Diagnostic Dosemeter DIADOS

1. Introduction

The international standard that all diagnostic dosemeters should comply with is IEC 61674, "Medical electrical equipment - dosimeters with ionization chambers and/or semi-conductor detectors as used in X-ray diagnostic imaging". This international standard considers the use of ionization chambers and semi-conductor detectors for diagnostic measurements and establishes the same set of rigorous requirements for both types of detectors.

Radiation detectors are defined in section 3.1.1.1 of IEC 61674 as either ionization chambers or semi-conductor detectors which transduces air kerma, air kerma length or air kerma rate into a measurable electrical signal.

The PTW-DIADOS diagnostic dosemeter uses semi-conductor detectors and is in complete compliance with IEC 61674. PTW uses semi-conductor detectors in this application because they do not require air-density corrections, they are more rugged and easier to handle than ionization chambers, and their small size enables dose or dose rate measurements to be made at a well-defined point without averaging over large areas.

This Technical Note addresses reservations that are sometimes expressed in conjunction with the use of semi-conductor detectors regarding accumulated dose stability and energy response.

2. Accumulated dose stability

IEC 61674 requires that the response does not change by more than 1 % after the detector was exposed to an air-kerma of 40 Gy in an unattenuated X-ray beam of 70 kV.

The PTW-DIADOS specification for the change in response is less than 0.1 % for 40 Gy in an unattenuated X-ray beam of 70 kV.

IEC 61674 requires a long-term stability of the dosemeter of 2 % per year or better.

The PTW-DIADOS specification is 1 % per year. Instruments that were in use between August 1995 and October 1999 and which were submitted to the PTW calibration laboratory for re-calibration after 2 years of clinical use did not change their response by more than 0.8 % per year, including the effects of long term stability and accumulated dose.

3. Energy response

IEC 61674 requires an energy response within 5 % in the 50 - 150 kV range for conventional diagnostic or the 25 - 35 kV range for mammography in both attenuated and unattenuated beams.

The PTW-DIADOS specification is 5 % for both ranges. However, this value is typically 3% as shown in figures 1 and 2.

4. Conclusions

The specifications and actual performance of the PTW-DIADOS clearly show the accumulated dose stability and the energy response of this device do not pose any issues for this application and are both within the specifications of IEC 61674.

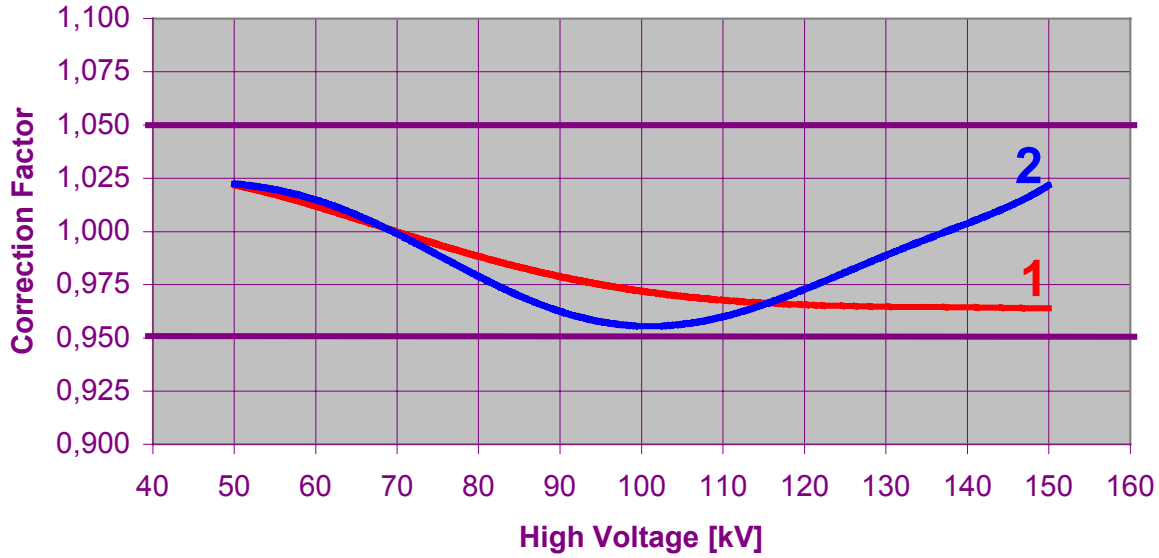

Figure 1: *Typical energy response of the DIADOS detector for conventional diagnostic (1 - unattenuated beam, 2 - attenuated beam)*

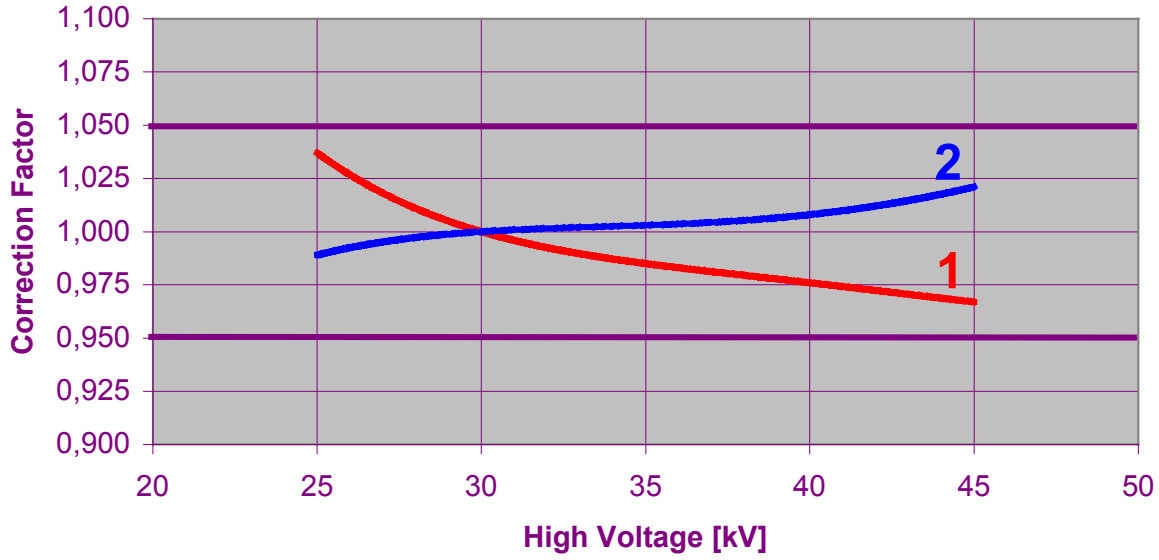

Figure 2: *Typical energy response of the DIADOS detector for mammography (1 - unattenuated beam, 2 - attenuated beam)*

Add. Cu-Filt.	0.2 mm	0.5 mm	1.0 mm	2.0 mm	2.5 mm
50 kV	1.01	1.05	-	-	-
70 kV	1.00	0.97	-	-	-
90 kV	0.97	0.97	0.95	0.92	0.90
120 kV	0.99	0.99	0.99	0.94	0.99
150 kV	1.00	1.00	1.01	1.03	1.05

Table 1: *Correction factor k_{Cu} when additional copper filters are in use (values are valid for an inherent filtration of 2.5 mm Al)*

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