Notification of changes to the IAEA dosimetry standards according to ICRU Report 90

Introduction

This letter is to inform all the Secondary Standards Dosimetry Laboratories (SSDLs) of changes to IAEA dosimetry standards following the decision of the Consultative Committee for Ionizing Radiation (CCRI) [1] on the adoption of the ICRU recommendations [2]. The changes came into effect on 1st of January 2019.

The International Commission on Radiation Units and Measurements (ICRU) published the Report 90 "*Key Data for Ionizing-Radiation Dosimetry: Measurement Standards and Applications*" in October 2016 [2]. This report recommends revised values and uncertainties for some physical data required for realization of air kerma, reference air-kerma rate and absorbed dose to water quantities of photon radiation by primary measurement standards. Details of these changes were published in 2018 [3].

Implementation of the changes at the IAEA

The Bureau International des Poids et Mesures (BIPM) implemented the change on 1st of January 2019 [4] and Physikalisch-Technische Bundesanstalt (PTB) on 1st of January 2018 [5]. The IAEA's dosimetry standards are traceable to BIPM and PTB and the changes to the IAEA standards have been calculated using the information provided and implemented for all calibrations performed after 1st of January 2019.

The changes to the calibration coefficients N of the IAEA standards are presented as a multiplicative factor k(2019) such that

$$N_Q(\text{post 1 January 2019}) = k(2019)\, N_Q(\text{pre 1 January 2019}),$$

where Q represents the calibration quantity for a specified radiation quality. The k(2019) values and the revised uncertainties for the IAEA calibration service claims are listed in Tables 1 - 3.

The changes will be fully implemented when the IAEA standards are recalibrated. In the meantime, the correction factors and revised uncertainties for calibration services given in Tables 1 – 3 will be used. If the uncertainty of the primary standard was decreased, the change is not implemented during the transfer period. The potential decrease of uncertainty will be considered after recalibration of the IAEA standard. For mammography calibrations a decision was made to use one k(2019) factor for all radiation qualities and the small uncertainty <0.05%, related to the variation within the radiation qualities, is included in the revised uncertainties.

Implementation of the changes in SSDLs

As a consequence, calibration coefficients issued from 1 January 2019 will differ from previous calibrations. The data given in Tables 1 - 3 enables the SSDLs, that are traceable to the IAEA, to correct their calibration coefficients N_Q and uncertainties, shown in certificates issued before 1 January 2019, for the changes in the primary standards. However, all IAEA/WHO SSDL network members are encouraged to implement the changes announced by the PSDLs or SSDLs to which they are traceable, and to inform the customers about the changes.

Distribution

The present note is distributed to all members of the IAEA/WHO SSDL Network and posted on the SSDL Network website. In addition, the attachments to the calibration certificates issued by the IAEA Dosimetry Laboratory after January 2019 are updated accordingly.

Table 1. The *k*(2019) correction factors and revised uncertainties for the IAEA standards.

Dosimetry scope	Quantity	Radiation quality	*k(2019)*	Uncertainty 2019 % (*k* = 2)
Radiation Therapy	Absorbed dose to water	^{60}Co	**0.9990**	1.0
	Air kerma	^{60}Co	**0.9918**	0.8
		10–250 kV	**Table 2**	1.1
Radiation Protection	Air kerma	^{137}Cs	**0.9920**	0.8
		^{60}Co	**0.9918**	0.8
		10–250 kV	**Table 3**	1.4
Diagnostic Radiology	Air kerma	IEC-61267 RQR, RQT, RQA	**0.9980**	1.4
	Air kerma	Mammography: RQA-M, Mo-Rh, W-Rh, W-Ag, W-Al	**0.9972**	1.6
	Air kerma	Mammography: RQR-M and W-Mo	**0.9972**	1.3

Table 2. The *k*(2019) correction factors for the IAEA standards for the radiation therapy reference X-ray radiation qualities.

Radiation quality	Tube voltage	1st HVL		
	kV	mmAl	mmCu	*k*(2019)
T7	10	0.04		**0.9953**
T8	30	0.16		**0.9968**
T9	25	0.23		**0.9969**
T10	50	1.00		**0.9977**
T11	50	2.37		**0.9980**
T1	100	4.03		**0.9980**
T2	135		0.52	**0.9980**
T3	180		1.00	**0.9981**
T4	250		2.51	**0.9986**

Table 3. The *k*(2019) correction factors for the IAEA standards for the radiation protection reference X-ray radiation qualities.

Radiation quality	Tube voltage	1st HVL		
	kV	mmAl	mmCu	*k*(2019)
N40	40	2.72		**0.9980**
N60	60		0.24	**0.9980**
N80	80		0.59	**0.9980**
N100	100		1.13	**0.9980**
N120	120		1.75	**0.9980**
N150	150		2.42	**0.9983**
N200	200		3.92	**0.9988**
N250	250		5.18	**0.9992**
N300	300		6.2	**0.9995**

References:

[1] Consultative Committee for Ionizing Radiation (CCRI) 2017 Report of the 26th meeting (29–30 June 2017)
[2] International Commission on Radiation Units and Measurements, Key data for ionizing-radiation dosimetry: Measurement standards and applications, Report No. 90: *J. ICRU* 14 (2016) 1-110, ICRU, Bethesda, MD
[3] Burns D., Kessler C., Re-evaluation of the BIPM international dosimetry standards on adaption of the recommendation of ICRU 90, *Metrologia* 55 (2018) R21-R26.
[4] Notification of changes to the BIPM dosimetry standards with effect from 1 January 2019 (23 November 2018).
[5] Buermann L., Changes to the magnitude of the unit of Gray according to ICRU Report 90, Physikalisch-Technische Bundesanstalt (PTB), (2018).