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Stability Study of Ionization Chambers in Standard Mammography Radiation Beams

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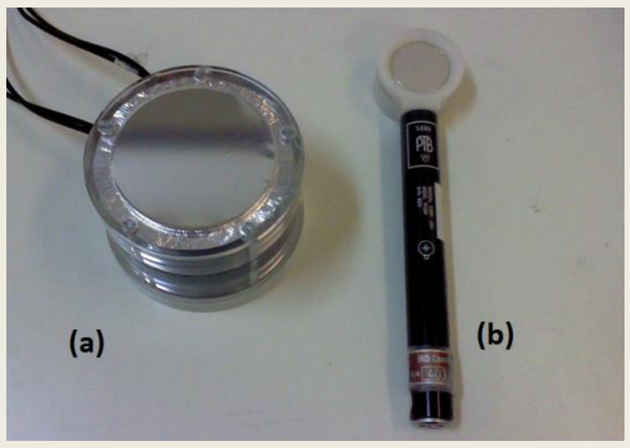
1. INTRODUCTION

For reliable measurements the ionization chamber should present stable responses over the time. It is important to reduce the errors in the measuring process and to ensure accurate measurements of the beam qualities. The ionization chamber stability response has to be checked periodically.

In this work, the stability of response of two ionization chambers was evaluated and compared. One of them was a home made ionization chamber and the other one was a Radcal RC6M reference ionization chamber.

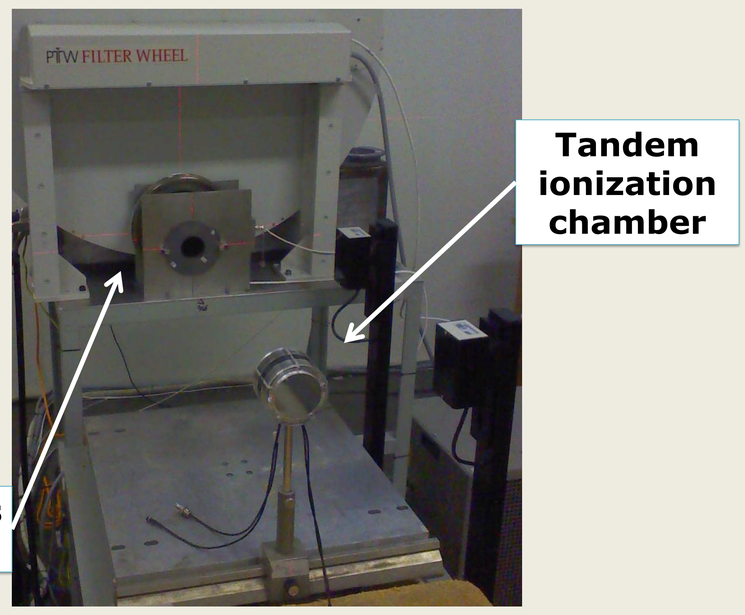
2. MATERIALS AND METHODS



(a) The homemade double faced ionization chamber with sensitive volumes of 6.0 cm³, with aluminum and graphite collecting electrodes, developed at LCI/IPEN (tandem ionization chamber).

(b) The Radcal RC6M reference ionization chamber

- **Electrometers: PTW UNIDOS E and Keithley 6517A**
- **X-rays equipment: Pantak Seifert Isovolt 160HS, tungsten target (5 to 160 kV and 0.1 to 45 mA)**

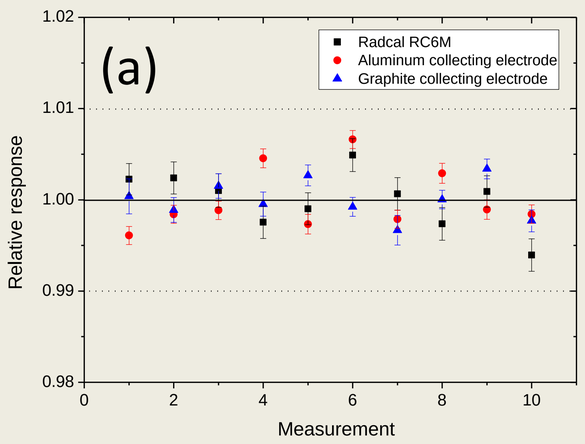


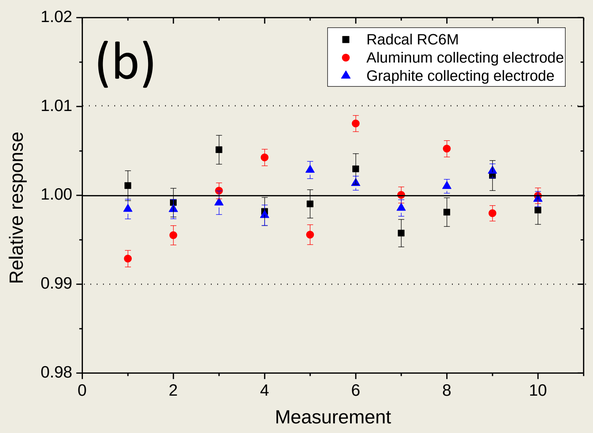
Experimental setup with the tandem ionization chamber system positioned at calibration distance

PTB mammography radiation qualities established at LCI/IPEN

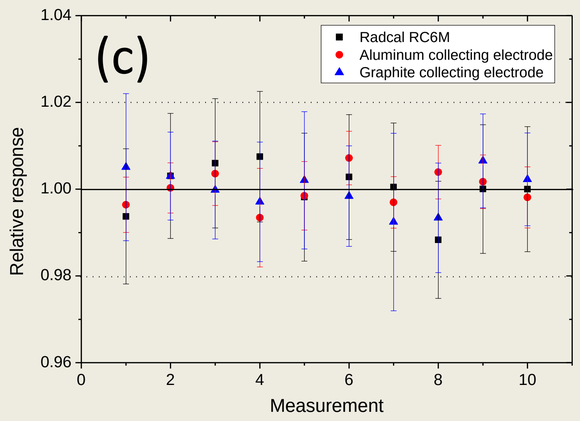
Radiation quality	Tube voltage (kV)	Tube current (mA)	Additional filtration mmAl	Additional filtration mmMo	Half-value layer (mmAl)	Air-kerma rate (mGy/min)
Direct beams						
WMV 28	28	10	---	0.07	0.37	11.94
WMV 30	30	10	---	0.07	0.38	13.48
Attenuated beams						
WMH 28	28	10	2.00	0.07	0.61	0.66
WMH 30	30	10	2.00	0.07	0.68	0.83

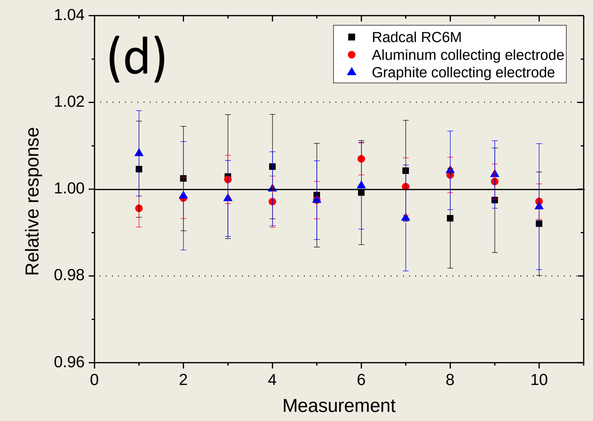
3. RESULTS AND DISCUSSION





Long-term stability test using the (a) WMV 28 and (b) WMV 30 radiation qualities





Long-term stability test using the (c) WMH 28 and (d) WMH 30 radiation qualities

The maximum variations were presented by the chambers in the attenuated beams, as shown by the error bars of Figures (c) and (d). This fact is due to the lower air kerma rates in the attenuated beams in relation to those in the direct beams.

Repeatability test of the ionization chambers

Radiation quality	Maximum coefficient of variation (%) Tandem chamber Aluminum collecting electrode	Tandem chamber Graphite collecting electrode	Reference chamber Radcal RC6M
WMV 28	0.09	0.26	0.12
WMV 30	0.11	0.18	0.12
WMH 28	1.62	2.87	1.83
WMH 30	0.89	1.98	1.78

4. CONCLUSIONS

In this work, the stability of two ionization chambers in standard mammography beams was evaluated. The maximum variation for the repeatability test (short-term stability) was 2.9% for the homemade ionization chamber with the graphite collecting electrode in the standard WMH 28 beam.

All ionization chambers presented long-term stability test results within the limits stated in the IEC 61674 standard.

ACKNOWLEDGEMENTS

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