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# Computed Tomographic Imaging of Selected Y-12 Components

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Computed Tomographic Imaging  
of  
Selected Y-12 Components

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by

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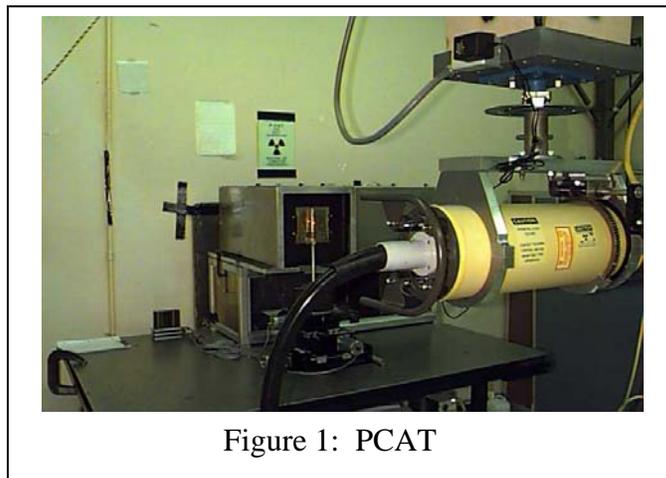
May 13, 2005

1. **Introduction:** Lawrence Livermore National Laboratory (LLNL) was tasked under project number D103401 to acquire computed tomographic (CT) images of selected components supplied by Y-12 National Security Complex personnel. A total of four components were imaged utilizing CT. In addition, LLNL personnel provided a basic review of the CT data acquisition and CT capabilities at LLNL to four Y-12 personnel.
2. **Scope:** This report identifies the equipment used to acquire the CT images on each of the four components. It also provides representative sample CT images from each of the four components. Additional imaging data along with image display software will be forwarded under separate cover.
3. **Computer Tomography Systems:** Two different computer tomography systems were utilized to support this effort. Table 1 provides a description (configuration) of each system. These systems are named PCAT and CCAT.

	Energy	Make	Spot Size	Type	FOV	Array	Pixel Pitch
PCAT	450 kV	Phillips	1.0/4.5 mm	IQI Glass	Variable	1000X 1000	
CCAT	225 kV	Feinfocus FXE	0.003 – 1.0 mm	Amorphous Si flat panel	406.4 x 283.4 mm	3200 x 2232	0.127 x 0.127 mm

Table 1 System Description

PCAT utilizes a Philips 450 kV x-ray machine and a cooled CCD camera which is lens coupled to a scintillating glass plate. A rotational turntable provides for manipulation of the part during CT data acquisition. The glass scintillator, a 45 degree folding mirror, lens, and camera are enclosed in a light tight box. Figure 1 provides a picture of PCAT.



CCAT utilizes a 225 kV micro-focus x-ray machine, an amorphous silicon flat panel detector and a manipulating stage consisting of a rotational table and two linear stages. The flat panel detector is positioned in a holding fixture which has both pitch and yaw adjustments. Figure 2 provides a picture of CCAT

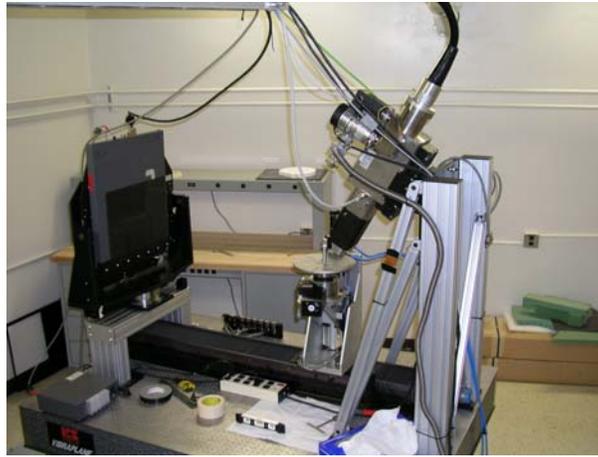


Figure 2: CCAT

- Components Imaged:** CT data was acquired on a total of four components. Three of the components were previously sectioned and encased in plastic for metallurgical evaluation. The samples were not altered and were imaged encased in plastic. The fourth sample was not encased in plastics. For the sake of this evaluation, the components were labeled one through four. Figure 3 provides a photographic image of the parts that were encased in plastic. Figure 4 provides an image of the remaining part.

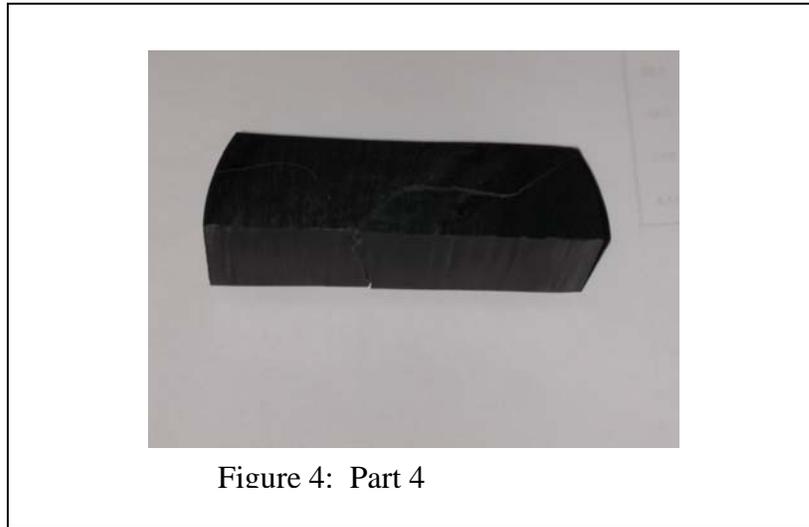


Part 1

Part 2

Part 3

Figure 3: Encased parts



5. **Computer Tomographic Imaging:** All of the CT images were acquired over 360 degrees at one degree increments. Therefore a total of 360 two dimensional projection radiographs were taken on each component and then processed to provide the CT sliced images. The slice plan parallel to the turntable horizontal surface is called a Z-Slice. For some parts we also reconstructed Y-Slice images from the three dimensional CT data. The Y-Slice image is a plane perpendicular to the Z-Slice (see Figure 5).

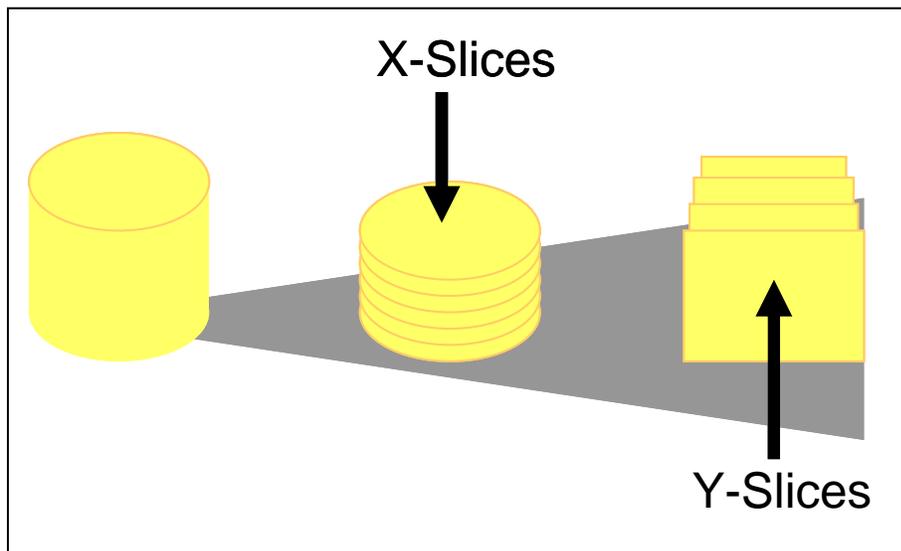


Figure 5: Slice orientation

CT images of part 1 are shown in Figure 6. These images are all Z-Slice images. Images are shown for slices numbered 77, 103 and 111. Also shown in Figure 6 is a visual photograph of part 1.

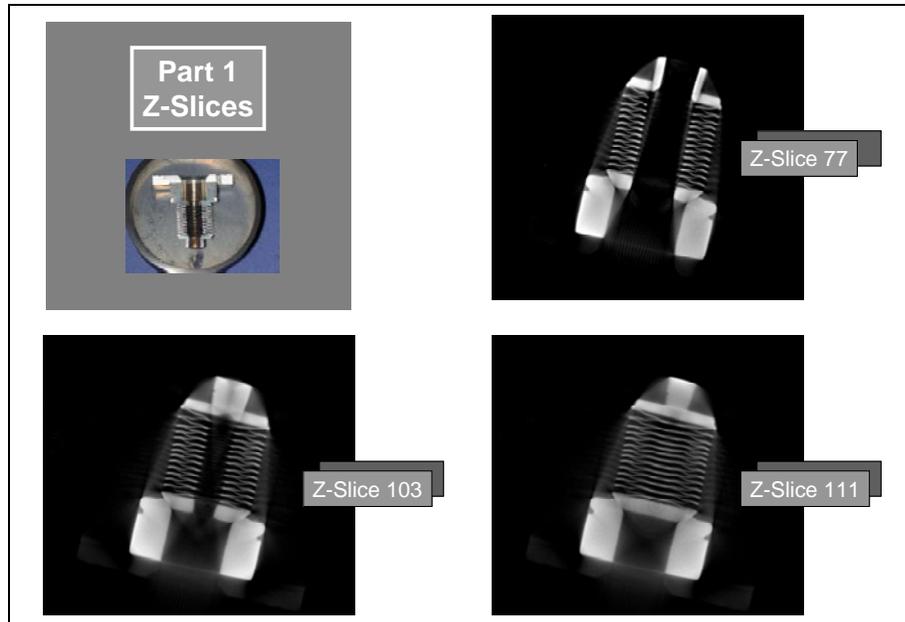


Figure 6: CT Images of Part 1

For reference, Figure 7 provides two orthogonal images that are processed digital radiological two dimensional projection images of part 1.

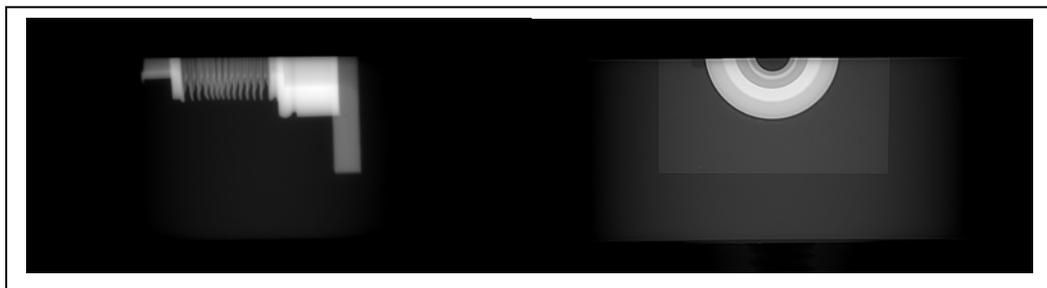


Figure 7: Processed Digital Radiological Projection Images of Part 1

CT images of part 2 are shown in Figure 8. Three images are Z-Slice images and one is a Y-Slice image. The Z-Slice images that are shown are from slices numbered 400, 500 and 600. The Y-Slice image is from slice 693. Also shown in Figure 8 is a visual photograph of part 2.

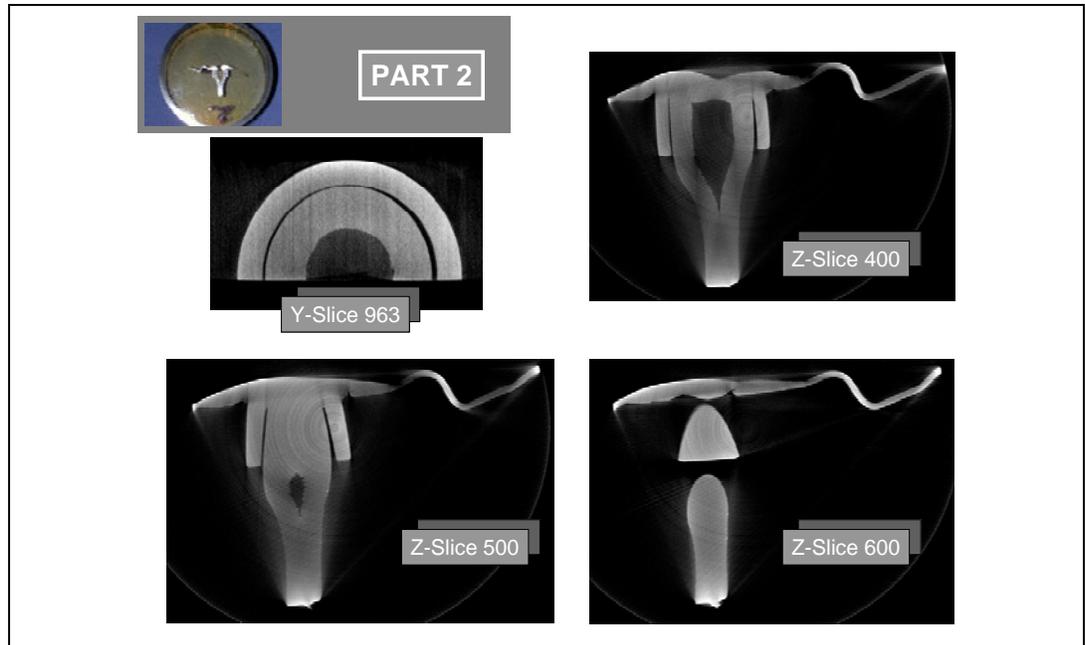


Figure 8: CT images of Part 2

For reference, Figure 9 provides two orthogonal images that are processed digital radiological two dimensional projection images of part 2.

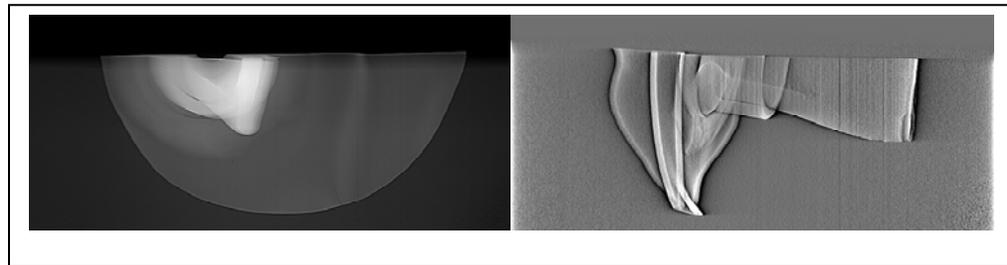


Figure 9: Processed Digital Radiological Projection Images of Part 2

CT images of part 3 are shown in Figure 10. Three images are Y-Slice images. The Y-Slice images that are shown are from slices numbered 100, 360, 430 and 500. Also shown in Figure 10 is a visual photograph of part 3.

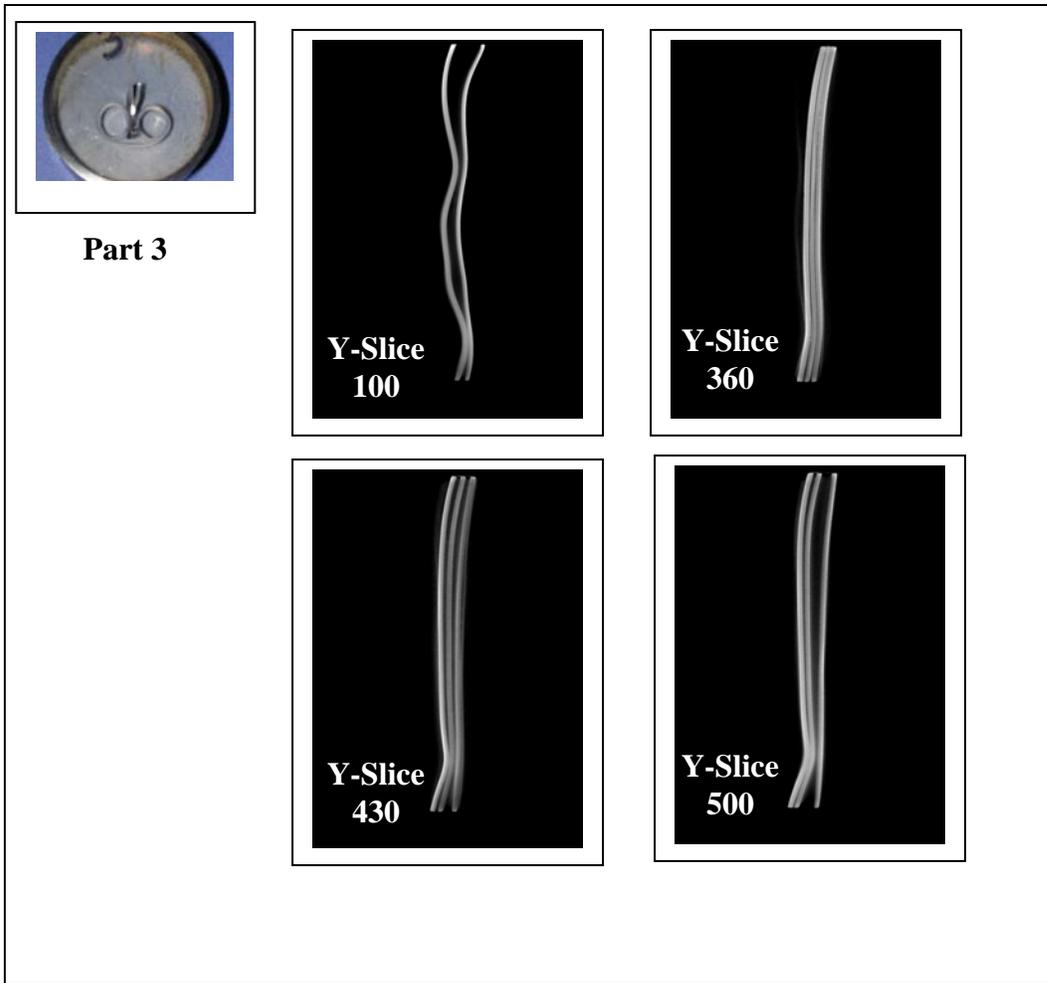


Figure 10: CT images of Part 3

CT images of part 4 are shown in Figure 11. Two Z-Slice images are shown for slices numbered 300 and 390. Also shown in Figure 11 is a visual photograph of part 4.

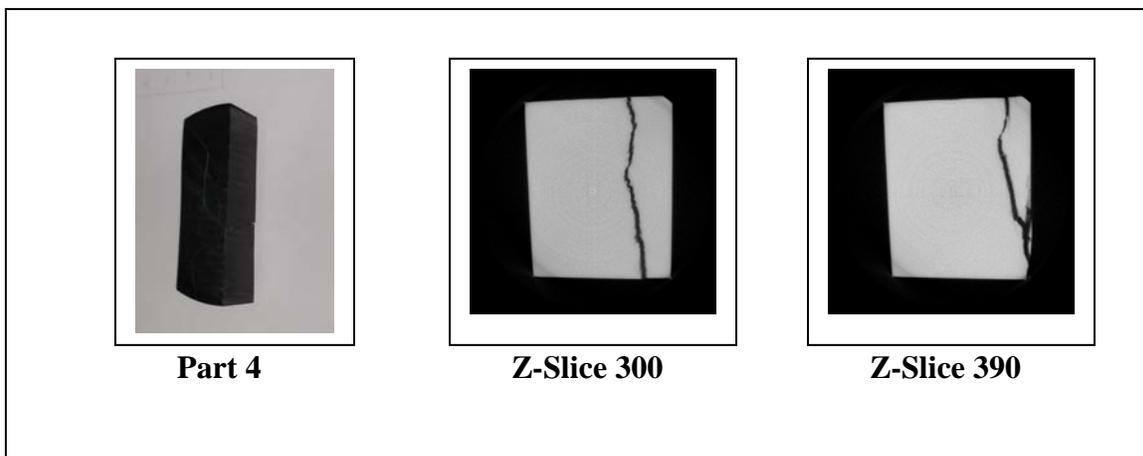


Figure 11: CT images of Part 4

Additional images are forwarded in digital form under separate cover. These digital images provide attenuation radiographs, sinograms and computer tomographic images.