Purpose:Due to the compact geometry of Positron Emission Mammography (PEM), WB-PET phantoms are not suitable for PEM scanners. This study aims to develop an image quality phantom that can be used for PEM image quality assessment.

Methods:A phantom with dimensions of 240 x 160 x 60 mm was designed to assess image quality (uniformity, contrast, linearity, resolution). It has three main components: 1), a cylinder quality phantom with 110 mm ID that consists of 5 suspended hot sphere lesion inserts of varying ID (4,6,8,12,16 mm) filled with 8:1 lesion-to-background activity ratio and a 16 mm cold lesion. The center background region (ID = 30 mm, thickness = 28 mm) is selected for uniformity calculation. The lesion-to-background ratio (LTB) is defined by the maximum of the region of interest (ROI) for the inserts divided by the mean of the background ROI. Image contrast is defined by (LTB-1)/(Actual Activity Ratio-1). 2), a 120 mm line source with 3.0 mm ID perpendicular to the detector motion for linearity evaluation. 3), fillable bar phantoms (ID = 1.1 mm) in X and Y direction with the bar center to center separation increased from 3.0 to 7.5 mm. An optional point source can be added for spatial resolution. A 10 minute, full field of view scan was performed.

Results: Quantitative analysis shows in-plane spatial resolution of 2.4 mm and uniformity of 7.0%. The image contrasts for the 5 spheres are 74%, 63%, 41%, 25% and 7%. The visual inspection shows the PEM scan detects all sphere inserts. The bar phantom and line source do not show linear distortion. The 3 mm bar phantom can be distinguished in high resolution mode (pixels size 0.4 mm).

Conclusions This phantom demonstrates it can be useful for visual and quantitative evaluation of PEM imaging.

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