Determination of the voltage applied to x-ray tubes from the bremsstrahlung spectrum obtained with a silicon PIN photodiode

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This work describes a methodology for the obtainment of the electron accelerating potential (kVp) applied to an x-ray tube, through the determination of the end point of the energy spectrum of the radiation emitted by the tube. The measurements have been performed utilizing alternatively two silicon PIN photodiodes, directly irradiated by the x-ray beam. Both were operated at room temperature, with low bias, so avoiding the drawbacks presented by photomultiplier tubes and germanium detectors. The energy calibration of the system was performed with X- and γ-emitter radioactive sources, which makes the method absolute. Each kVp value was determined by means of a linear regression in the end of the spectrum, to give, simultaneously, a good fit of the straight line to the experimental data and a low standard deviation for the kVp value. Results of the measurements carried out with an x-ray tube connected to a three-phase generator, using additional filtration between 1.5 and 4.0 mm of Cu, are presented. This filtration was used in order to minimize the contribution of low energy photons and to reduce pulse pile-up. Errors determined for the values of kVp are between 0.06 and 0.16 kV, in the potential range from 50 to 100 kV. As an example, the methodology has been applied in the verification of the secondary calibration of a voltage divider, utilized, by its turn, in the tertiary calibration of noninvasive kVp meters. All intrinsic sources of errors involved in the process are discussed and evaluated. [S0094-2405(00)01111-1]

Key words: calibration of kVp meters, x-ray spectrometry, PIN photodiodes, radiodiagnostic x-ray tubes