

Nuclear Medicine/PET Phantom Image Atlas

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INTRODUCTION

Images Included are not meant to show pass or fail, they are examples only.

The links below will direct users to requirements for NM & PET Clinical and Phantom submissions. Please review carefully prior to the uploading of images and submission of the testing packets.

<https://accreditationsupport.acr.org/support/solutions/articles/11000062796-accreditation-testing- overview-nuclear-medicine-and-pet>

<https://accreditationsupport.acr.org/support/solutions/articles/11000062797-clinical-image-testing- nuclear-medicine>

<https://accreditationsupport.acr.org/support/solutions/articles/11000062798-phantom-images-nuclear- medicine>

<https://accreditationsupport.acr.org/support/solutions/articles/11000062799-clinical-image-testing-pet>

<https://accreditationsupport.acr.org/support/solutions/articles/11000062800-phantom-testing-pet>

The link below will display phantom criteria:

<https://accreditationsupport.acr.org/support/solutions/articles/ 11000080933-phantom-criteria-revised-1-6-20->

Testing packages are based on the exams selected in the accreditation application. If you need to make correction to the testing packet, i.e., remove module or change exams; please submit a support ticket at the link below BEFORE submitting the testing packet.

<https://accreditationsupport.acr.org>

How can we help you today?

SEARCH

+ New support ticket

Check ticket status

Emergency use:

If you are doing a type of scan less than 5 times a month or 25 times a year, **YOU ARE NOT REQUIRED TO APPLY**. This also applies to Tl201, Ga67, & In111.

Timeframe	Acceptable Number of 'Emergency Use' Examinations Performed Outside a Unit's Accreditation Status	
	MRI	Nuclear Medicine/PET/Ultrasound
30 days	Fewer than 10	Fewer than 5
12 months	Fewer than 50	Fewer than 25

GENERAL TIPS AND REMINDERS

1. Incomplete or incorrect uploads (images and/or documentation) will be removed and sites will need to re-upload. This can slow down the review process.
2. Cell phone images, scanned paper or color photos and non-digital images (i.e., scanned documents saved as jpg) are not acceptable as electronic clinical or phantom uploads. The image below on the left shows a paper print scanned and uploaded as jpg. The image on the right is the same image submitted as a “true” digital image.



3. Look for red-lettering instructions when uploading images in the ACRedit database.



4. The following images are examples only. They are not meant to show required formatting.
5. If your scanner is not capable of planar imaging, the application should reflect that by selecting “This unit is unable to acquire planar images.”

If you are submitting for Cardiac only and the scanner is capable of planar imaging, do not select this option. You are required to submit planar uniformity for scanners capable of acquiring planar images.

Please select isotopes for Planar Phantom

Please tell us which of the following isotopes are used on this unit.
From the list provided below, you **MUST** select all isotopes that apply

You must acquire your planar spatial resolution images with an ACR-approved phantom for Tc-99m if SPECT or nuclear cardiology was selected. The 4-quadrant bar phantom should be used for isotopes that are selected as planar only.

- ☒ Tc-99m
- ☐ Tl-201
- ☐ Ga-67 and/or In-111
- ☐ This unit is unable to acquire planar images

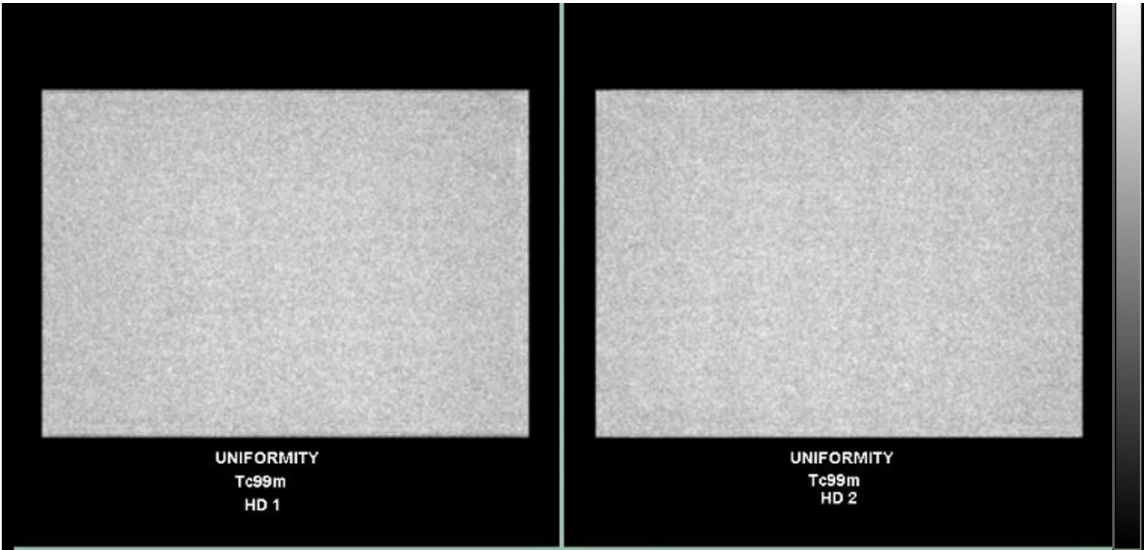


If you filled out the application incorrectly for your type of scanner, please submit a support ticket to request correction BEFORE submitting the testing packet.

PLANAR IMAGES

Uniformity

Phantom images **MUST** be submitted in gray scale. Color images will be returned as not reviewable. Please ensure isotope and detector head is identified (if submitting more than a single head). Images should include a gray scale (see image on right below). Images **MUST** be acquired according to the phantom testing instructions.

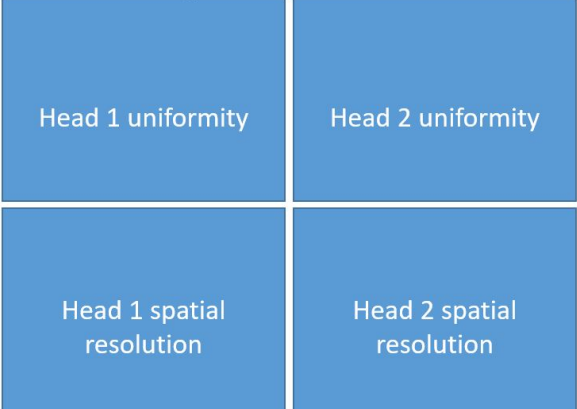


Planar images may be formatted using 1 on 1, 2 on 1, or 4 on 1 formats. If using a 2 on 1 or 4 on 1 format, you would upload the same image for planar uniformity and planar spatial resolution.

Single head using a 2 on 1 format



Dual head using a 4 on 1 format

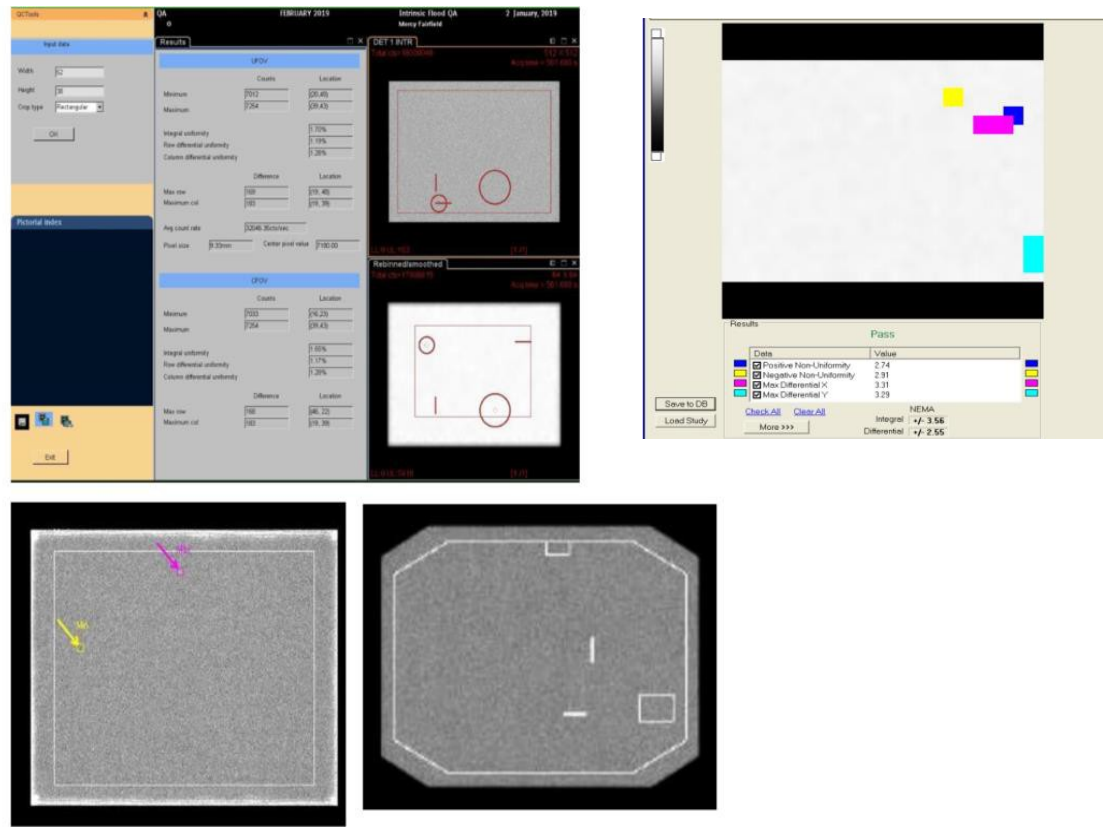


DO NOT send images with part of the image obscured.

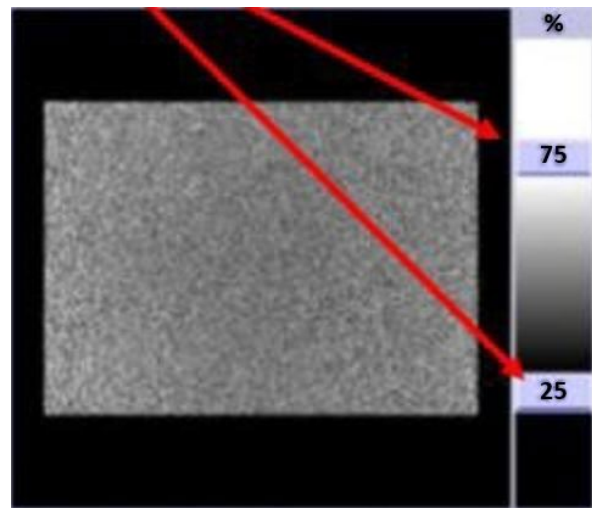


[Return to Top](#)

DO NOT send images with overlays.



The image gray scale should use linear mapping of the display with the lower threshold set at 0 (or \leq 5% of the maximum upper level) and the upper threshold set to the maximum count.



It is NOT recommended to submit Intrinsic/Extrinsic Verification images.



If submitting for Siemen's scanners:

1. If using a Co57 sheet source for extrinsic acquisition:
 - a. Do not use a Siemens QC program. The ACR does not require or request QC numbers.
 - b. Set up a static acquisition using a Co57 window, 256x256 and 10 million counts.
2. If using Tc99m for intrinsic acquisition:
 - a. Do not use the Siemens point source holder. Images acquired using the source holder will be returned as not reviewable.
 - b. Place the source 3-5 FOV away and acquire each head separately. See the phantom Acquisition Instructions for more specific instructions.
3. DO NOT send high count calibration images. Images must be acquired as outlined in the phantom testing instructions. Uniformity images must be acquired with a 256x256 matrix and with 5 or 10 million counts, depending on the scanner dimensions. Some cardiac scanners are only able to acquire 64x64 matrix, and this is acceptable ONLY for those scanners. LUMAGEM scanners are only able to acquire 128 this is acceptable ONLY for those scanners.



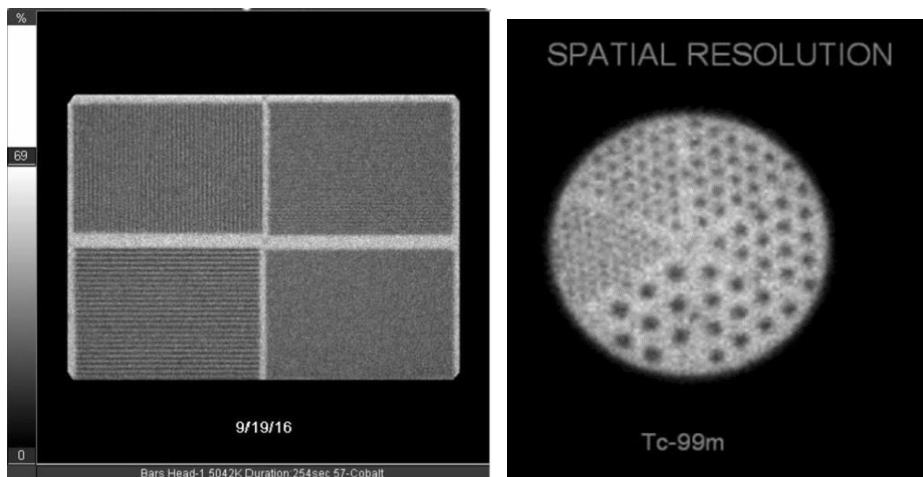
DO NOT send non-curvature corrected images



Spatial Resolution

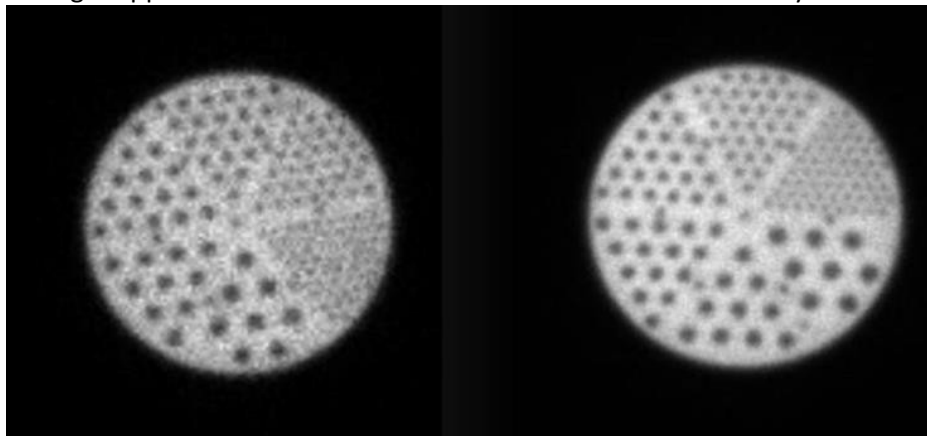
Planar spatial resolution – you may use 4 quadrant bar images OR the ACR phantom. If submitting bars, the smallest bars MUST be small enough to meet the phantom criteria for isotope and collimator used.

Ensure the data form matches the images submitted. Do not fill out the data form for ACR phantom and then upload 4 quadrant bars or fill out bar sizes in the data form and then submit ACR phantom planar spatial resolution images.

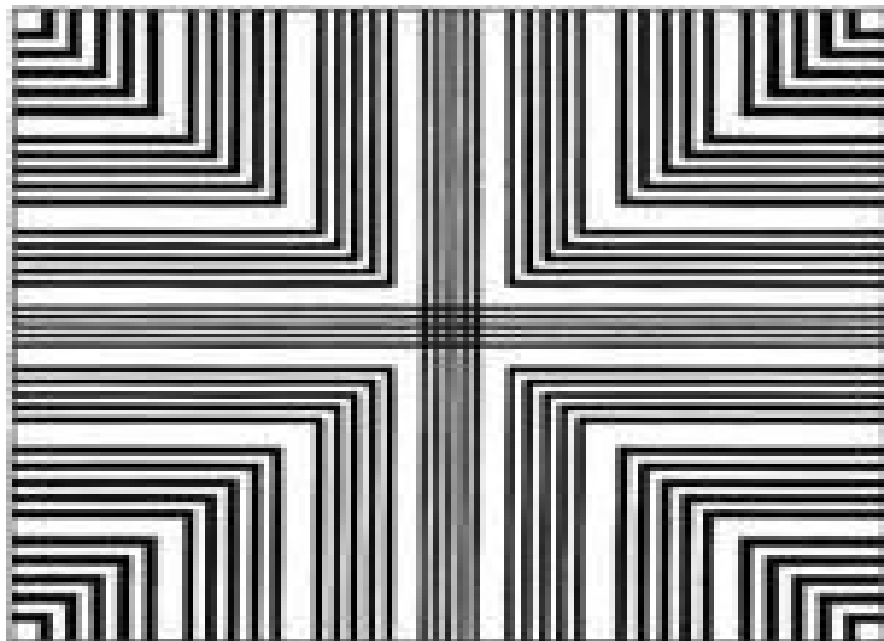


Ensure the images are labeled for detector # and isotope if submitting more than 1 head or isotope.

Ensure settings are correct. The image on the left is the correct 600k image. The image on the right appears to be 6 million counts based on the count density in the image.

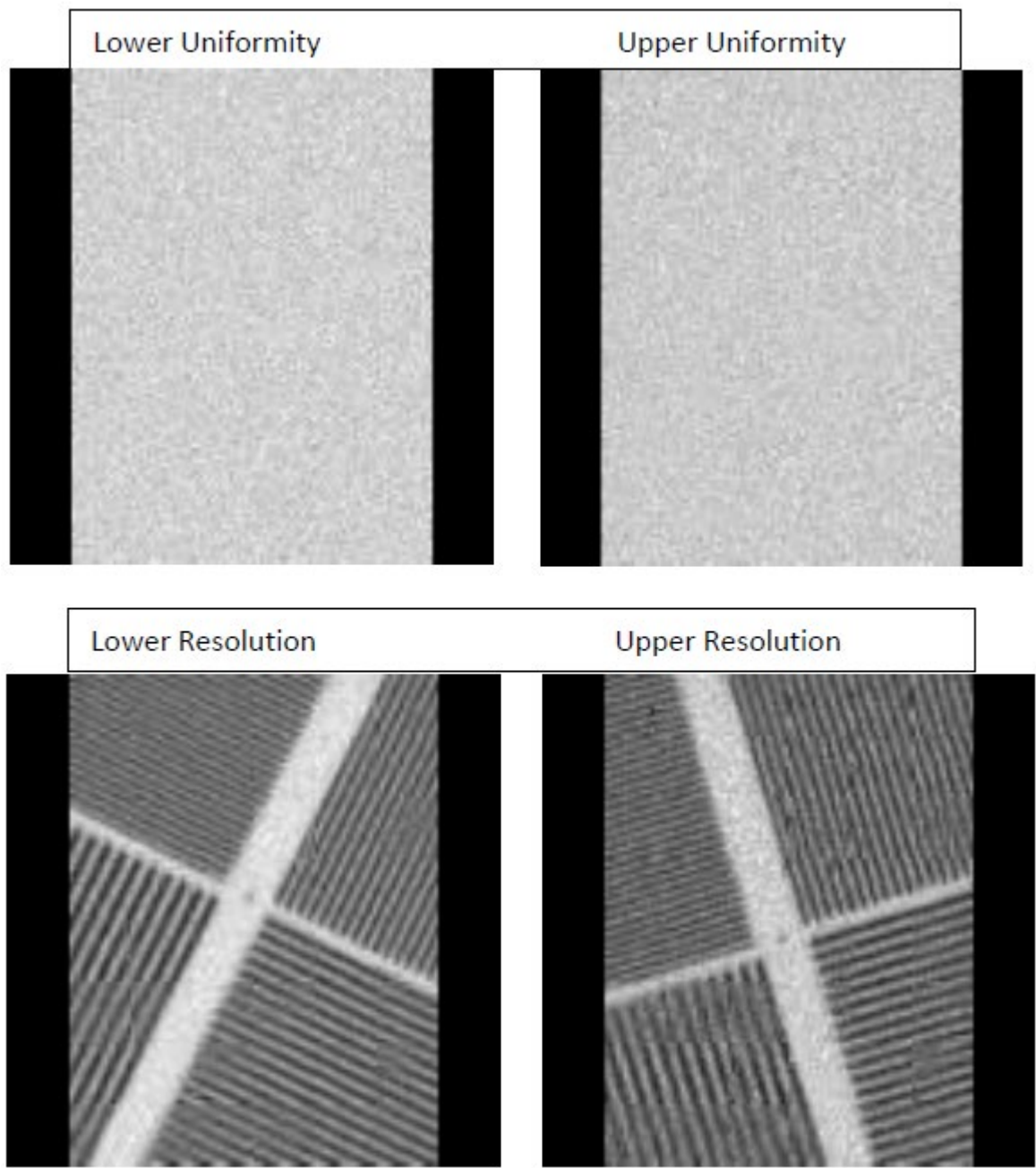


UB bars ARE NOT approved for ACR accreditation.



Non-traditional scanners

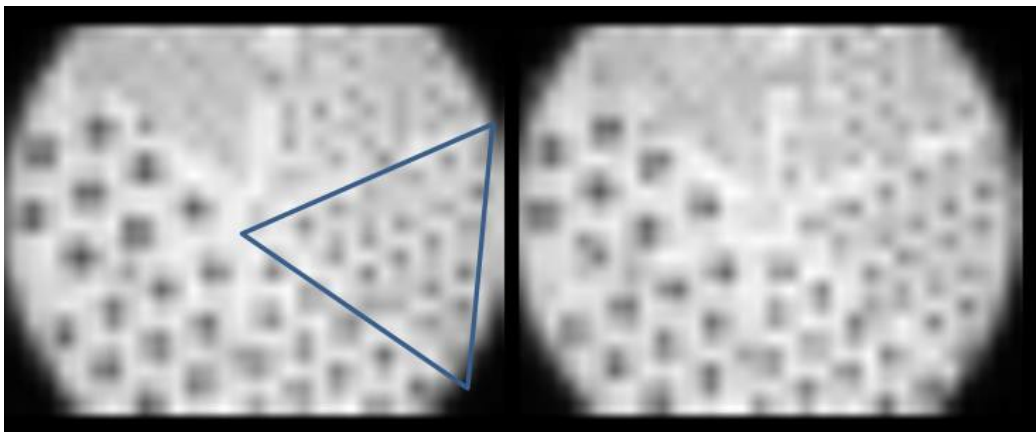
Breast imaging scanners are similar to mammography scanners. The submissions are examples from a LUMAGem scanner. These scanners may not be capable of 256x256 matrix. Use the largest matrix available. Counts should be 5 million for uniformity and 3 million for bars. The FOV is small, but the planar spatial resolution is best imaged using the quadrant bar phantom at a 30-45 degree angle as shown below. The bar sizes in this image are 2.0, 2.5, 3.0, and 3.5 mm. The phantom is the same one used for the large field-of-view gamma cameras.



Some Digirad scanners will automatically show overexposed uniformity images on the user's screen as seen on the left image below. Please check with the vendor to adjust more appropriately as seen on the right.



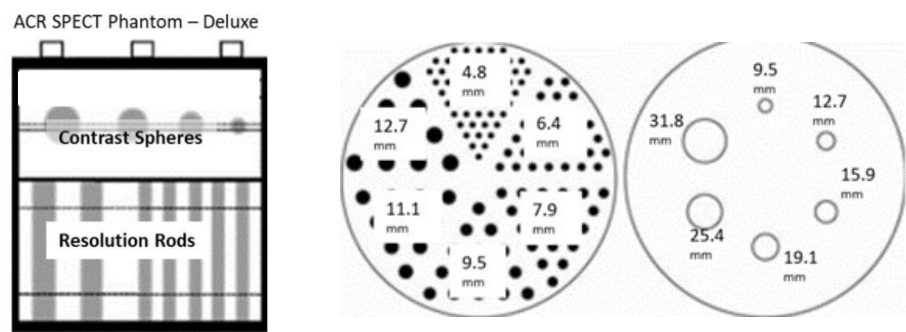
Digirad planar spatial resolution images will show as seen below. Please ensure the 7.9 mm rods are fully in the FOV. (Must resolve 7.9 mm rods with high contrast and greater).



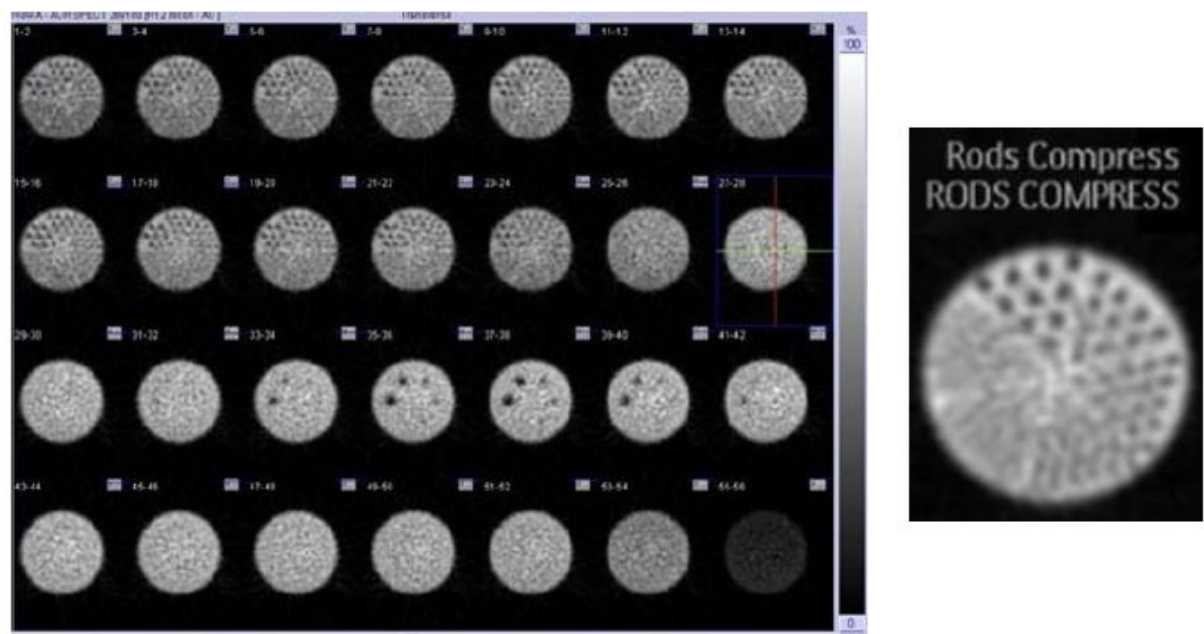
SPECT

Traditional scanners

Screen captures, jpgs, tif, etc., are required for the summed resolution image and may also be used to submit a complete set of the transaxial slices. It is recommended you also upload the slices as DICOM axial images. DICOM images allow reviewers to window, zoom, and scroll through.
Include the ENTIRE SPECT volume! Uniformity is evaluated throughout the entire phantom.



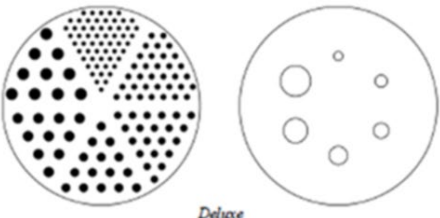
Example of phantom images top to bottom. Make sure to include the summed rods with the axial SPECT slices.



The standard phantom is no longer approved for use. The smallest rods in the standard phantom are 6.4 mm while the deluxe phantom is 4.8 mm. Please ensure you are using the correct phantom.

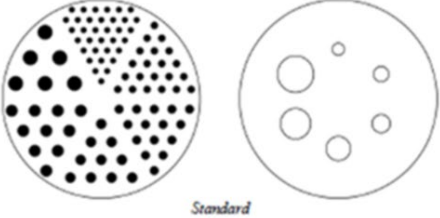
Deluxe Jaszczak Phantom™
Model ECT/DLX/P
■ For use with high to very high spatial resolution SPECT and PET systems.

Specifications:
Rod diameters: 4.8, 6.4, 7.9, 9.5, 11.1 and 12.7 mm
Solid sphere diameters: 9.5, 12.7, 15.9, 19.1, 25.4, and 31.8 mm

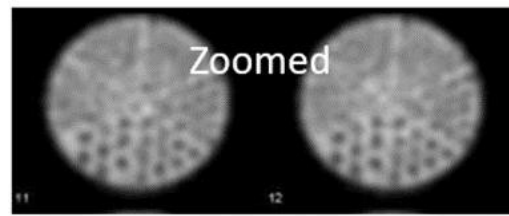
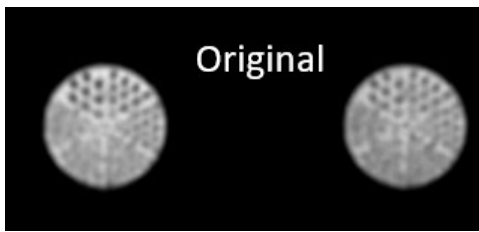


Standard Jaszczak Phantom™
Model ECT/STD/P
■ For use with medium to high spatial resolution SPECT and PET systems.

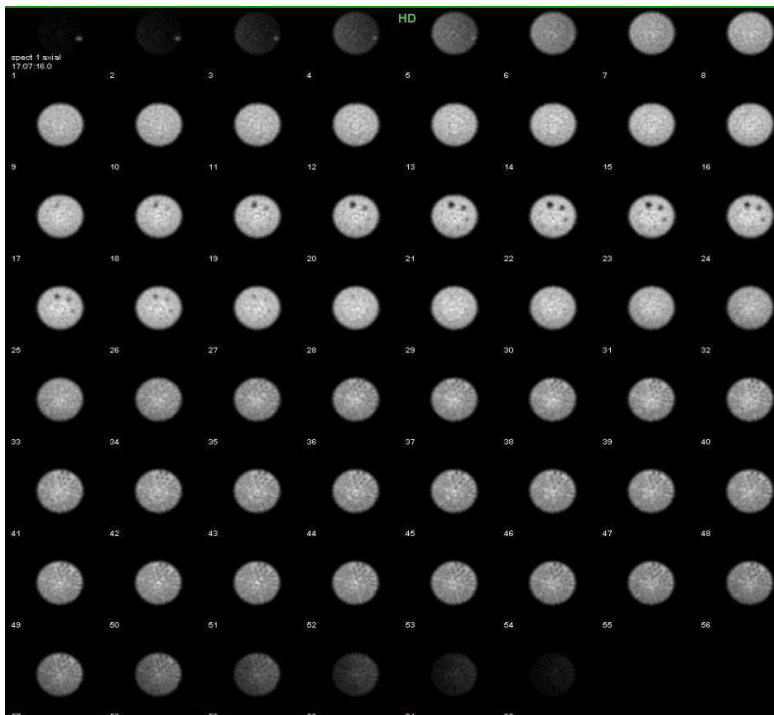
Specifications:
Rod diameters: 6.4, 7.9, 9.5, 11.1, 12.7 and 19.1 mm
Solid sphere diameters: 12.7, 15.9, 19.1, 25.4, 31.8, and 38 mm



Screen captures of the phantom should have display zoom to the series, so the images fill 80% of each frame.

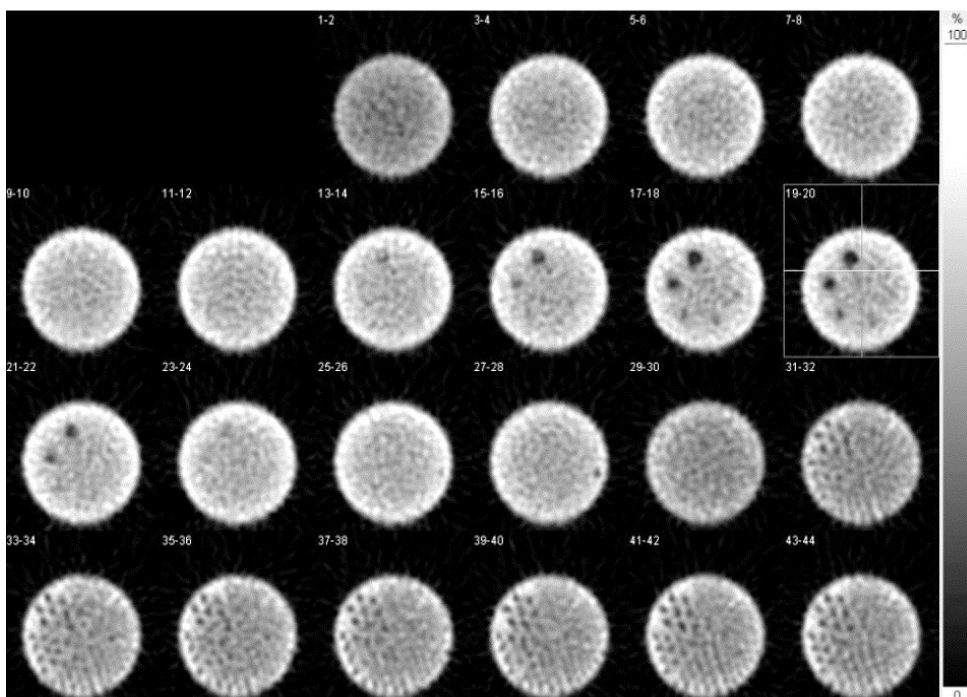


The submission in the image below should have been broken up into 2-3 pages of 9-28 on 1 formats. These images are too small to properly evaluate. Additionally, the slice thickness in the image below does not appear to be 6-9 mm thick as required in the phantom instructions. If images are correctly summed to a 6-9 mm thickness, the total number of images is usually 22-33. This would be returned as not reviewable.



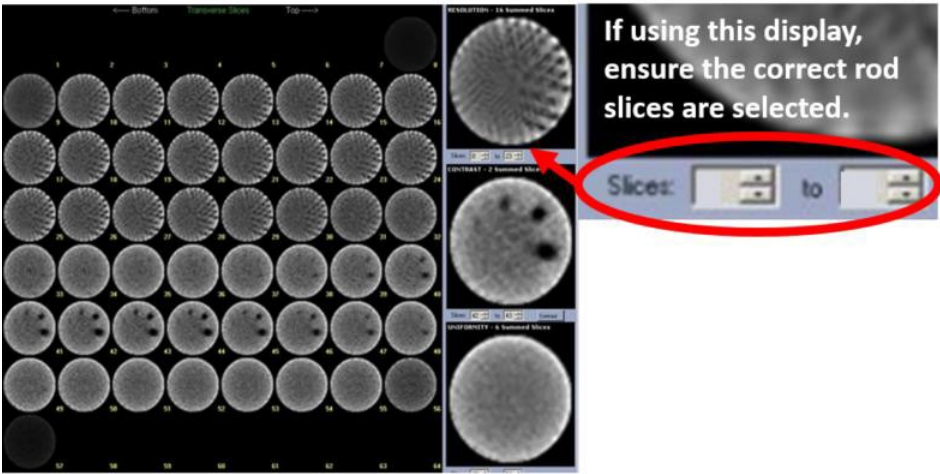
Attenuation correction is required if available on the scanner. A decrease in intensity from the edge to the center of the axial images shown below suggests the attenuation correction was not applied or applied incorrectly.

Additionally, it's recommended to check the position of the attenuation correction region (circle) around phantom. If you are unsure of the attenuation correction factor, contact your physicist or vendor applications. Some systems do not have attenuation correction, or the saved system default attenuation correction may not be correct.

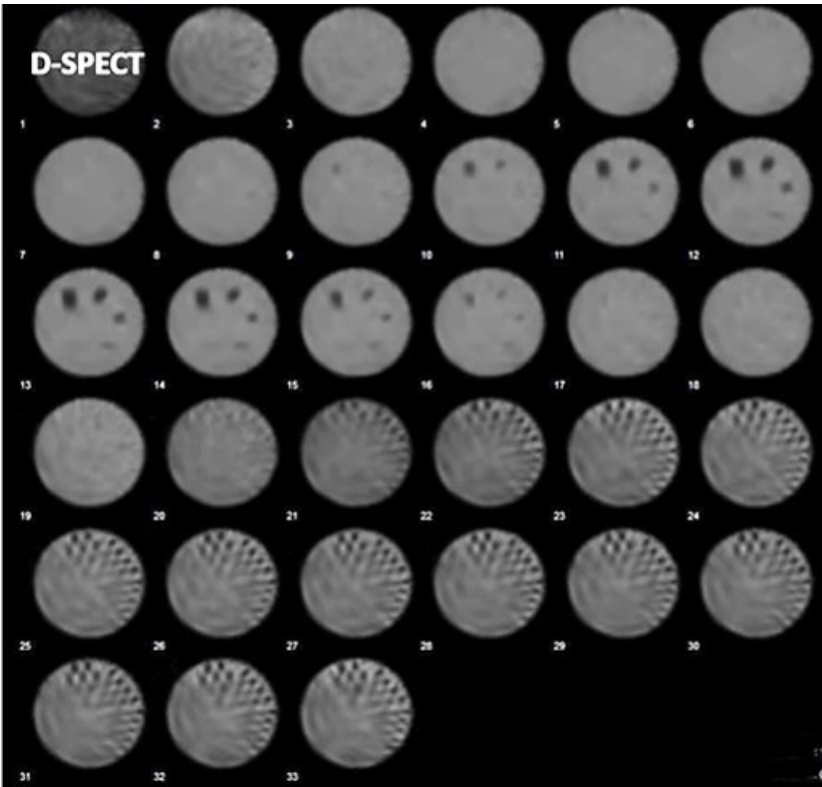


Non-traditional scanners

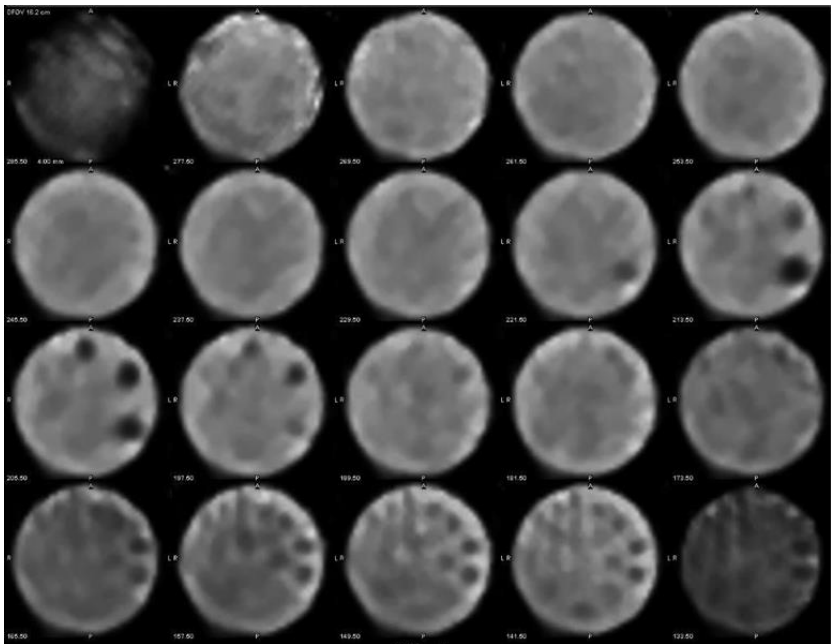
Digirad: The slices displayed below are too thin, but the image shows a general SPECT display that includes the summed rods image.



D-SPECT: Normal appearance of D-SPECT screen capture.

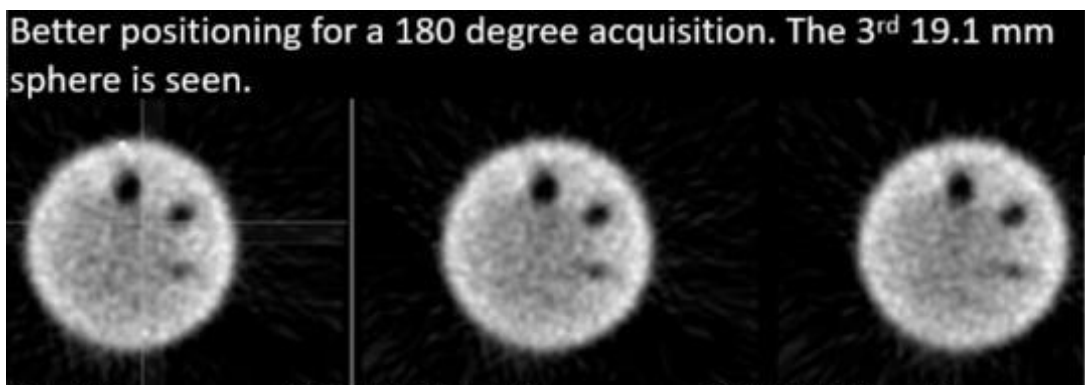
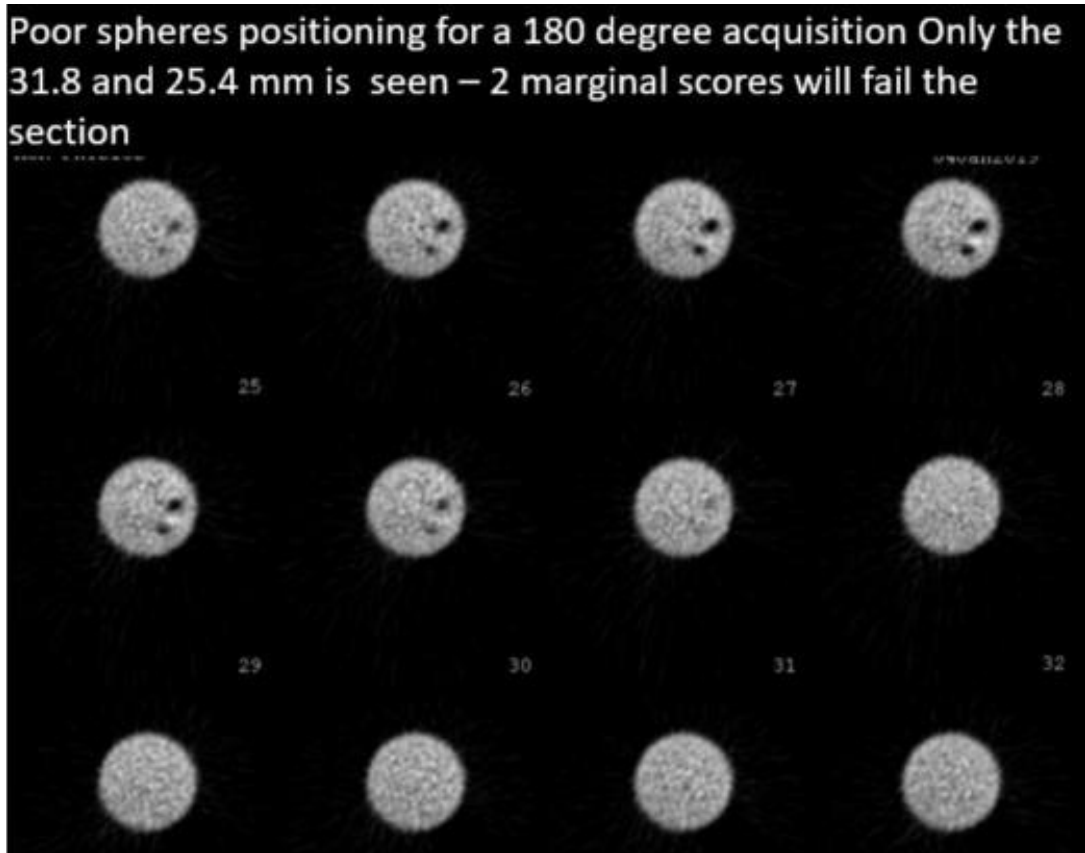


GE 530C: This a normal appearance for this type of scanner using a small phantom. A summed image is still required.



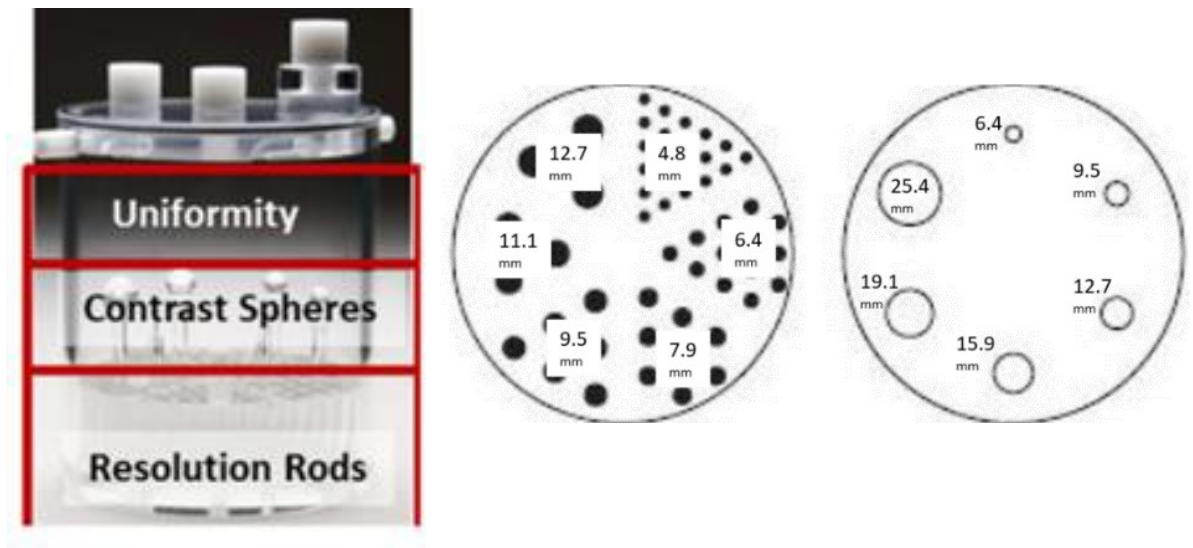
Cardiac Scanner with 180° acquisition

For a camera, which is only capable of rotating 180 degrees, rather than a complete 360 degrees, special caution must be exercised in the orientation of the spheres. Position the phantom so the 3 largest spheres are visible in the image between the 11 and 3 o'clock position.

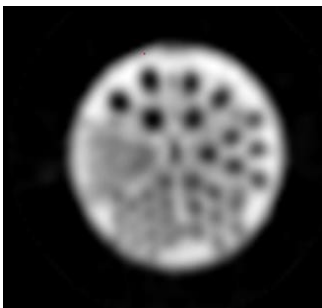


Small SPECT Phantom

Example of a small phantom (see instructions for units approved to use the small phantom). **Ensure the data form matches the images submitted.**

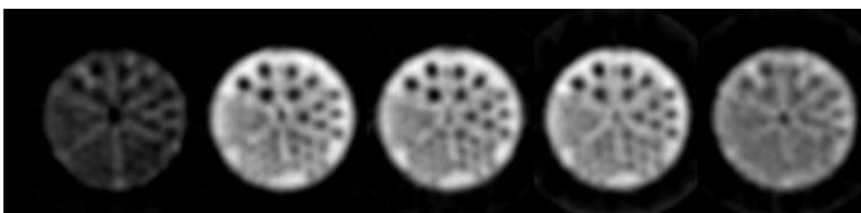


Summed Image

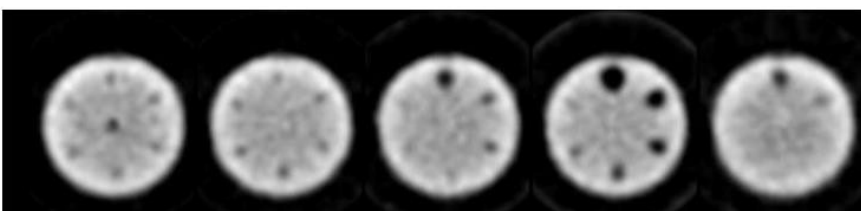


Although the images below show the individual sections of the phantom, remember that all reconstructed images must be submitted and not a representative group as shown here.

Spatial Resolution section (Rods)



Contrast section (Spheres)



Uniformity section

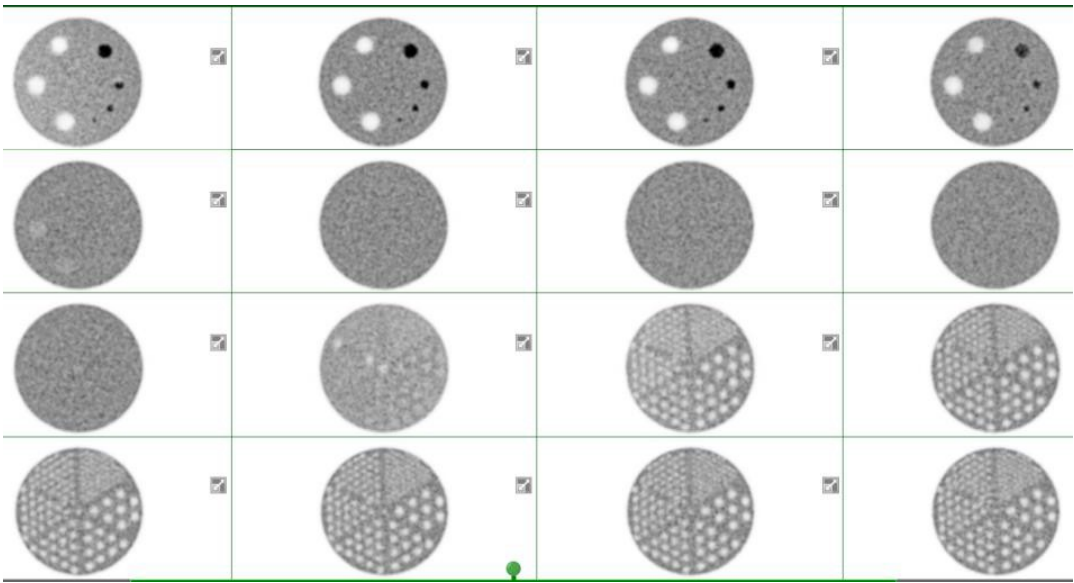


PET

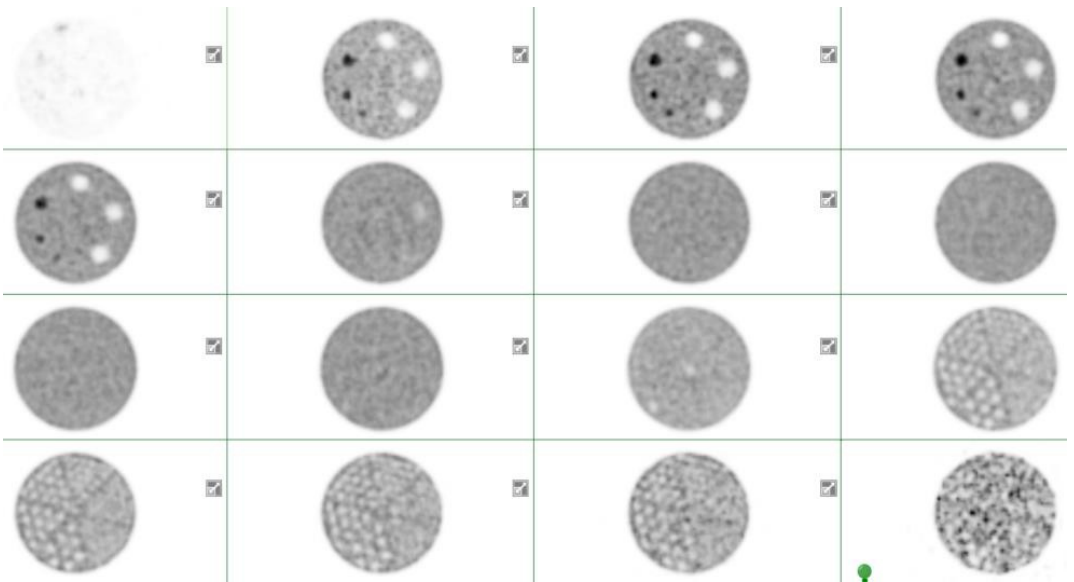
Sites may still upload screen captures, jpg, png, etc., images. However, the complete set of DICOM format transaxial slices must also be submitted. Submission of the DICOM PET transaxial images allow the reviewers to adjust the windowing, zoom, and scroll through the slices. This eliminates errors of incomplete data submission, the images are too small, or are inappropriately windowed. DICOM uploads will also allow the reviewers to draw ROIs to check for errors that may occur when filling out the data form.

The ROI image with statistics must be submitted as a screen capture image. This may take more than one screen capture. It is recommended that the axial phantom slices be uploaded as a DICOM file with 1 cm thick slices (per the testing instructions). When images are screen captured or saved as jpgs, the windowing, zoom, etc., is fixed and reviewers cannot adjust for optimal review.

Example of an excellent phantom submission for PET – 2020 scanner:

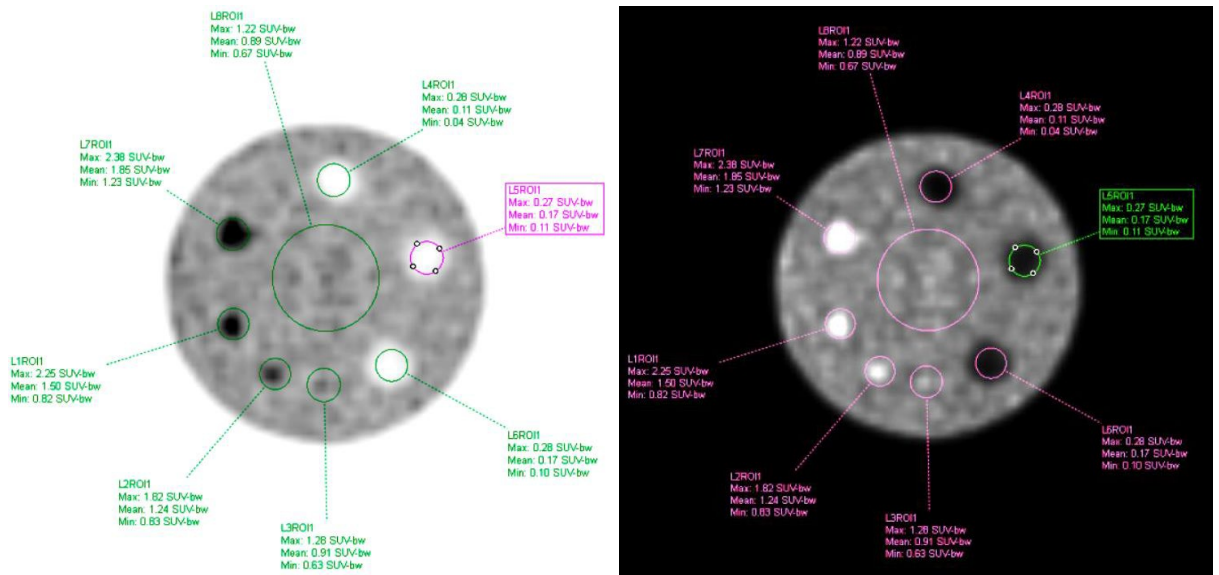


Images from 2011 scanner:

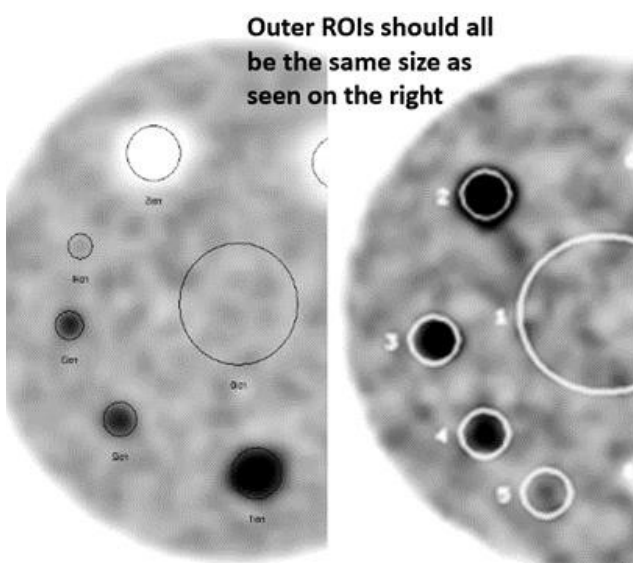
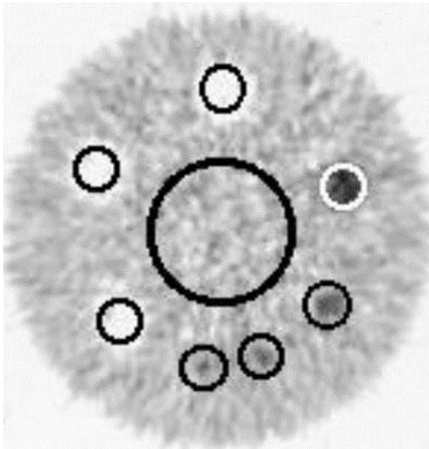


Example of the phantom ROI image with statistics.

Images may be submitted using a black or white background. If images uploaded are DICOM, reviewers can invert as necessary.

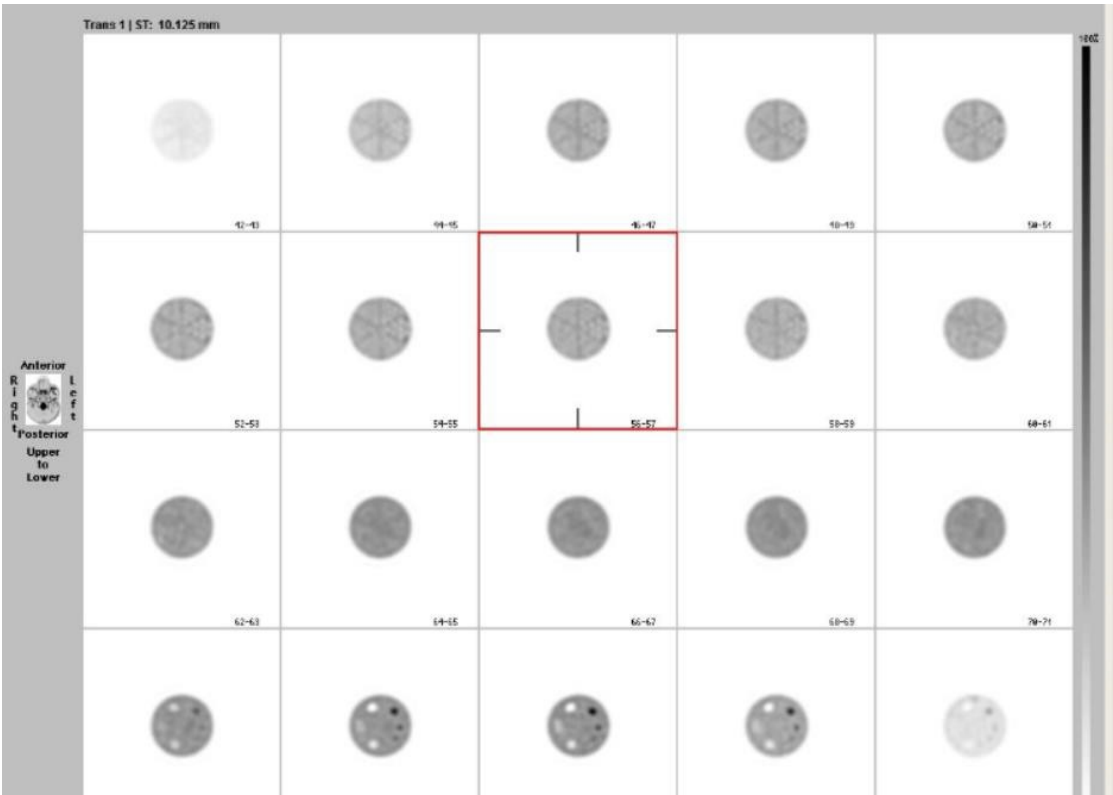


All ROIs drawn on the contrast cylinders should be the same size as shown below.

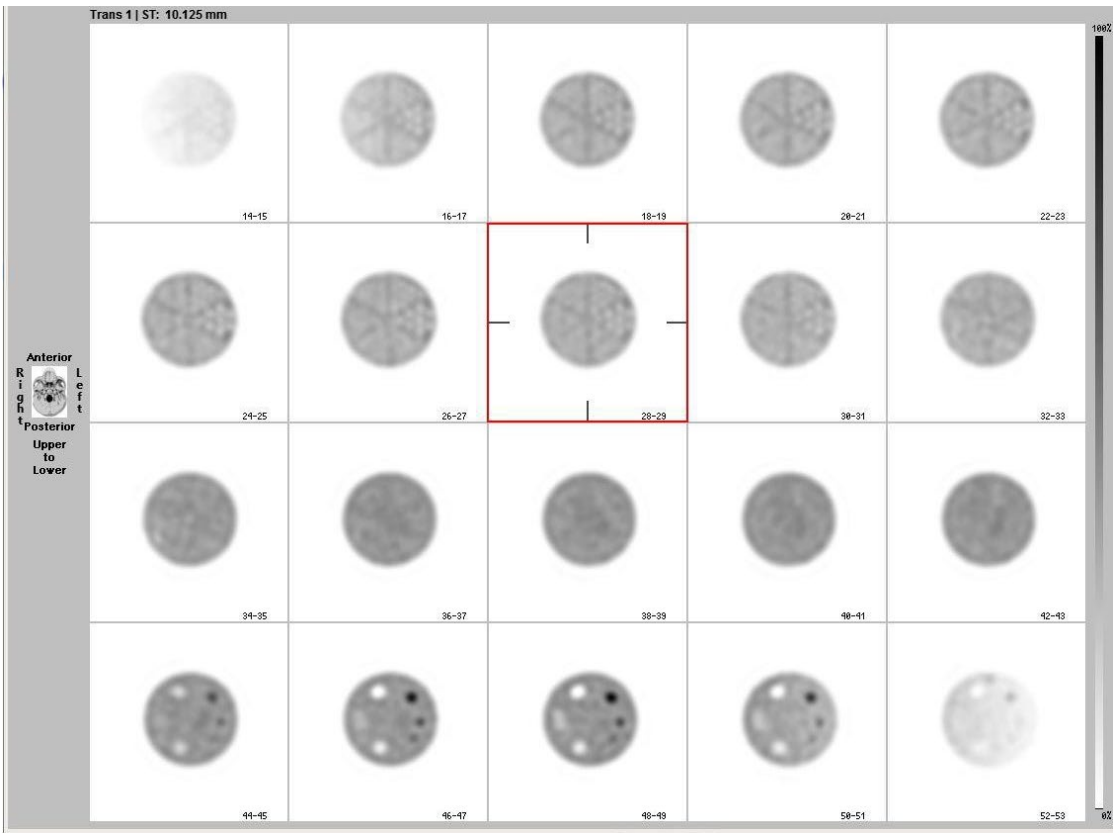


Submit the secondary capture images using a display zoom factor so the image fills about 80% each frame. When reviewers try to zoom the screen capture, the images may become “pixely” and will be returned as not reviewed. The images will be cleared, the testing packet re-opened, and sites will need to re-upload the same images reformatted.

The images below are too small.



Images correctly zoomed to fill each frame.



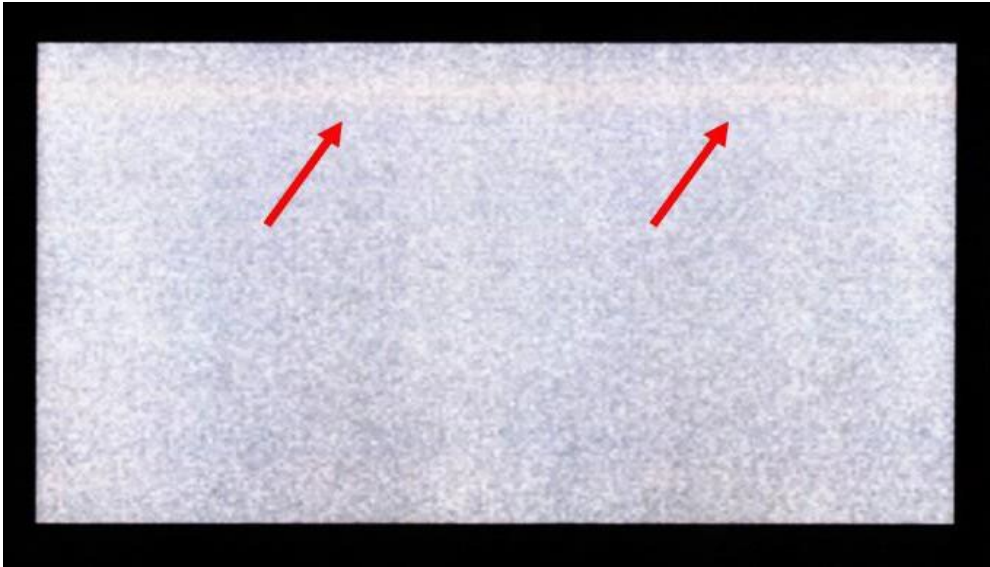
Artifacts

Planar

It is highly recommended to review the images with your physicist prior to submission.

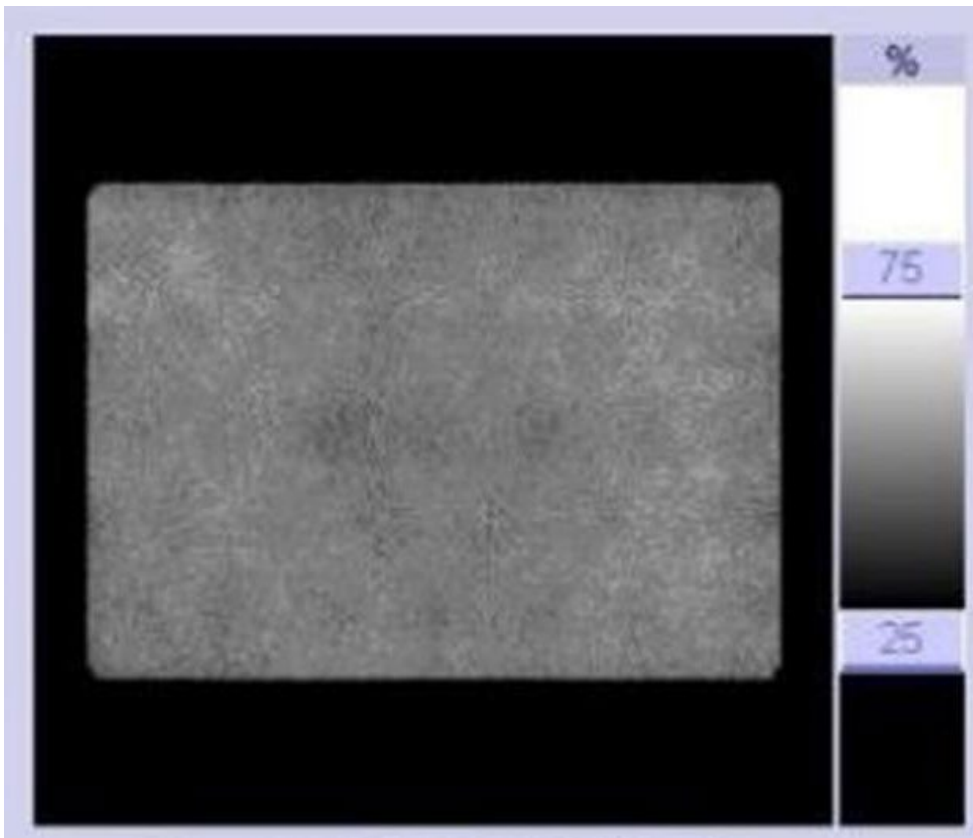
Paper Print (not allowed for submission)

Poor paper print that was scanned and submitted as a jpg. The red arrows show an artifact on the paper printout that is accentuated when scanned as jpg.



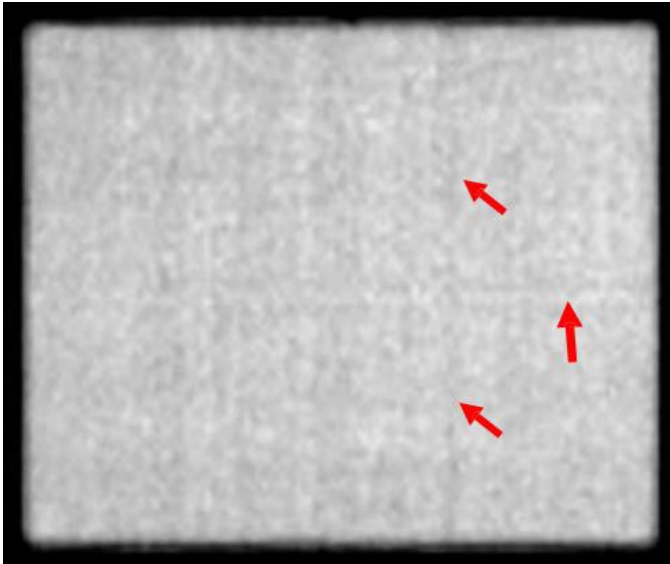
Wrong Window

Gray scale set at 25% and 75% can adversely affect images. The image gray scale should use linear mapping of the display with the lower threshold set at 0 (or $\leq 5\%$ of the maximum upper level) and the upper threshold set to 100% or the maximum count.

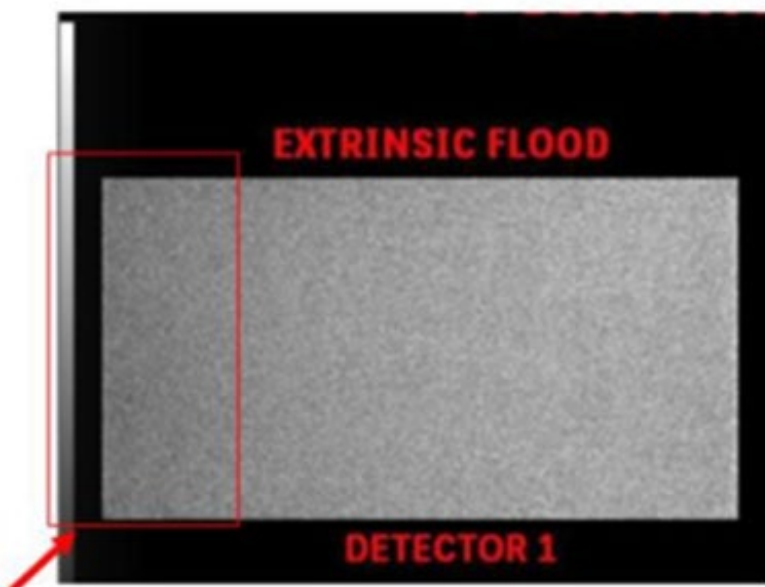


Digitization Error

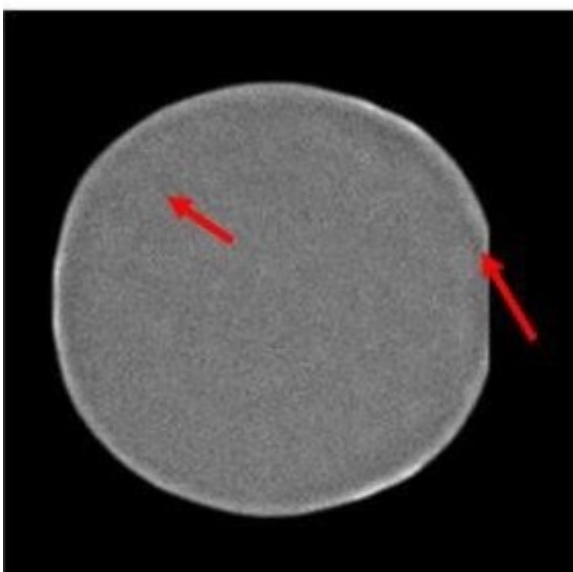
Siemen's camera where changing the display zoom results in a digitization error. This can be corrected by adjusting the zoom to a different size.



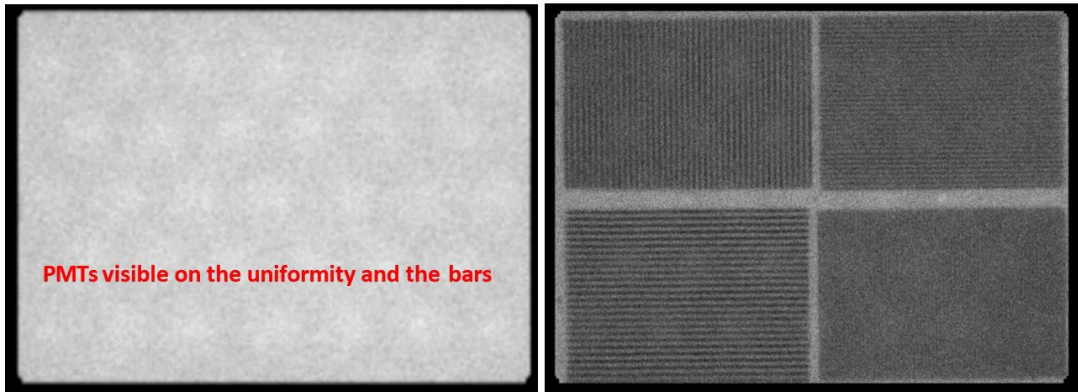
There is count drop off on the left side of the image. This image may not be appropriate for submission.



Edge of Field-of-View Cut

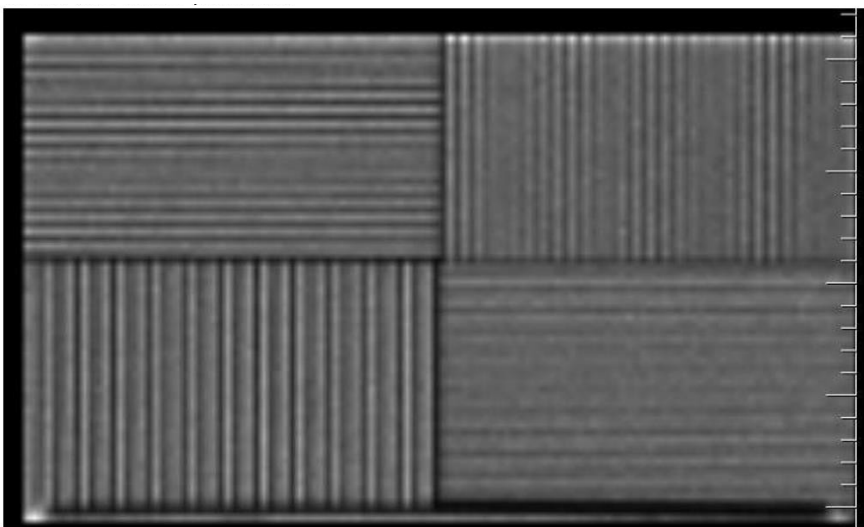


PMTs Visible

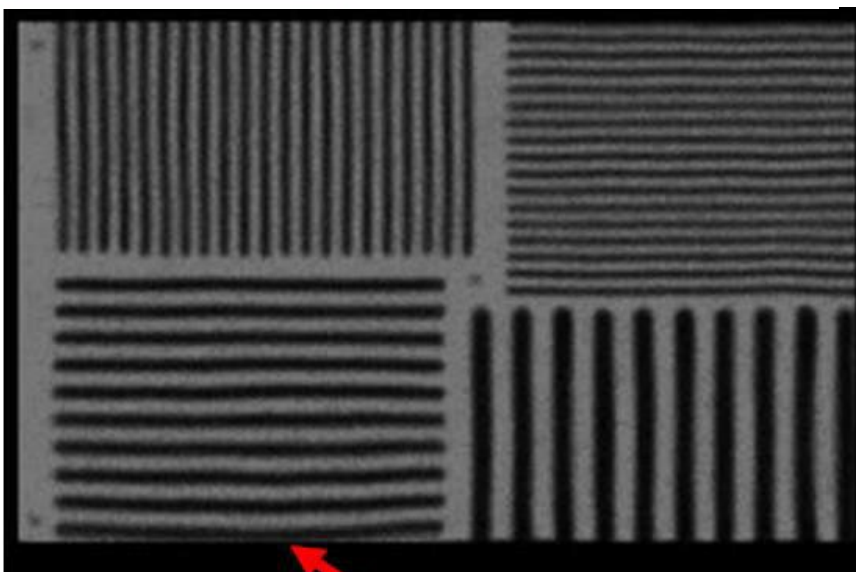
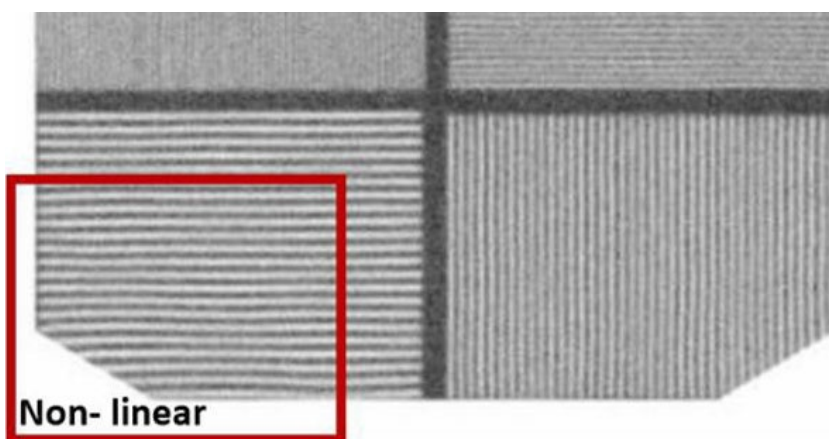


Wrong Matrix Size

Image below is an example of aliasing. The matrix used was most likely a 256x256 and the pixel size was too large for the bars. This results in under sampling and loss of resolution.



Non-Linearity artifacts

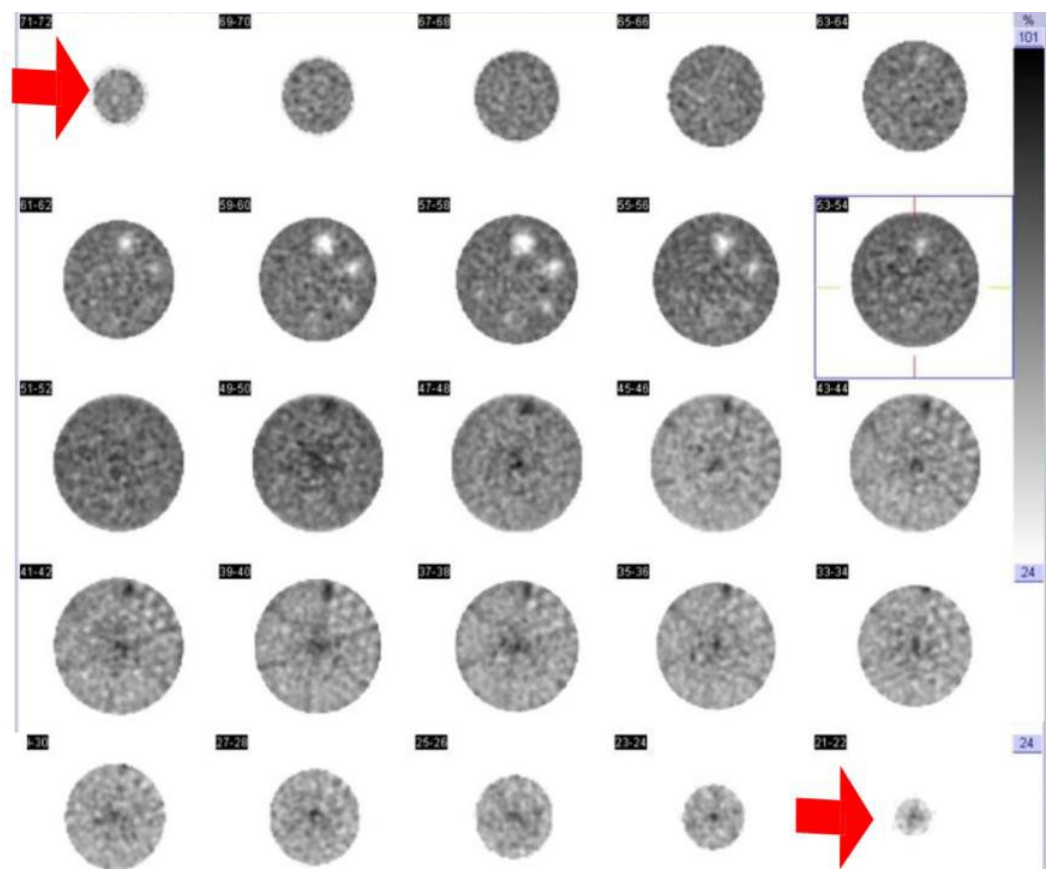


SPECT

It is recommended to review the images with your physicist prior to submission.

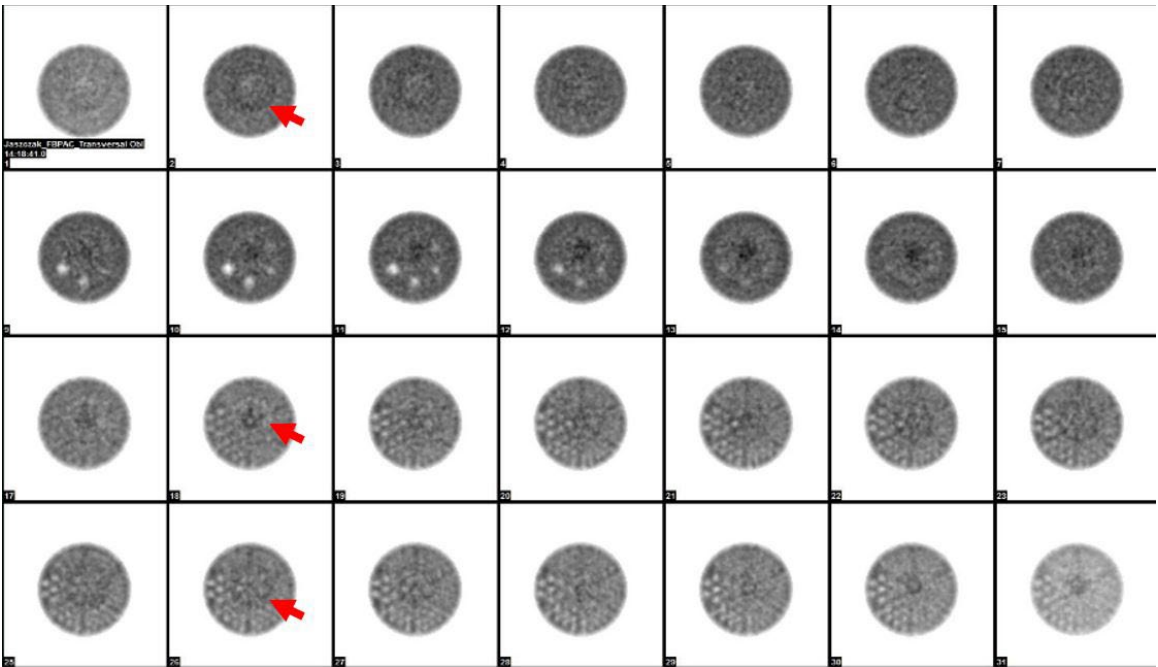
Remember, the entire phantom must be submitted, top to bottom. Uniformity is evaluated over all slices of the transaxial data set.

Images below showing poor masking and non-circular images. Masking should not be used, and images should all be the same size.

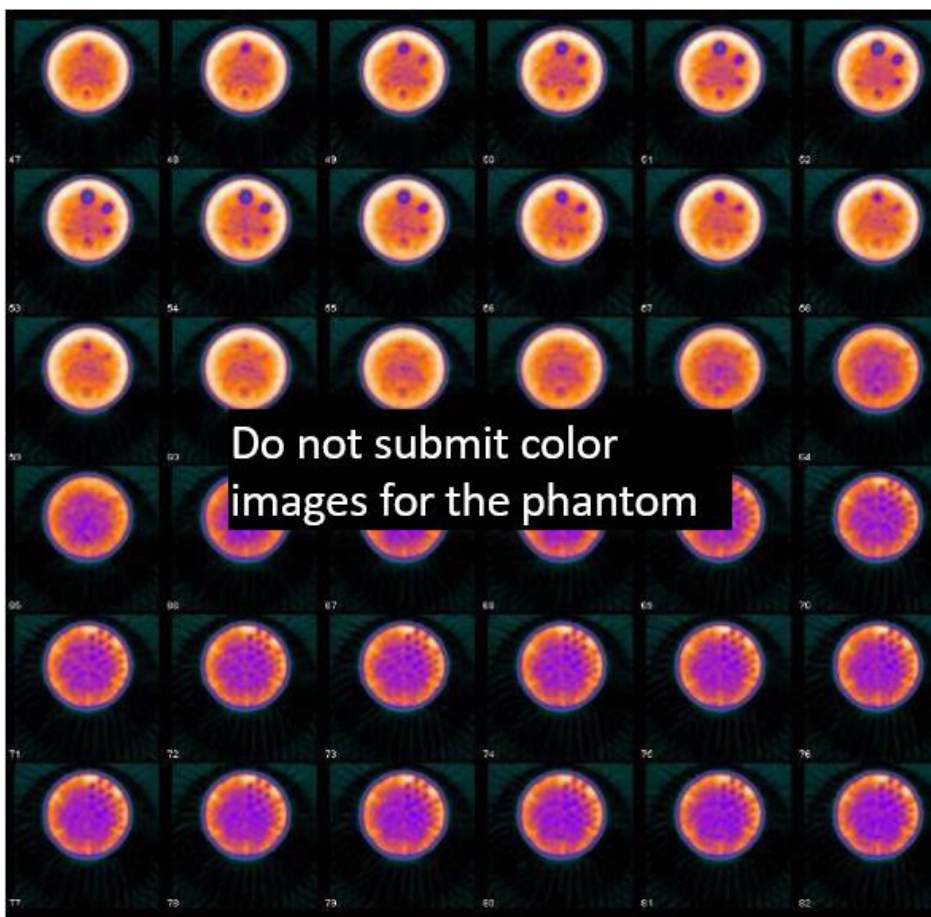
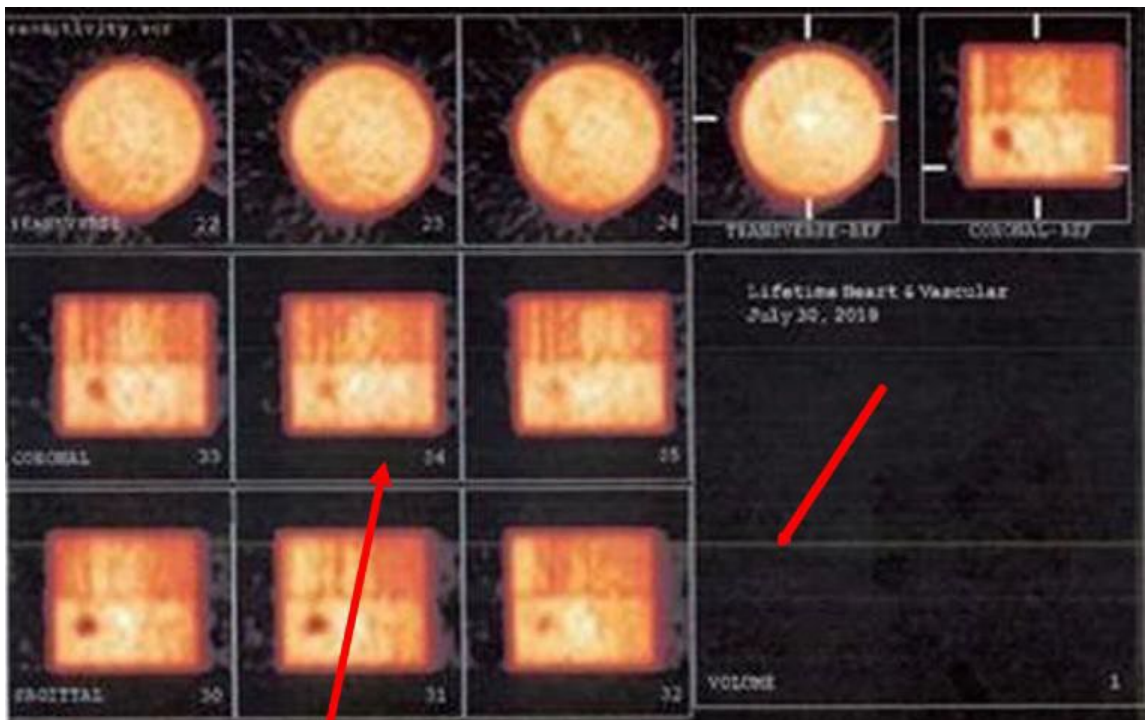


Example of a bullseye (nonuniformity) ring artifact. It is always recommended that a new uniformity calibration and COR be acquired prior to the phantom acquisition.

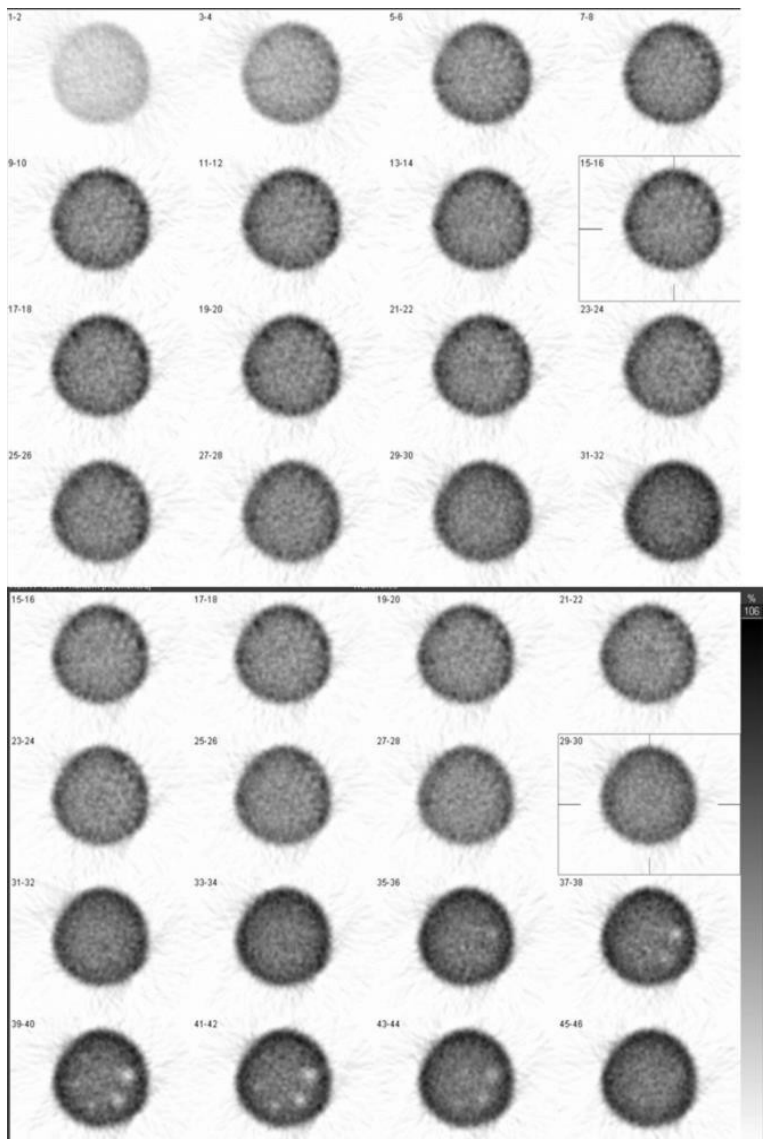
The example below shows ring artifacts extending into the rods section.



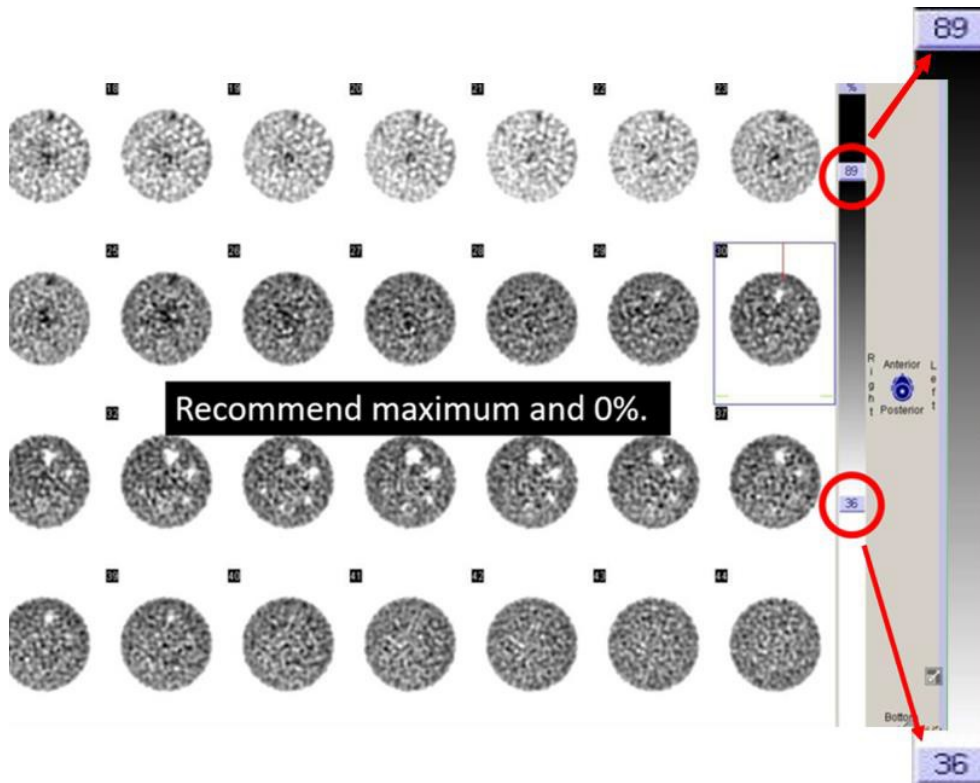
Color images are not accepted. Additionally, please do not include raw data. Below is also an example of a poor color print or paper image scanned in to create a jpg for upload. This is not acceptable. Red arrows point to printer or scanner artifacts.



Non-circular image and lack of the rods section visualization resulted in failure.



The image gray scale should use linear mapping of the display with the lower threshold set at 0 (or $\leq 5\%$ of the maximum upper level) and the upper threshold set to 100% or the maximum count.

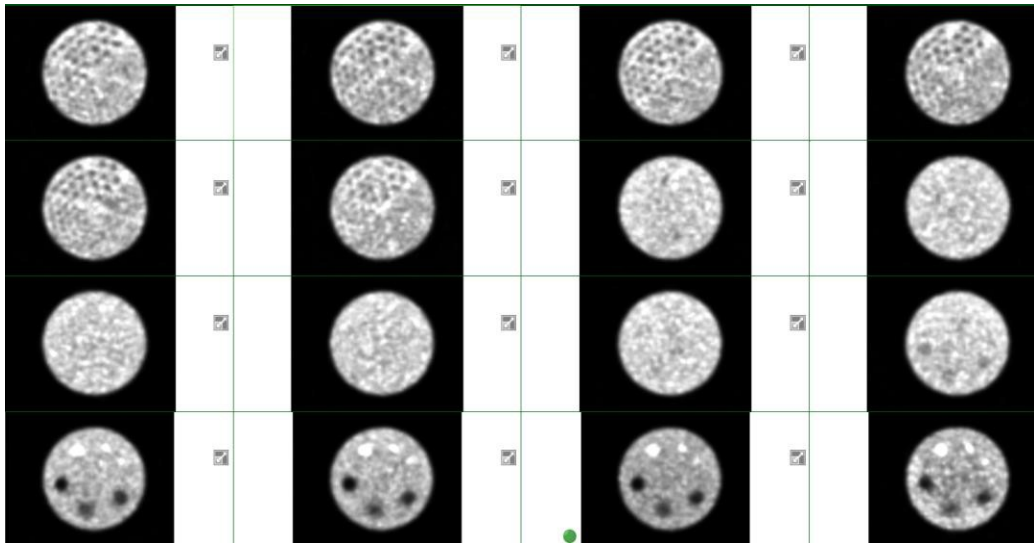


PET

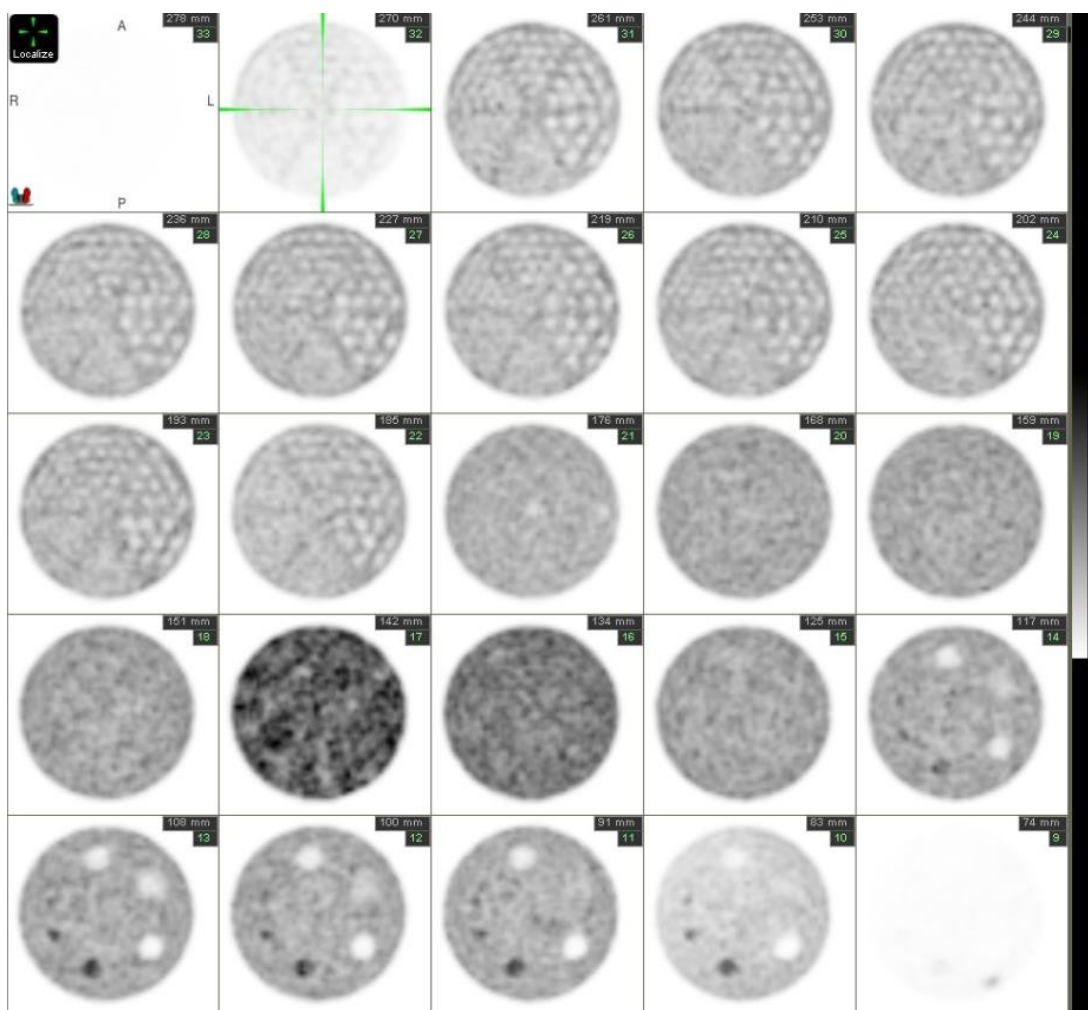
It is recommended to review the images with your physicist prior to submission.

Images below are quite noisy and the 16mm cylinder does not appear completely circular. Images most likely were over windowed to focus on displaying the rods section. This created noisy images and distorted the cylinders.

Submission of DICOM slices eliminate problems with windowing artifacts in screen captures because reviewers are able adjust the window as needed.



Images should be normalized to the series, not each frame. Images 17-18 are brighter than the rest of the series due to normalizing each frame to itself and not the series.



Poor spatial resolution displayed below. Only the largest rods are seen.

