A new standard cylindrical graphite-walled ionization chamber for dosimetry in 60-Co beams at calibration laboratories

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The use of ^{60}Co sources is largely disseminated at dosimetry laboratories, in order to calibrate the ionization chambers utilized for radiotherapy dosimetry, mainly in those laboratories where there is no linear accelerator available. In this work, a new cylindrical ionization chamber was developed and characterized to be used as a reference dosimeter at the Calibration Laboratory of the IPEN. This ionization chamber was entirely made of high-purity graphite, with a sensitive volume of 2.34 cm^3 and a wall thickness of 4.0 mm, to allow electronic equilibrium for ^{60}Co radiation. The central collecting electrode has a diameter of 2.0 mm, and is 16.0 mm long. The support of the collecting electrode and the stem are made of Teflon®. The characterization tests were conducted according to the IEC 60731 standard. All tests presented results within the limits recommended by this standard: the ionization chamber achieved saturation on the whole tested interval (−400 V to +400 V), the highest variation in the stability test was 0.23%, the ion collection efficiency was better than 99.9%, the polarity effect was lower than 0.5%, the leakage current was lower than 0.5% for all tests, the response was linear, and the angular dependence (360° around the central axis) was lower than 0.2%. Furthermore, in order to complete the study of this new dosimeter, Monte Carlo simulations with the EGSnrc code were carried out. The wall of the ionization chamber presented an influence of 1.5% and the chamber stem 0.8% on the ionization chamber response. These results indicate a low influence of the chamber components, as expected for a reference dosimeter. Therefore, the ionization chamber characterized in this work presents potential used as a reference dosimeter at calibration laboratories.