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Electrometers intercomparison using ionization chamber and radioactive check source

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Introduction

Radiophysics department of the Institute of Oncology Ljubljana, use different electrometers for absolute dosimetry. They are from two different vendors PTW Freiburg GmbH and IBA Dosimetry GmbH. Intercomparison study was carried out in which a total of nine electrometers were compared by using a radioactive check source. An electrometer used by the Institute of Occupational Safety was used as a reference as the institute is approved by national authority to perform external dosimetry audits in the field of radiotherapy.

Materials and methods

In the study we used five electrometers from PTW (2 PTW Unidos and 3 PTW UnidosWebline) and four from IBA Dosimetry (3 IBA Dose1 and 1 IBA Dose2) (figure 1). The 0.6 cm³ Farmer type chamber (PTW 30013) was inserted in a Sr-90 radioactive check device (PTW T48012-0444) with an activity of 33 MBq from 15/2/2010. The chamber was connected with a triaxial extension cable to the electrometer. Collected charge at bias voltage +400V for the time of 180 s was measured. The ambient temperature and air pressure were monitored during the measurements to be able to correct the results. With each electrometer we carried out 3 measurements to ensure the stability as well as to minimize the statistic error.

Results

From the results in the table 1 we can see that the PTW electrometers collected charge is positive while for IBA electrometers charge is negative, even though the voltage was set to +400V. The reasons for these discrepancies are the differences in conventions expressing the polarity of the voltage of the two manufactures. In IBA electrometers a central electrode of the chamber is positive when you apply +400V while for the PTW electrometers central electrode is charged to -400V. Discovering this difference the measurements were repeated in a physically correct way. The repeated results as well as the difference regarding to the electrometer of the Institute of Occupational Safety are shown in the table 1. During the measurements the temperature and the pressure were stable therefore no correction was necessary.

Conclusion

This study showed an excellent agreement between the electrometers for the same vendor and series. As we could expect, there is a minor difference between the manufactures which is very low and can be neglected. We have to emphasize in the results we did not consider the uncertainty of the measurements. However we discovered that the oldest electrometers (PTW Unidos) used in our test had the largest difference to a reference and a manufacture recalibration should be considered. Unfortunately the manufactures do not use the same convention for the definition of the polarity of central electrode which can lead to larger discrepancies when measuring the absolute dose.

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