

Commissioning of two secondary standards in the Spanish Ionizing Radiations Metrology Laboratory

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Introduction

- Secondary Standard ion chambers for radiation protection levels (gamma) must show an excellent performance.
- Therefore, a comprehensive characterization of the ion chambers is a must.
- High accuracy, low uncertainty and correct dissemination of standards must be ensured.

Purpose

- To perform a series of tests on two reference ion chambers:
 - Routine laboratory test.
 - Extended checks.
 - Consistency, stability and reproducibility studied during 6 months.
- To discuss their suitability as secondary standards.

Methods and Materials

- Ion chambers.
 - PTW 32003/PTW UNIDOS electrometer.
 - PTW 32002/IBA Dose 1 electrometer.
- Checks.
 - Radiological study. The ion chambers were studied under fluoroscopy, in order to check their integrity.
 - Energetic dependence: relative dose measurements for the following radiation qualities: Cs-137, Co-60, positron-electron annihilation photons from Ge-68.

Methods and Materials

■ Checks (cont'd):

- Sr-90 stability checks.
- Angular dependence. For each radiation quality, relative response between different orientations and the reference one was obtained.
- Ion recombination. Voltage was varied between the reference one (+400 V) and +100 V at 50 V intervals. The effect was evaluated using a fit.
- Polarity effect. Ratio of corrected charge at +/-400 V.
- Leakage currents (pre and post irradiation).

Methods and Materials

■ Checks (cont'd):

- Dose linearity. The electrometer timer was used to control the detection time. Charge was fitted versus time.
- Dose rate linearity. Different dose rates were obtained by accurately setting different distances.
- Range Factors were established for the PTW UNIDOS electrometer.

Results

- Both ion chambers were in proper conditions, the x-ray examination revealed no defects.
- The response at different radiation qualities was within experimental uncertainty.
- Sr-90 checks were repeatable within 0,4% during a 6 months period.
- Angular dependence. No angular dependence was detected within experimental uncertainty.

Results

- Ion recombination, acceptable results.
- Polarity. At low Cs-137 dose rates, 15 $\mu\text{Sv/h}$, PTW 32003 showed a marked polarity dependence (factor $\sim 1,101 \pm 0,003$).
- Leakage currents $< 10 \text{ fA}$ for both ion chambers.

Results

- For a wide range of dose and dose rate, linearity results were within 0,5%.
- Energy dependence was within 0,4% for energies ranging from Cs-137 to Co-60.

Conclusions

- Both ion chambers have been comprehensively characterized, and were found to fulfil our laboratory requirements.
- Tests results will be taken as references for constancy checks.
- These ion chambers will be set as Spanish national secondary standards at radiation protection levels, gamma radiation.