

Characterization of a CT ionization chamber for radiation field mapping

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A cylindrical ionization chamber (special pencil type), developed at the Calibration Laboratory of IPEN, was utilized to verify the possibility of its application in standard X-ray CT (Computed Tomography) beams. The ionization chamber is made of PVC, the wall material of the chamber sensitive volume is graphite coated, and its collecting electrode material is aluminum, with a thickness of 1.20mm. The chamber internal diameter is 6.70mm, and its wall thickness and the sensitive length are 0.26mm and 10.00mm, respectively. The sensitive volume has in this case only 1.0cm length instead of the usual 10.0cm of commercial pencil ionization chambers, therefore its potential use for beam mapping. The characterization tests were performed using an X-ray unit, Pantak/Seifert, model ISOVOLT 160HS and a ⁹⁰Sr+⁹⁰Y check source, PTW, model 8921. The ionization chamber was connected to a PTW electrometer UNIDOS E. The main tests performed were: short- and long-term stability, stabilization time, saturation, ion collection efficiency, leakage current, linearity of response, angular and energy dependence. The response stability tests (repeatability and reproducibility) were performed using the check source that was positioned in a reproducible geometry using an acrylic support. The results obtained showed values within those recommended internationally (IEC, 1997). The reproducibility test is shown in Figure 1, with results within the recommended limit of $\pm 3\%$ (IEC, 1997). The wall coefficients of variation observed in the repeatability test were lower than $\pm 1\%$. To map the standard X-ray radiation field, the ionization chamber was exposed to known air-kerma rates of RQT-8, RQT-9 and RQT-10 X-ray qualities. Steps of 1.00cm for both vertical and horizontal directions were utilized, and 10 measurements were taken for each position. The result for the vertical direction using the RQT-9 quality is shown in Figure 2. All results were considered satisfactory and showed the usefulness of this homemade pencil ionization chamber for beam mapping.

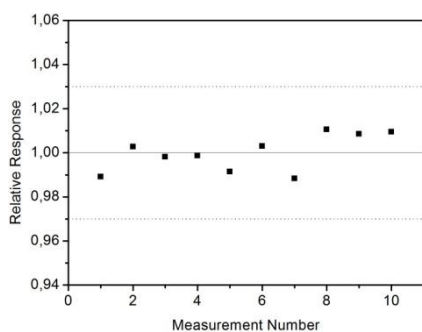


Figure 1: Long-term stability test of the ionization chamber

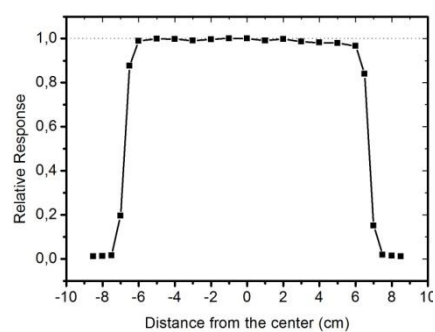


Figure 2: Mapping the standard X-ray radiation field in the vertical direction.

IEC 1997, *Medical electrical equipment - Dosimeters with ionization chambers and/or semiconductor detectors as used in X-ray diagnostic imaging*, IEC 61674, International Electrotechnical Commission, Genève.

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