

Study of the Performance of Diagnostic Radiology Instruments During Calibration

Rodrigo N. de Freitas^{*}, Vitor Vivolo and Maria da Penha A. Potiens

*Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP
Av. Professor Lineu Prestes 2242,
05508-000 São Paulo, SP, Brazil*

Abstract

The instruments used in diagnostic radiology measurements represent 8 % of the tested instruments by the calibration laboratory of IPEN annually (approximately 1600 in 2007). Considering that the calibration of this kind of instrument is performed biannually it is possible to conclude that almost 300 instruments are being used to measure the air kerma in diagnostic radiology clinics to determine the in beam values (in front of the patient), attenuated measurements (behind the patient) and scattered radiation.

This work presents the results of the calibration of the instruments used in mammography, computed tomography, dental and conventional diagnostic radiology dosimetry, performed during the period of 2005 to 2007. Their performances during the calibrations measurements were evaluated. Although at the calibration laboratory there are three available series of radiation quality to this type of calibration (RQR, N and M, according to standards IEC 61267 and ISO 4037-1.), the applications can be assorted (general radiology, computed tomography, mammography, radiation protection and fluoroscopy). Depending on its design and behaviour, one kind of instrument can be used for one or more type of applications. The instruments normally used for diagnostic radiology measurements are ionization chambers with volumes varying from 3 to 1800 cm³, and can be cylindrical, spherical or plane parallel plates kind. They usually are sensitive to photon particles, with energies greater than 15 keV and can be used up to 1200 keV. In this work they were tested in X radiation fields from 25 to 150 kV, in specific qualities depending on the utilization of the instrument. The calibration results of 390 instruments received from 2005 to 2007 were analyzed. About 20 instruments were not able to be calibrated due to bad functioning. The calibration coefficients obtained were between 0.88 and 1.24. The uncertainties were always less than $\pm 3.6\%$ to instruments used in scattered radiation measurements; $\pm 3.0\%$ to mammography instruments; $\pm 1.6\%$ to computed tomography instruments and $\pm 1.5\%$ to in beam and attenuated radiation in conventional diagnostic radiology. The results showed that the performance of the diagnostic radiology ionization chamber must be well determined to select the correct calibration and use.

KEYWORDS: *diagnostic radiology; calibration; metrology; ionization chamber; X radiation*

^{*} Presenting author, E-mail : rnfreitas@ipen.br