AbstractID: 5198 Title: Micro-Computed Tomography: A tool for the determination of the sensitive volume of cylindrical and plane parallel ion chambers

Purpose: To use micro-computed tomography (micro-CT) as a tool for non-destructive imaging of air ionization chambers for independent sensitive volume determination and quality assurance of the chambers.

Methods and Materials: A GE Locus Micro-CT imaging system was used to acquire high-resolution images of several common small-volume chambers (Exradin T11 plane-parallel chamber and Exradin A1SL cylindrical chamber). Initial scans were taken of these chambers with a 4cm field of view, 80kVp energy, 450μA tube current, 399 views, and 400ms exposure time per view. Images were reconstructed with 89μm pixel size. GE MicroView visualization software was used to determine the chambers´ air volumes for comparison with the manufacturer´s specifications. The ability of micro-CT to differentiate materials and the effect of high density materials on image quality was assessed. In addition, four Exradin A1SL cylindrical chambers were imaged with an increased number of views (720) and acquisition angles (360°) and reconstructed with 20μm pixel size. Air volumes from all of the chambers were compared to the chamber relative ionization signals generated in a 10x10cm^2 reference field from a Varian 2100C/D linac.

Results: The air cavity volumes derived from the micro-CT images agreed with nominal volumes given by the manufacturers within 5% for both the cylindrical and plane parallel chambers. The relative response of the cylindrical chambers agreed with the relative volumes (semi-automatic method) within 2%. The presence of the connecting cables or pins within the chambers did not affect the ability to accurately visualize the sensitive air volumes.

Conclusions: Micro-CT is a promising tool for the measurement of ion chamber air volume and potentially for determining calibration factors for use in dosimetry. These high resolution images could also prove useful as input to Monte Carlo simulations and the calculation of ion chamber response factors from first principles.