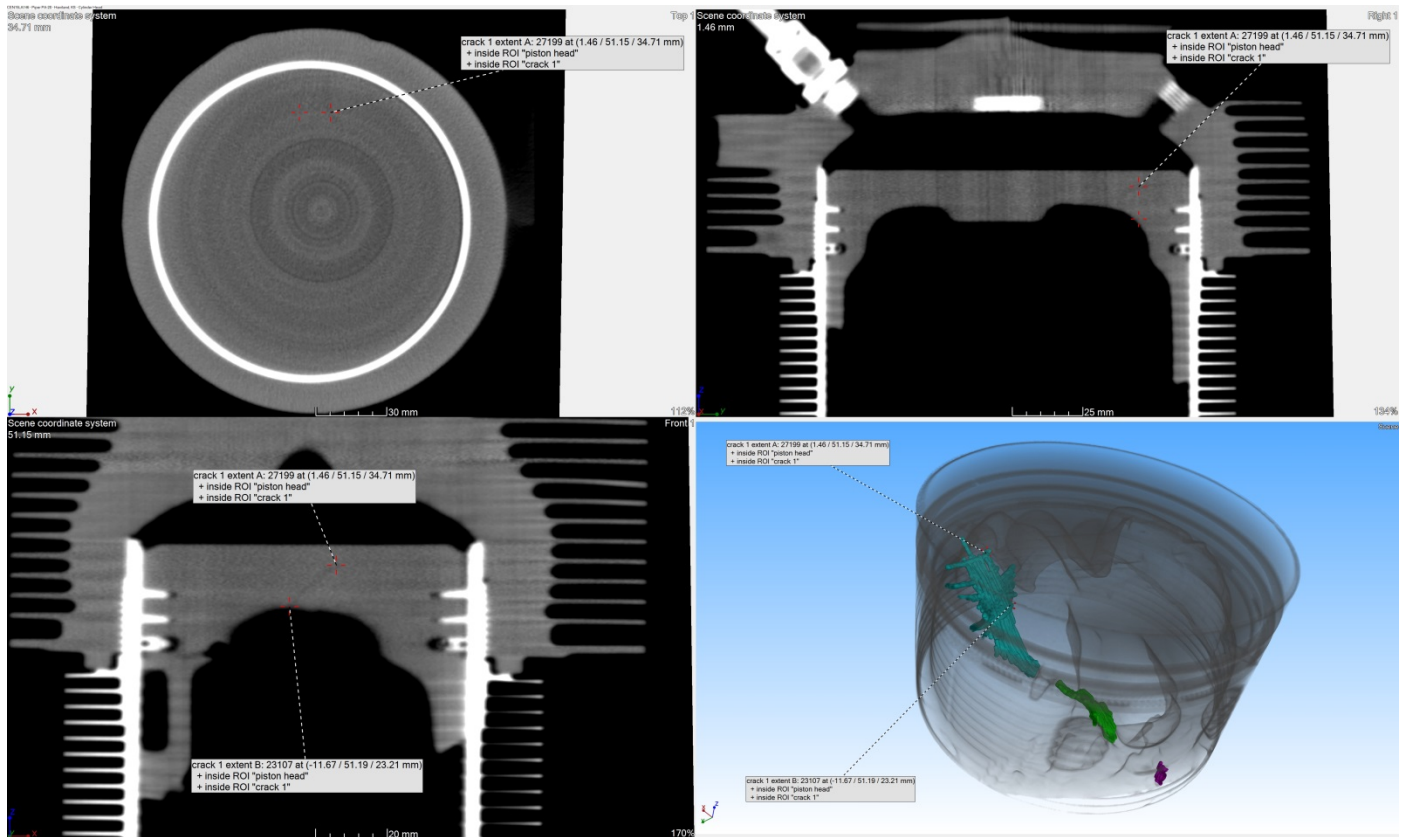


Figure 19  
Cylinder head – Crack 1 – extent A and B

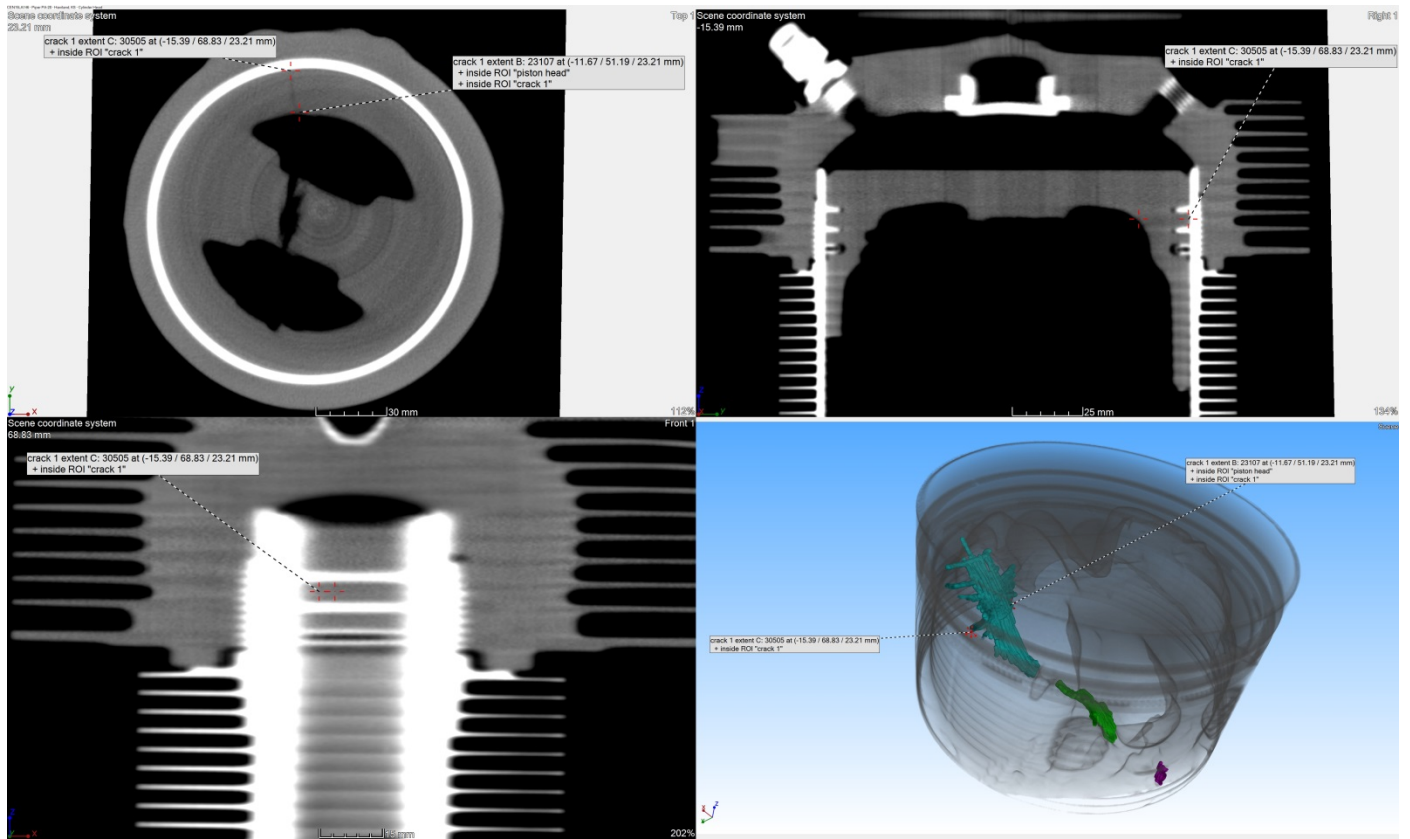


Figure 20  
Cylinder head – Crack 1 – extent B and C

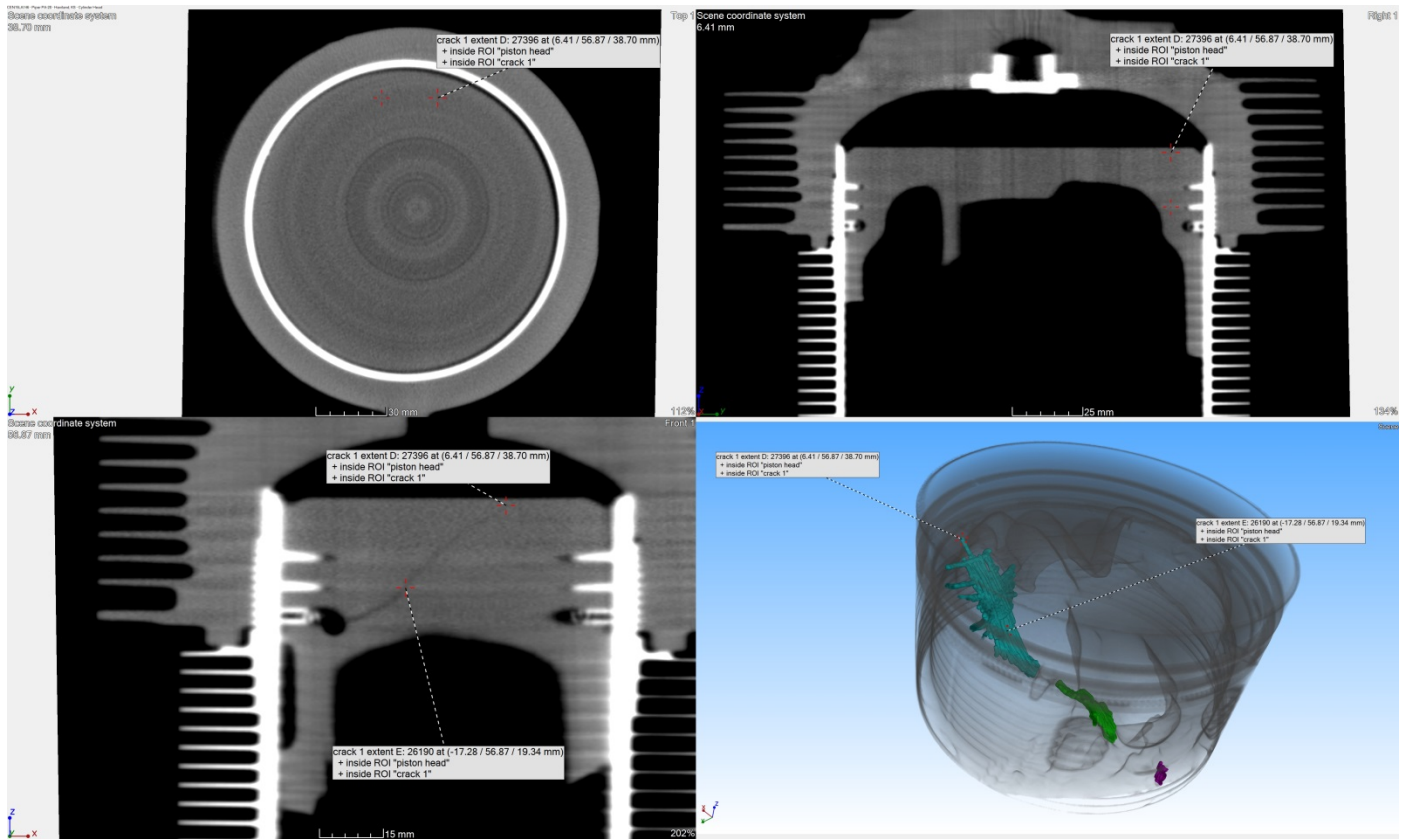


Figure 21  
Cylinder head – Crack 1 – extent D and E

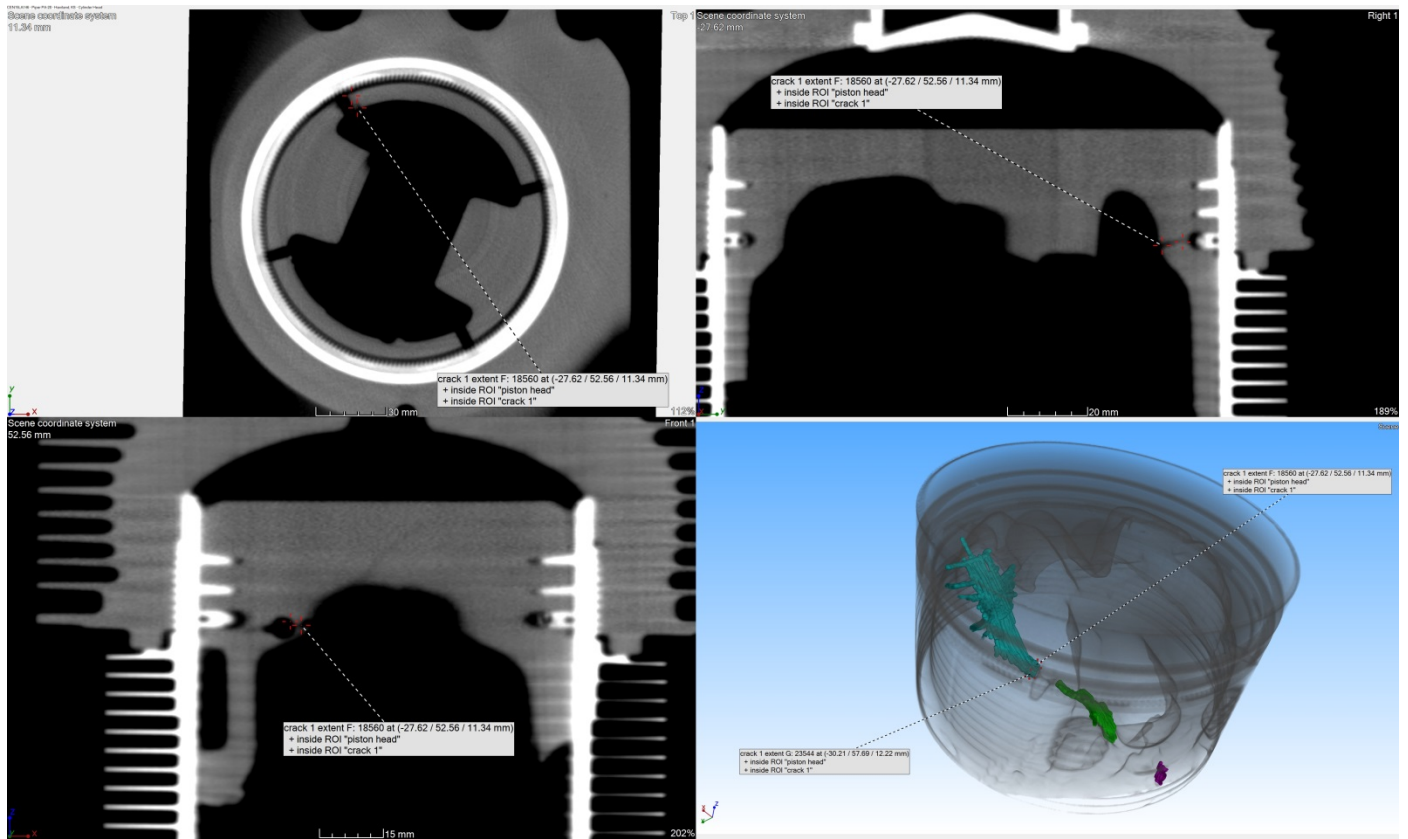


Figure 22  
Cylinder head – Crack 1 – extent F and G

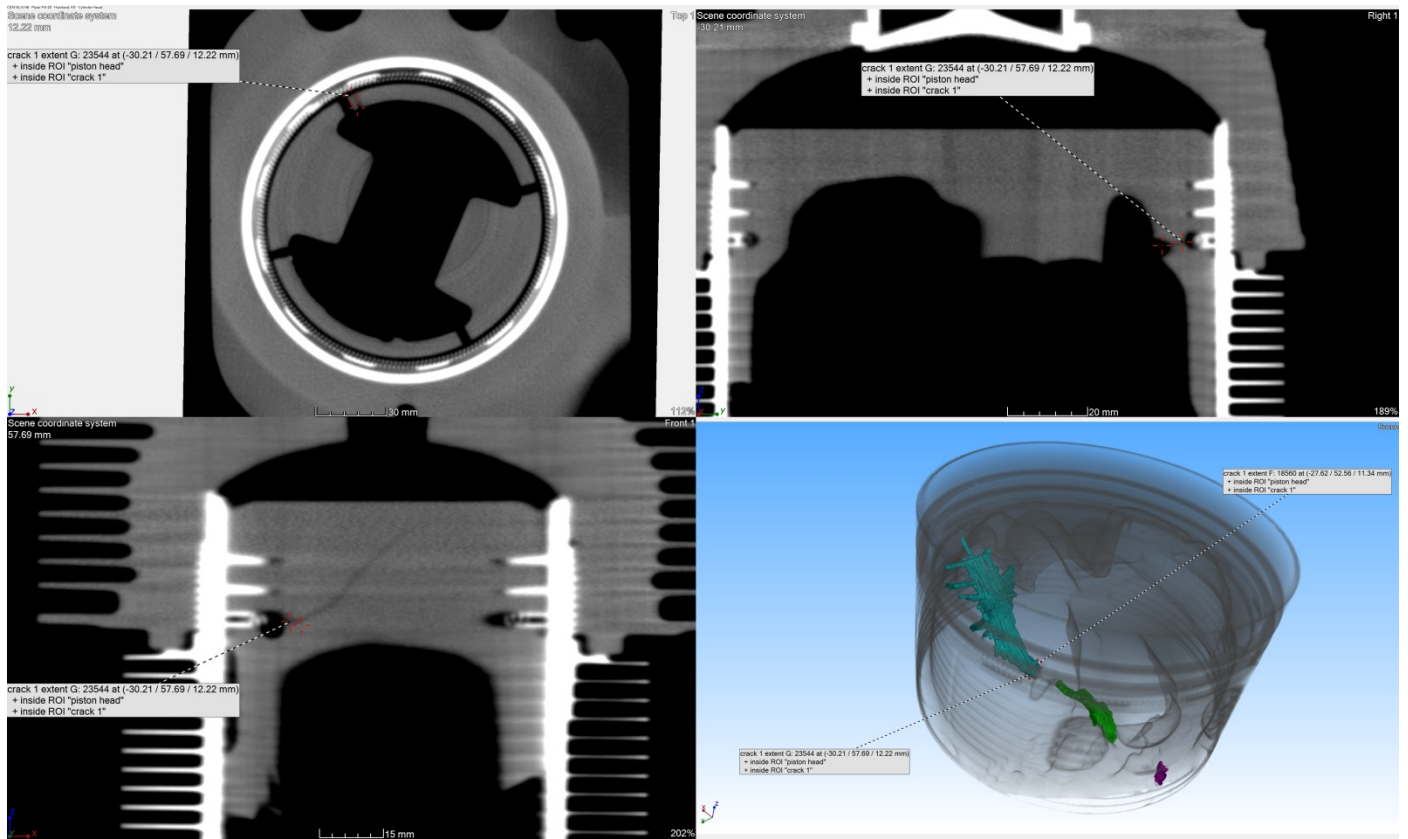


Figure 23  
Cylinder head – Crack 1 – extent F and G – view 2

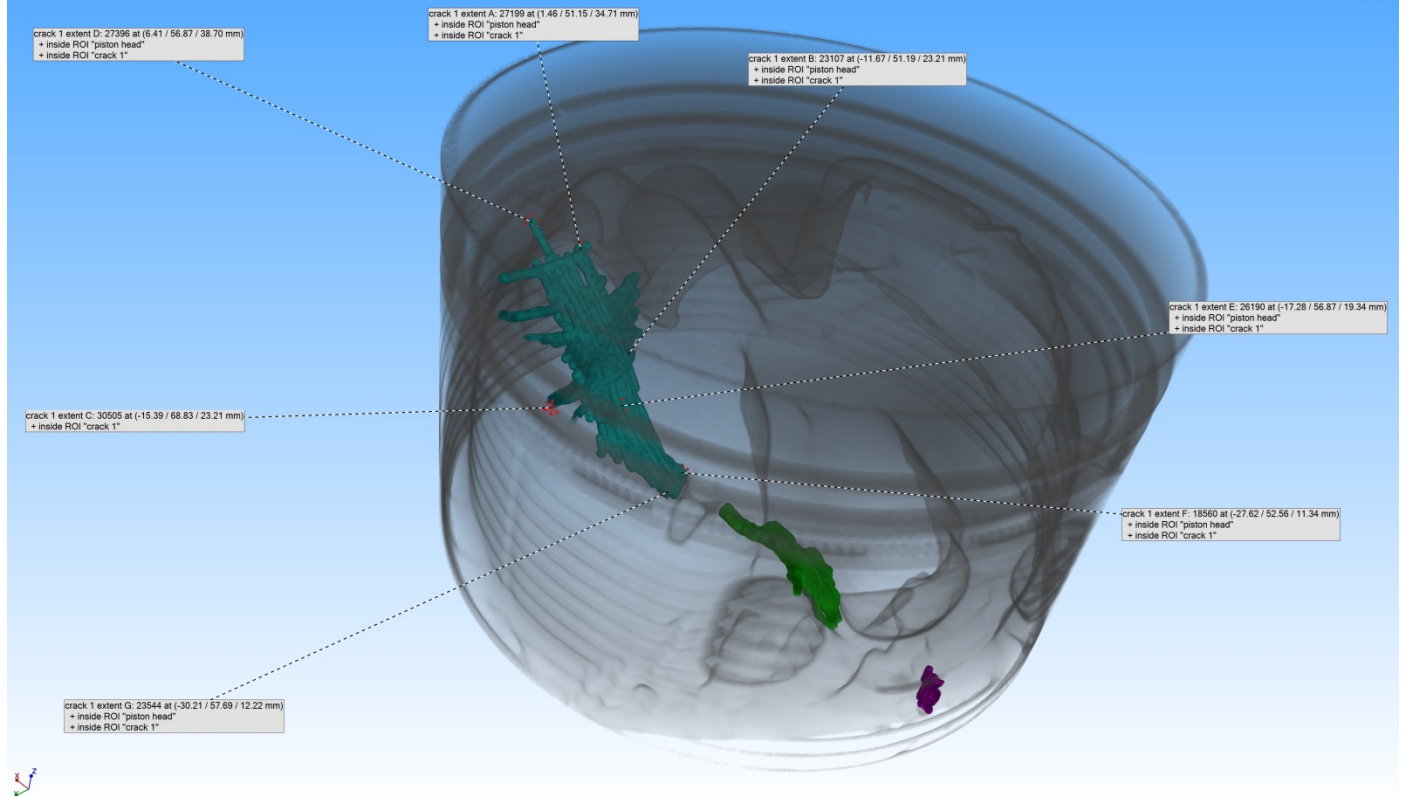


Figure 24  
Cylinder head – Crack 1 – overall view

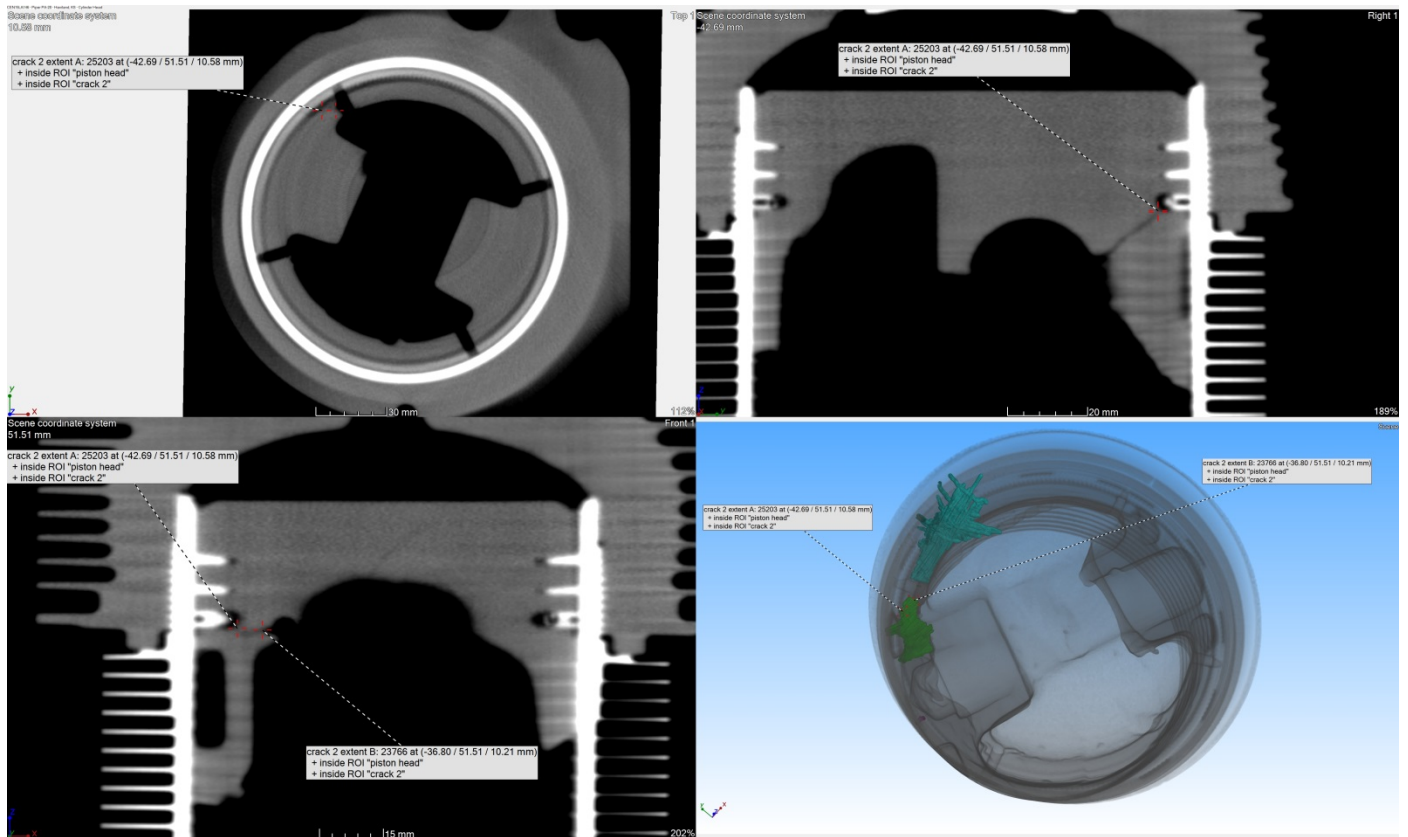


Figure 25  
Cylinder head – Crack 2 – extent A and B

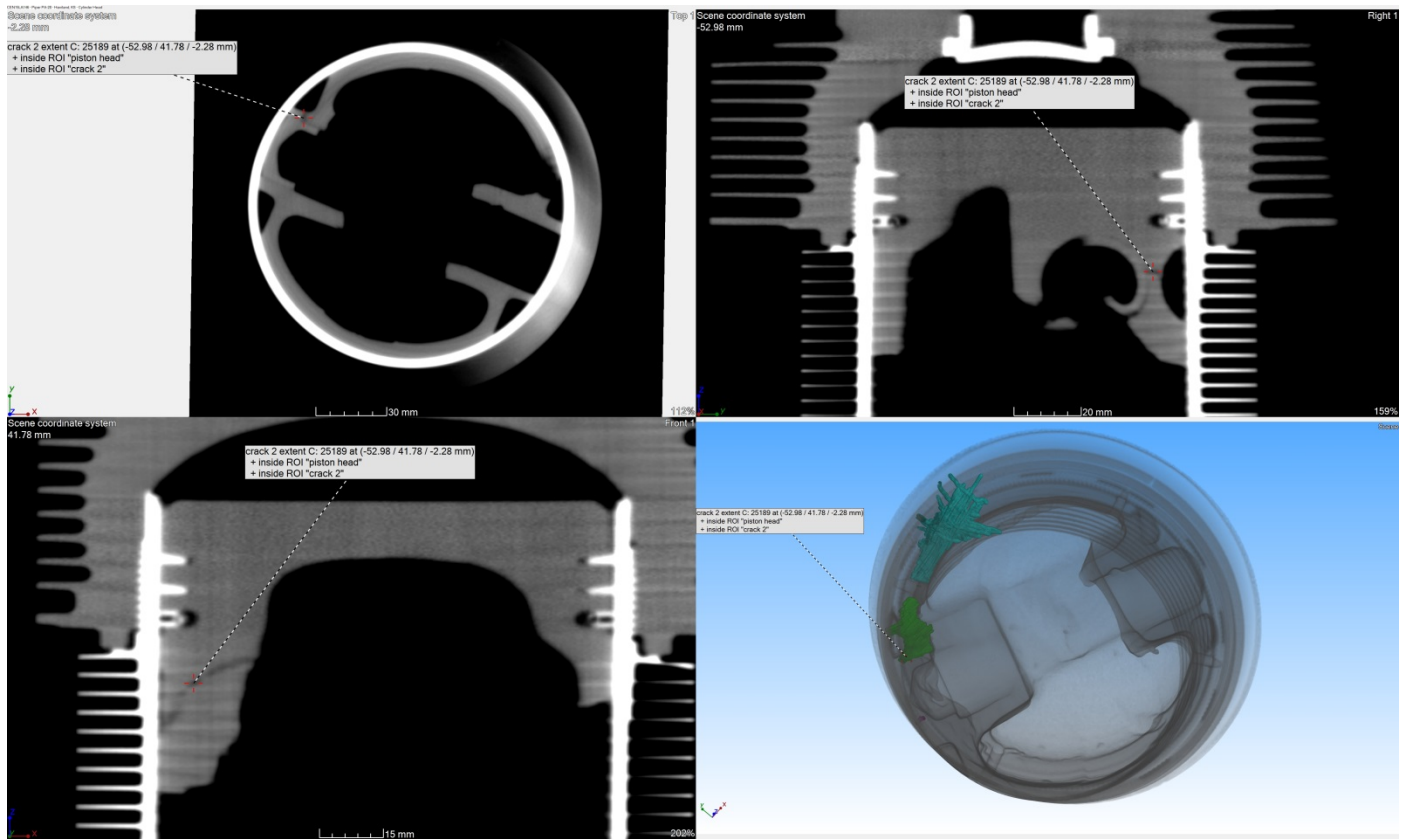


Figure 26  
Cylinder head – Crack 2 – extent C

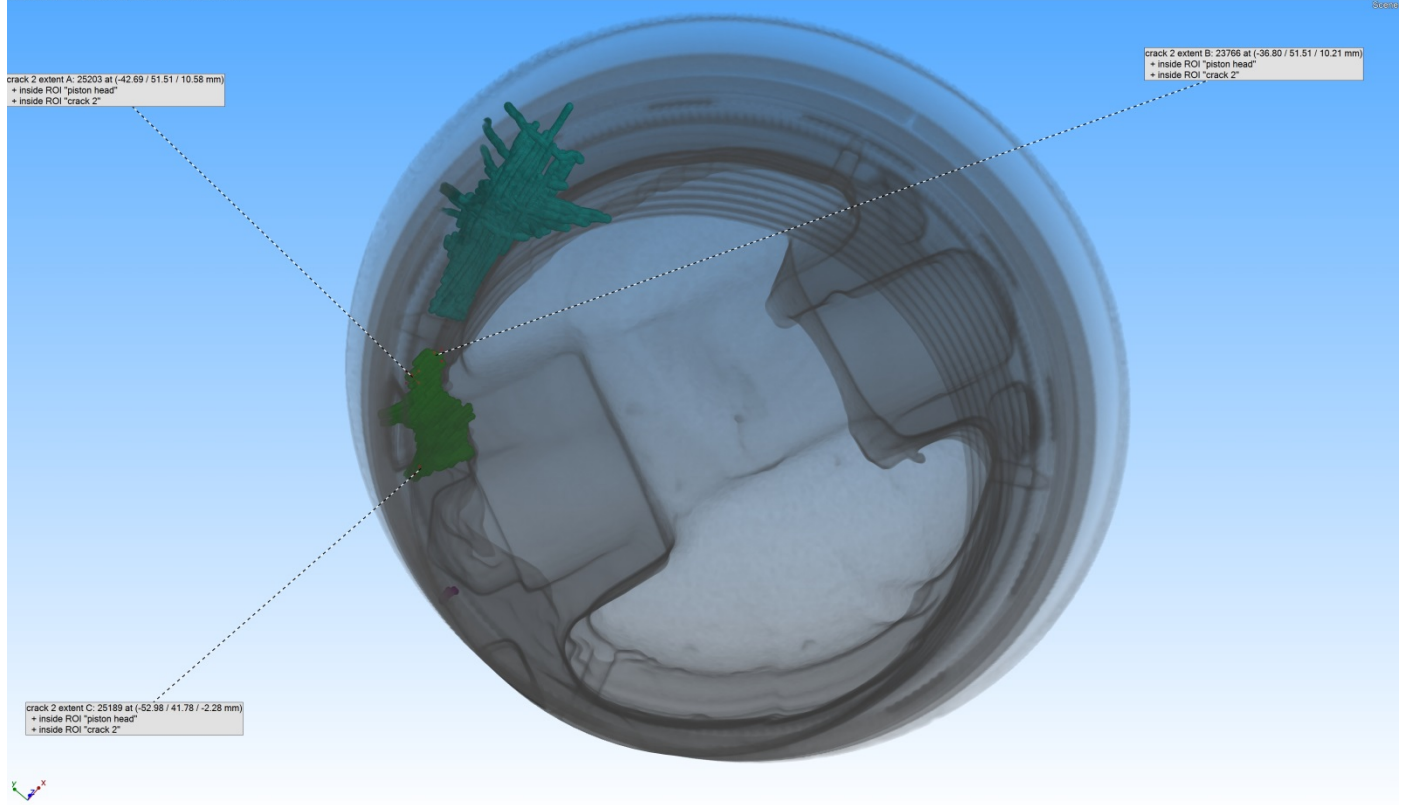


Figure 27  
 Cylinder head – Crack 2 – overall view

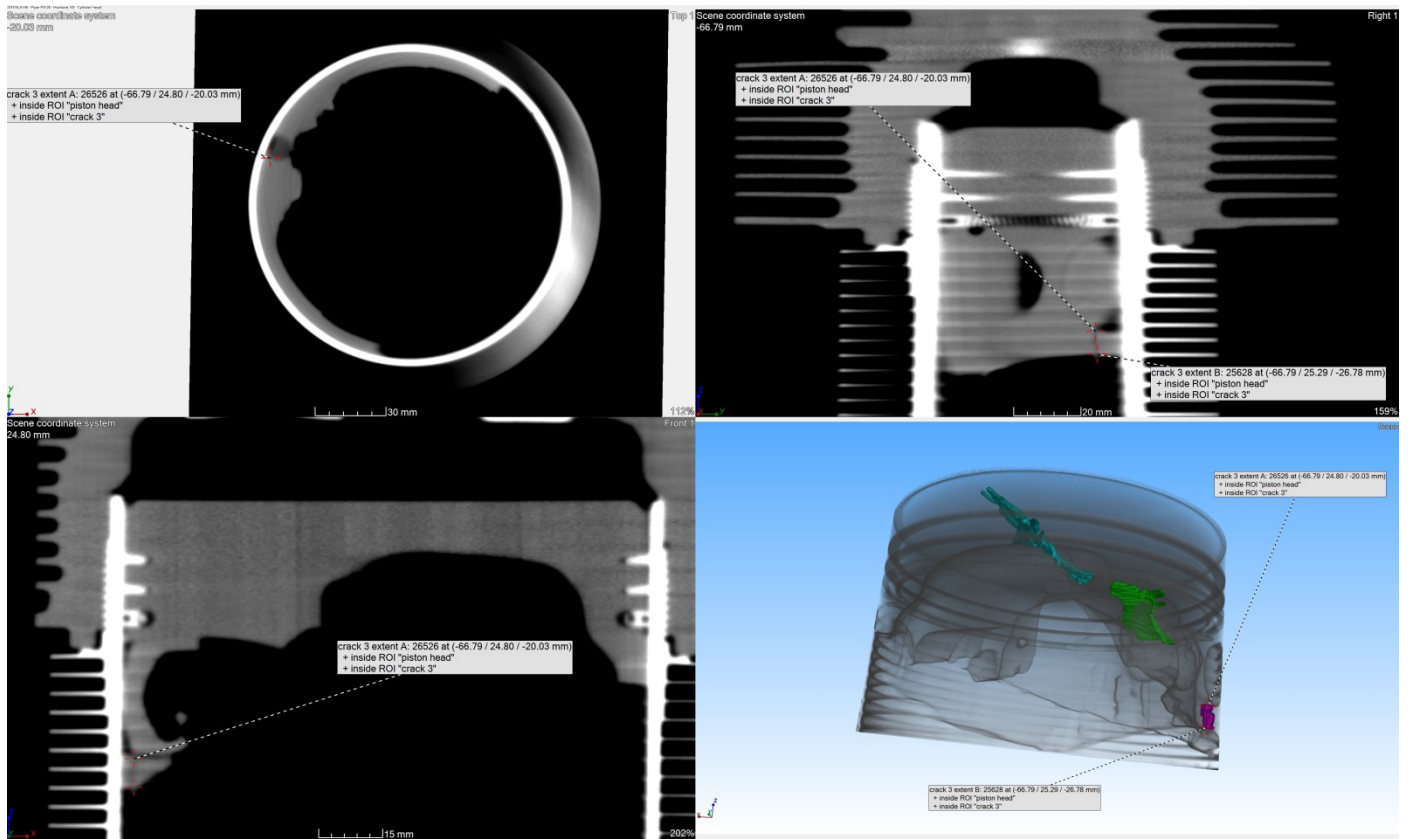


Figure 28  
Cylinder head – Crack 3 – extent A and B

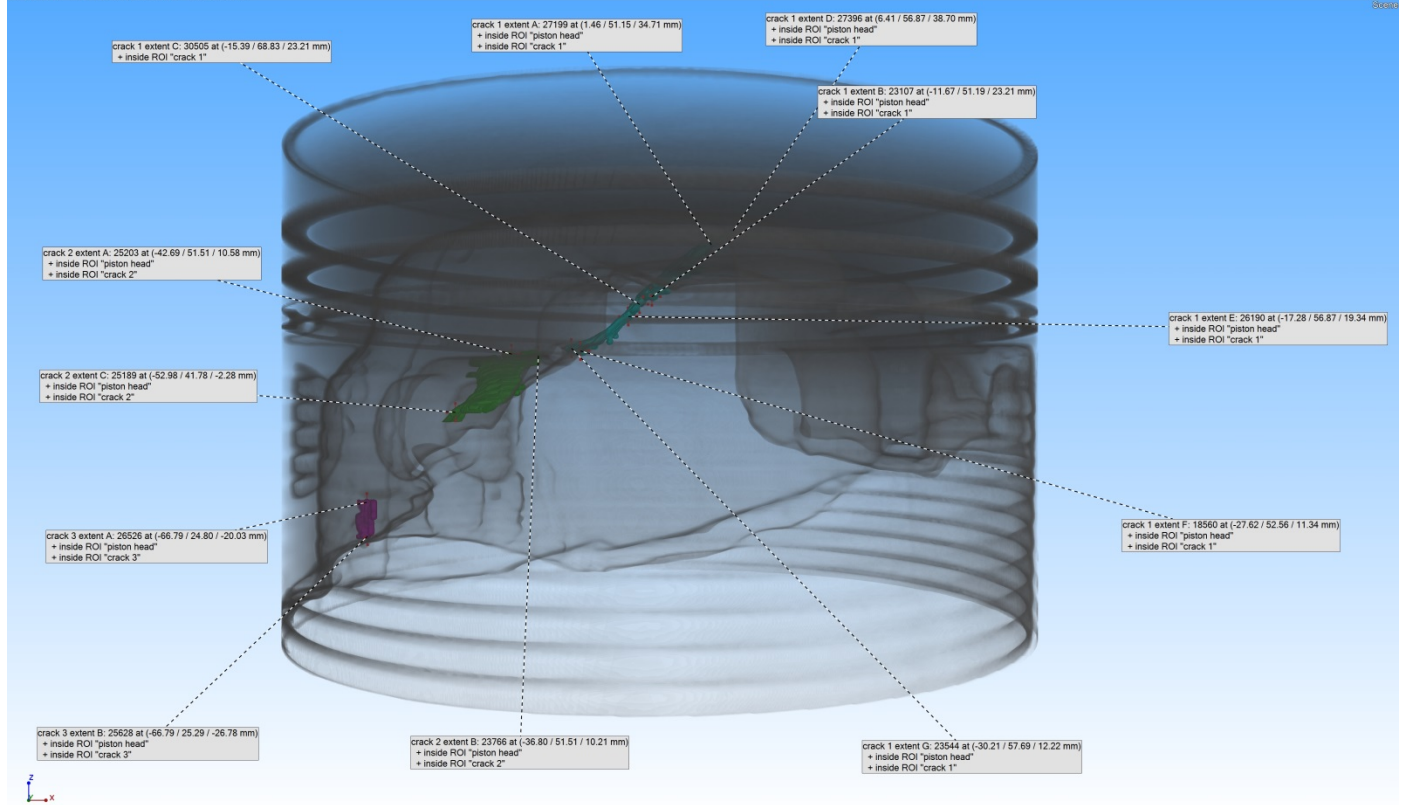


Figure 29  
Cylinder head – All cracks – side 1

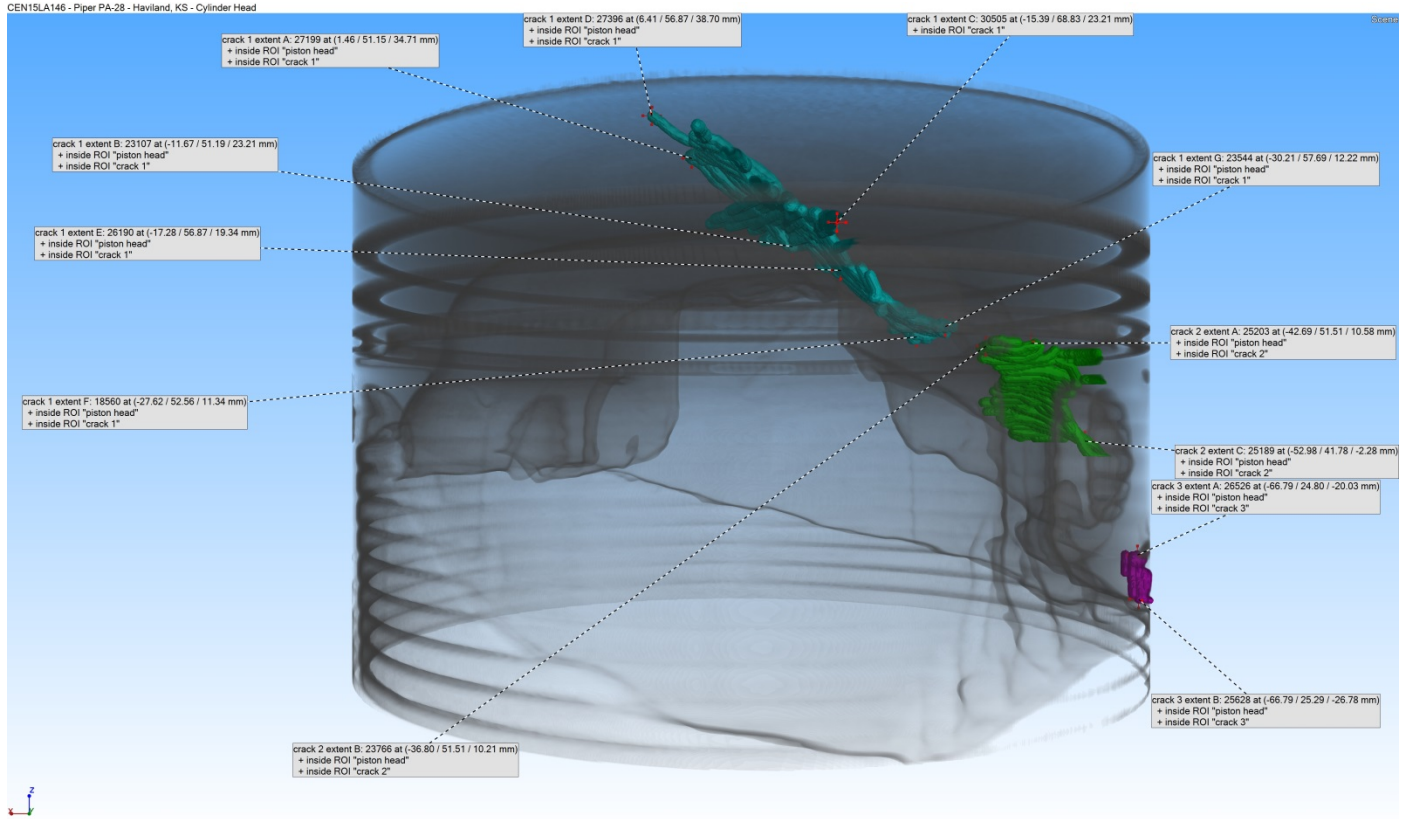


Figure 30  
Cylinder head – All cracks – side 2

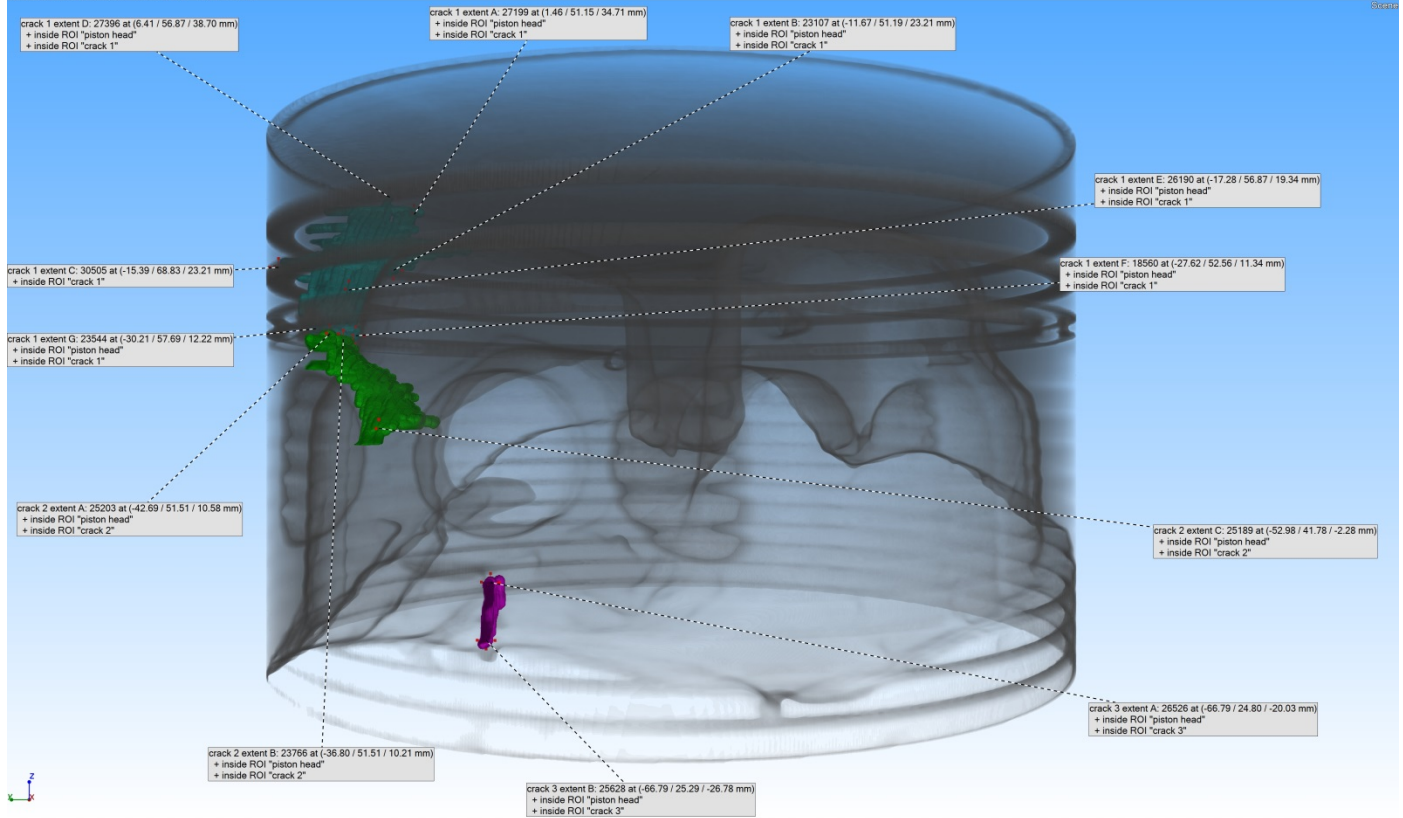


Figure 31  
Cylinder head – All cracks – side 3

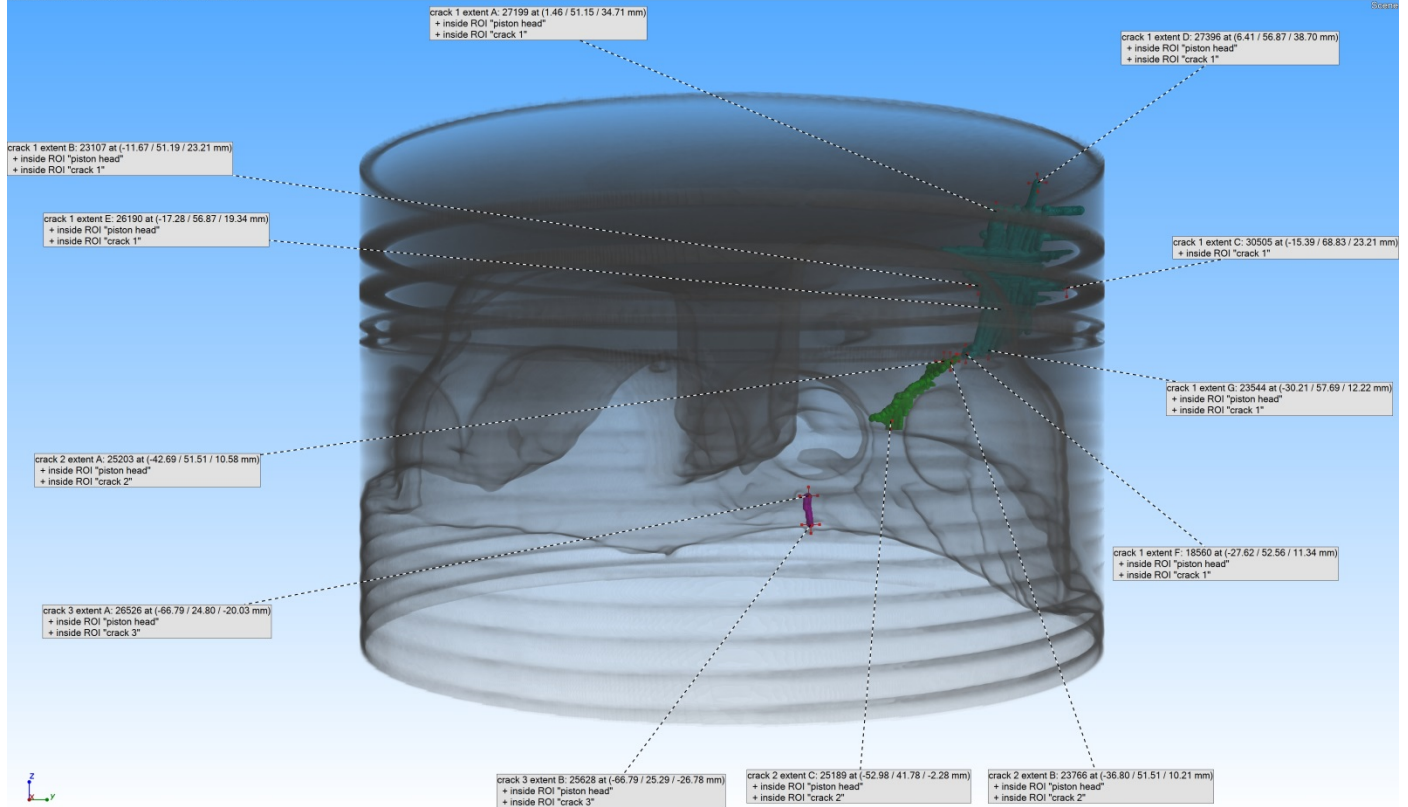


Figure 32  
Cylinder head – All cracks – side 4

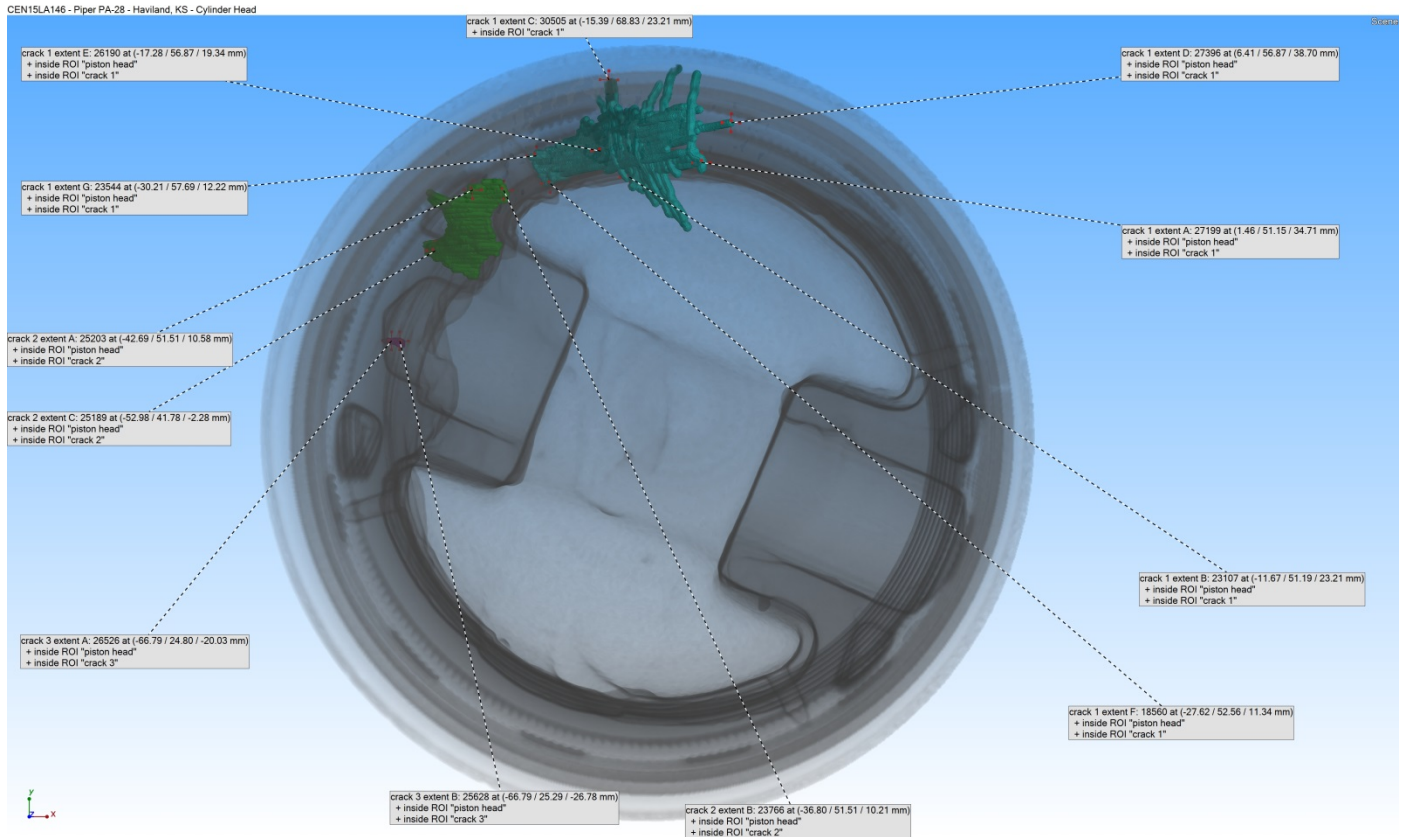


Figure 33  
Cylinder head – All cracks – from top

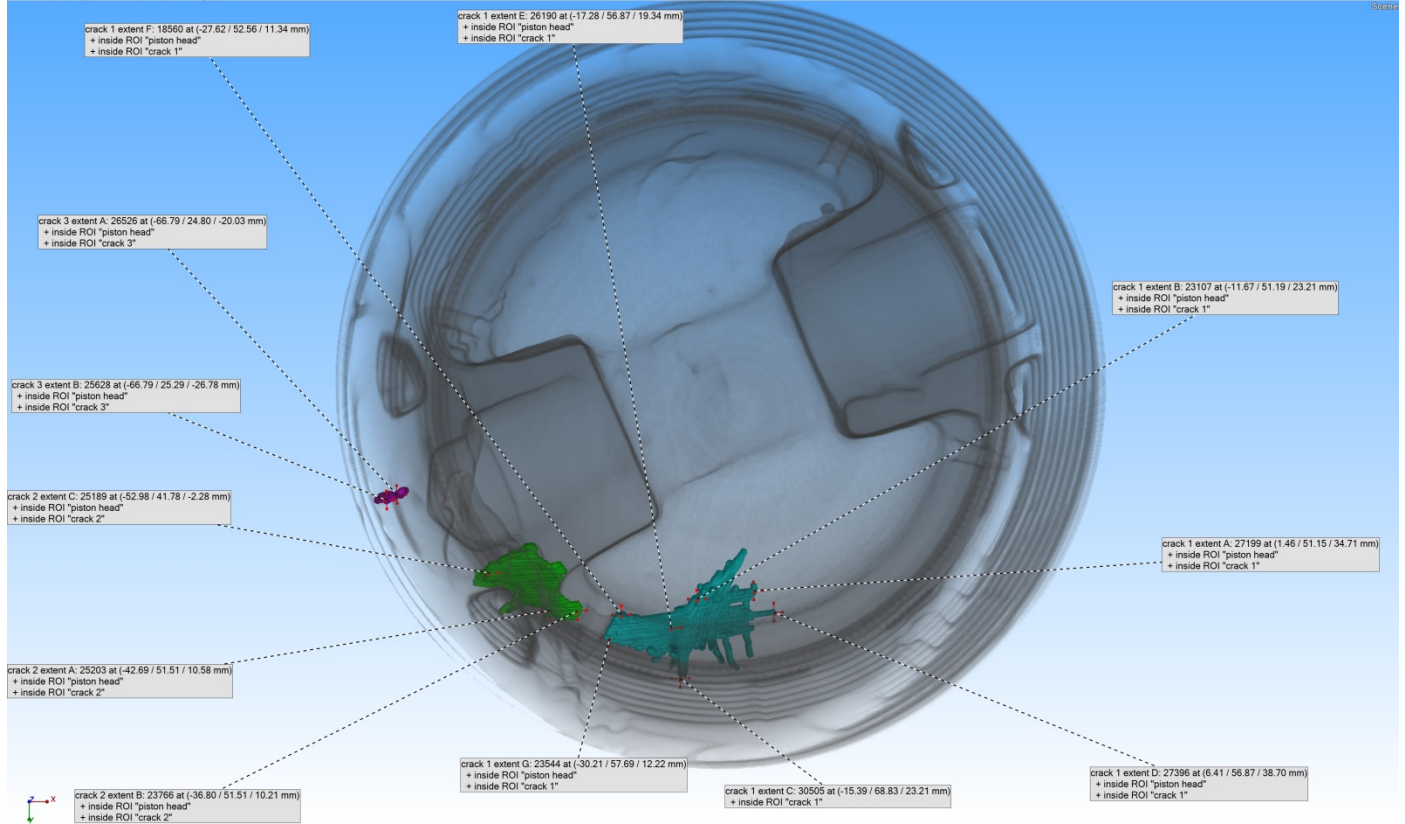


Figure 34  
Cylinder head – All cracks – from bottom

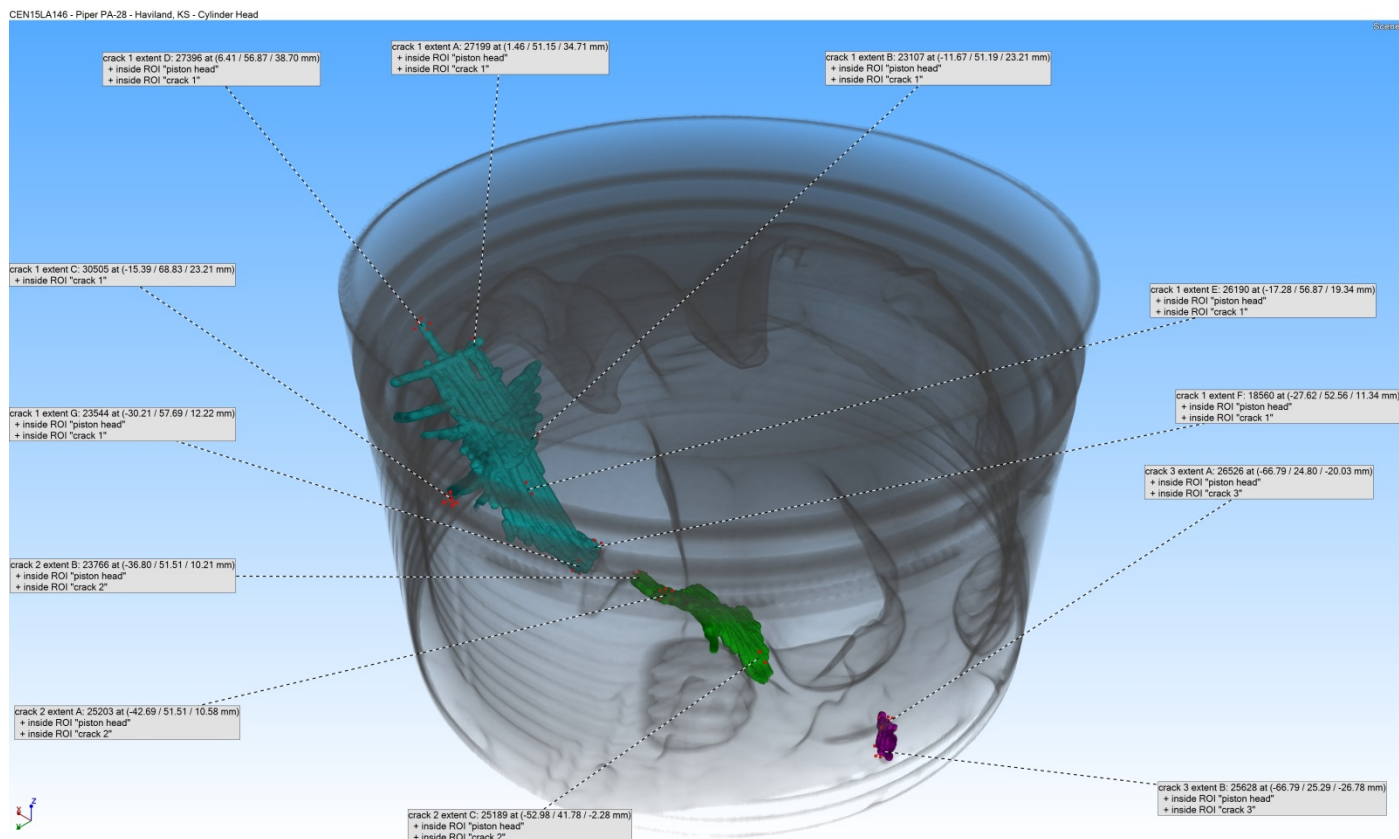


Figure 35  
Cylinder head – All cracks – three quarter view

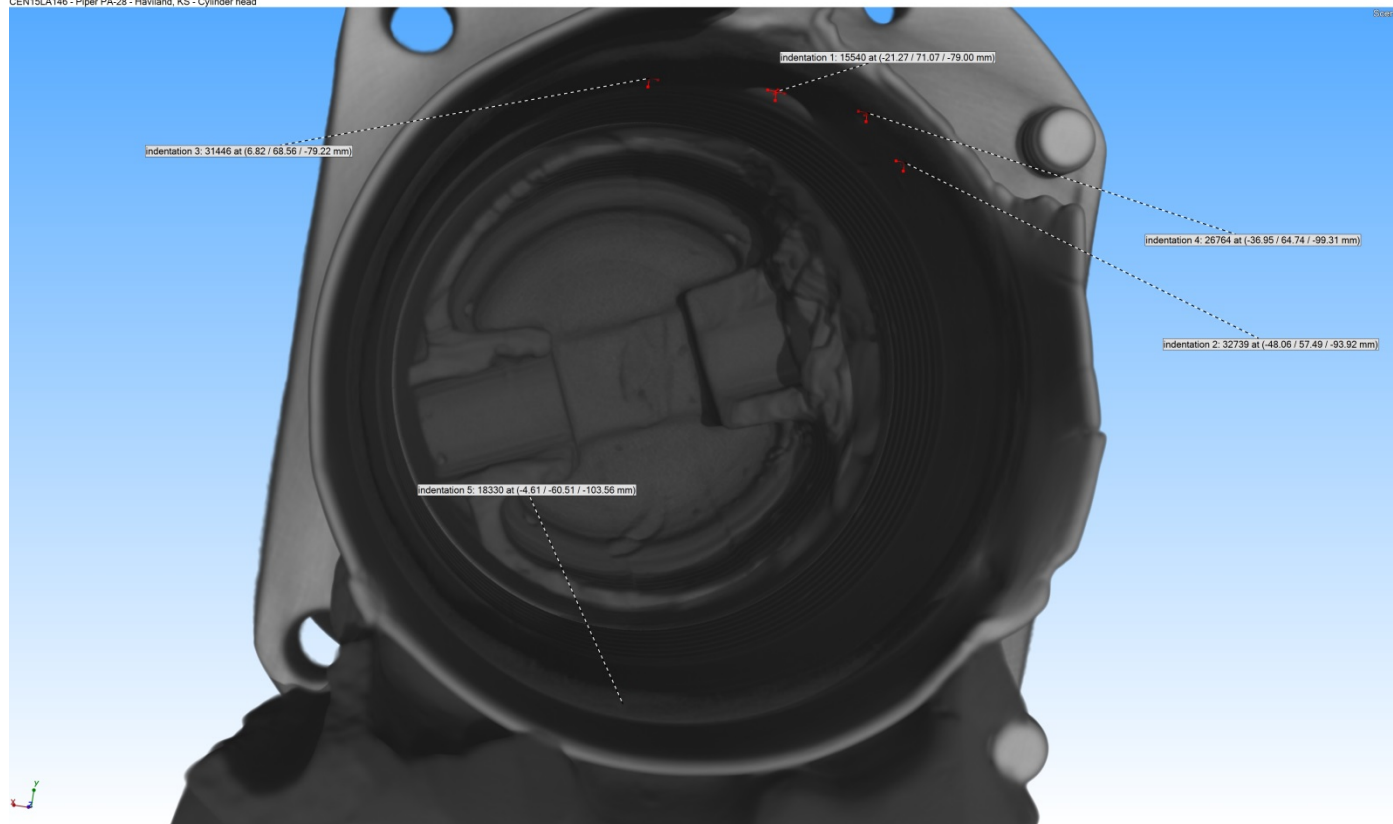


Figure 36  
Cylinder head – Wall indentations - overview

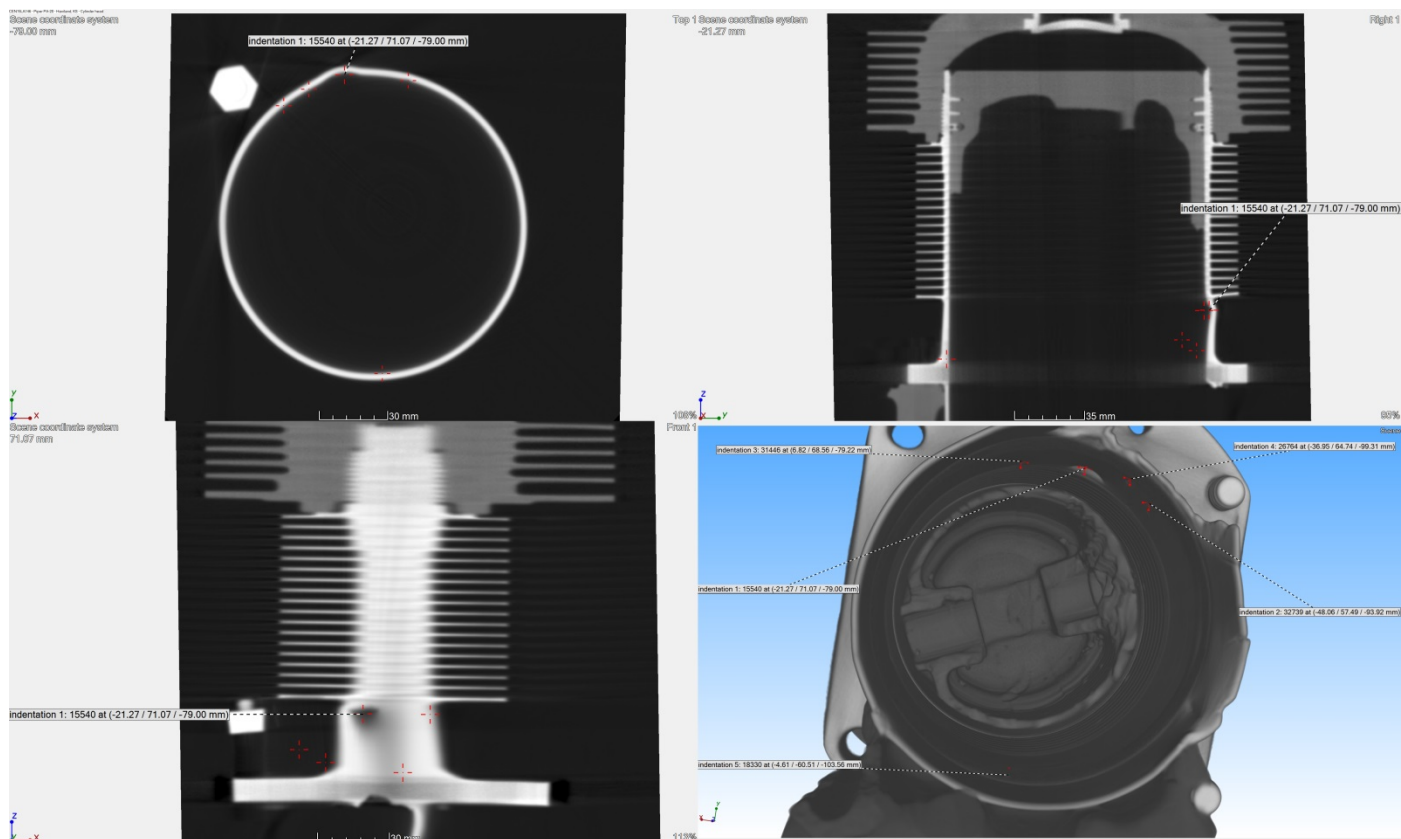


Figure 37  
Cylinder head – Wall indentations – indentation 1 close up view

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