

## Calibration services offered by the Dosimetry Laboratory of IBA Dosimetry

The Secondary Standard Dosimetry Laboratory (SSDL) of IBA Dosimetry offers calibration of dosimeters used in radiation therapy and diagnostic radiology according to the recent dosimetry codes of practice in a wide range of quantities and radiation qualities (*Table 1*). The SSDL calibration services and the electrometer calibrations are accredited according the ISO 17025:2005 standard. Additionally, factory calibrations are available for all dosimetry quantities with the exception of high energy x-ray/electron beams.

Table 1. Calibration quantities, beam qualities, standards and dosimetry protocols, and combined expanded uncertainties of calibration coefficients.

Quantity	Measurement range	Measurement conditions		$U (k = 2)$	
		Beam quality	Specification	SSDL	Factory
Air kerma rate	100 mGy/min to 5 Gy/min	Co-60	TRS-277, TG-21	1.0 %	2.2 %
	1 mGy/min to 200 mGy/min	X-rays 40 kV to 280 kV	IEC 61627	1.2 %	2.3 %
Air kerma	100 mGy to 20 Gy	Co-60	TRS-277, TG-21	1.0 %	2.2 %
	1 mGy to 10 Gy	X-rays 40 kV to 280 kV	IEC 61627	1.2 %	2.3 %
Kerma area product	20 pGy·m <sup>2</sup> to 100 μGy·m <sup>2</sup>	40 kV to 160 kV	IEC 61627, DIN 6809-5	1.8 %	3.3 %
Kerma length product	0.1 μGy·m to 1 mGy·m	40 kV to 160 kV	IEC 61627, DIN 6809-5	1.8 %	3.3 %
Absorbed dose rate to water	100 mGy/min to 5 Gy/min	Co-60	TRS-398, TG-51, DIN 6800-2	1.0 %	2.2 %
	1 mGy/min to 300 mGy/min	X-rays 120 kV to 280 kV	DIN6809-5	2.3 %	3.5 %
	5 mGy/min to 100 mGy/min	X-rays 20 kV to 100 kV	TRS-398, DIN 6809-4	3.2 %	4.0 %
Absorbed dose to water	1 Gy to 20 Gy	Electrons 6 MeV to 15 MeV	TRS-398	2.2 %	N/A
	1 Gy to 20 Gy	High energy x-rays 6 MV to 15 MV	TRS-398	1.6 %	N/A
	0.1 Gy to 20 Gy	Co-60	TRS-398, TG-51, DIN 6800-2	1.0 %	2.2 %
	1 mGy to 5 Gy	X-rays 120 kV to 280 kV	DIN 6809-5	2.3 %	3.5 %
	5 mGy to 3 Gy	X-rays 20 kV to 100 kV	TRS-398, DIN 6809-4	3.5 %	4.0 %
DC current	200 pA to 10 μA		IEC 60731	0.2 %	N/A
	20 pA to 199 pA		IEC 60731	0.3 %	N/A
	1 pA to 19.9 pA		IEC 60731	0.5 %	N/A



### **Calibration request**

Inquiries for scheduling and turnaround time should be addressed to the IBA Dosimetry Customer Service by letter, fax or e-mail. The inquiry must provide the technical specification of the instrument to be calibrated, the radiation qualities and the name and a phone/fax number or an e-mail address of a person, who can answer technical questions that may arise. Please use the "Calibration Request" form. After arrangements for calibration, the instruments can be shipped to IBA Dosimetry. Care must be taken for packaging the instruments to avoid damage during their transport. The transport itself should be covered by insurance.

### **Calibration traceability**

Ionization chambers are calibrated by the substitution method using reference standards calibrated at the primary standard dosimetry laboratory of PTB-Braunschweig (German Federal Metrology Institute) or at the primary standard dosimetry laboratory of the National Physical Laboratory (NPL), UK. IBA Dosimetry Laboratory is an official member of the IAEA/WHO SSDL Network and is regularly participating in inter-laboratory comparisons organized by recognized dosimetry laboratories (BIPM, IAEA) to verify the declared level of performance.

### **Contact us**

If you need additional information, feel free to contact us at one of the following addresses:

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**Additional Notes:**  
**Details on Calibrations**

**Co-60 calibrations**

Calibrations are performed either for an ionization chamber alone or for a measuring system consisting of an ionization chamber and an electrometer. Ionization chambers can be calibrated in terms of air-kerma and/or absorbed dose to water in a collimated Co-60 gamma-ray beam.

***Absorbed dose to water***

The chamber is positioned in a water phantom at a source-to-chamber distance of 105 cm and at a depth of 5 g/cm<sup>2</sup> in a field of 10 × 10 cm<sup>2</sup> (at the phantom surface). If the chamber is not inherently waterproof, the waterproof sleeve must be sent together with the chamber. Calibrations are performed in accordance with IAEA TRS-398 dosimetry code of practice and they also correspond to recent national protocols (e.g. AAPM TG-51 or DIN 6800-2).

***Air-kerma***

The chamber with its build-up cap is positioned at a source-to-chamber distance of 100 cm in a field of 10 × 10 cm<sup>2</sup> (at the plane of the chamber). The build-up cap must be sent together with the chamber. In-air calibrations are performed according to IAEA TRS-277 code of practice (or AAPM TG-21).

**High energy x-ray and electron beam calibrations**

SSDL-level calibrations in terms of absorbed dose to water are performed either for an ionization chamber alone or for a measuring system consisting of an ionization chamber and an electrometer, according to the IAEA TRS-398 code of practice. Photon beam qualities of 6, 10, and 15 MV and electron beam qualities from 6 to 15 MeV are available.

**Kilovoltage x-ray calibrations**

Ionization chambers can be calibrated in terms of air-kerma (TH, RQR, RQA, and RQT) or absorbed dose to water (TH, TW) at beam qualities indicated in Table 2. The characteristics of the ionization chambers submitted for calibration should be taken into account at the selection of beam qualities. The Dosimetry Laboratory is operating an x-ray generator with the HV range from 16 to 320 kV. In combination with filters located in automatic carousel wheels, a total of 36 ISO/DIN beam qualities can be generated.

***Kerma area product and kerma length product***

Calibrations are performed according to the IAEA TRS-457 code of practice in TH, RQR, RQA, and RQT beam qualities. For the ***kerma area product*** calibrations, a standard 50-mm diameter aperture is used; apertures from 6.6 mm to 95 mm (0.3 cm<sup>2</sup> to 70 cm<sup>2</sup>) are available. For the ***kerma length product***, a standard length of 54 mm is used; further, lengths from 10 mm to 54 mm are available.

***Absorbed dose to water for low- and medium-energy kilovoltage x-ray beams***

Calibrations in ***low-energy x-ray*** beams are performed in accordance with IAEA TRS-398 and DIN 6809-4. The chamber is positioned in a plastic phantom, at a focus-to-surface distance of 50 cm in a field of 5 cm (diameter, at the phantom surface). The chamber-specific plastic phantom, as well as the electron compensator foils, must be sent together with the chamber.

Calibrations in ***medium-energy x-ray*** beams are performed in accordance with DIN 6809-5. The chamber is positioned in a water phantom at a focus-to-chamber distance of 105 cm and at a depth of 5 cm in a field of 10 cm (diameter, at the phantom surface). If the chamber is not inherently waterproof, the waterproof sleeve should be sent together with the chamber.

Please note that the reference depth for calibration of ionization chambers in medium-energy x-ray beams recommended by the DIN 6809-5 is 5 cm, which differs from the value of 2 g/cm<sup>2</sup>, recommended by the IAEA TRS-398.

***Air-kerma for low- and medium-energy kilovoltage x-ray beams***

The chamber is positioned at a focus-to-chamber distance of 100 cm in a circular field of 10 cm (diameter, at the plane of the chamber). Calibrations of radiation therapy chambers are performed in accordance with IAEA TRS-277 (or AAPM TG-61). Calibrations of diagnostic radiology chambers are performed according to IAEA TRS-457.

Table 2: List of kilovoltage x-ray beam qualities.

<b>Q</b>	<b>U</b> [kV]	<b>b</b> [mm]	<b>s<sub>1</sub></b>		<b>A</b> [cm]	<b>d</b> [cm]	<b>Standard</b>
			[mm Al]	[mm Cu]			
TH50*	50	4 mm Al	2.3	-	100	10	DIN 6809-5
TH70*	70	4 mm Al	3.1	-	100	10	DIN 6809-5
TH100	100	4 mm Al + 0.5 mm Al	4.6	0.19	100	10	DIN 6809-5
TH120	120	4 mm Al + 2.0 mm Al	6.3	0.29	100	10	DIN 6809-5
TH140	140	4 mm Al + 5.0 mm Al	8.3	0.47	100	10	DIN 6809-5
TH150	150	4 mm Al + 0.5 mm Cu	11	0.84	100	10	DIN 6809-5
TH200	200	4 mm Al + 1.0 mm Cu	15	1.6	100	10	DIN 6809-5
TH250	250	4 mm Al + 1.6 mm Cu	17	2.5	100	10	DIN 6809-5
TH280	280	4 mm Al + 3 mm Cu	19	3.4	100	10	DIN 6809-5
* TH50 and TH70 qualities are only available for air-kerma calibrations.							
TW20	20	0.2 mm Al	0.12	-	50	5	DIN 6809-4
TW30	30	0.5 mm Al	0.37	-	50	5	DIN 6809-4
TW40	40	0.8 mm Al	0.73	-	50	5	DIN 6809-4
TW50	50	1.0 mm Al	1.0	-	50	5	DIN 6809-4
TW70	70	4 mm Al	3.1	-	50	5	DIN 6809-4
TW100	100	4 mm Al + 0.5 mm Al	4.7	-	50	5	DIN 6809-4
RQR2	40	2.50 mm Al	1.4	-	100	10	IEC 61267
RQR3	50	2.50 mm Al	1.7	-	100	10	IEC 61267
RQR4	60	2.65 mm Al	2.2	-	100	10	IEC 61267
RQR5	70	2.65 mm Al	2.5	-	100	10	IEC 61267
RQR6	80	3.00 mm Al	3.0	-	100	10	IEC 61267
RQR7	90	3.00 mm Al	3.4	-	100	10	IEC 61267
RQR8	100	3.30 mm Al	3.9	-	100	10	IEC 61267
RQR9	120	3.75 mm Al	5.0	-	100	10	IEC 61267
RQR10	150	4.50 mm Al	6.4	-	100	10	IEC 61267
RQA2	40	2.5 mm Al + 4 mm Al	2.2	-	100	10	IEC 61267
RQA3	50	2.5 mm Al + 10 mm Al	3.8	-	100	10	IEC 61267
RQA4	60	2.5 mm Al + 16 mm Al	5.3	-	100	10	IEC 61267
RQA5	70	2.5 mm Al + 21 mm Al	6.8	-	100	10	IEC 61267
RQA6	80	2.5 mm Al + 26 mm Al	8.1	-	100	10	IEC 61267
RQA7	90	2.5 mm Al + 30 mm Al	9.2	-	100	10	IEC 61267
RQA8	100	2.5 mm Al + 34 mm Al	10	-	100	10	IEC 61267
RQA9	120	2.5 mm Al + 40 mm Al	12	-	100	10	IEC 61267
RQA10	150	2.5 mm Al + 45 mm Al	13	-	100	10	IEC 61267
RQT8	100	3.4 mm Al + 0.2 mm Cu	7.0	-	100	-	IEC 61267
RQT9	120	3.7 mm Al + 0.25 mm Cu	8.5	-	100	-	IEC 61267
RQT10	150	4.4 mm Al + 0.3 mm Cu	10	-	100	-	IEC 61267

Column headings:

- Q** beam quality
- U** generating potential
- b** additional filtration
- s<sub>1</sub>** 1<sup>st</sup> half value layer
- A** focus to chamber distance (or focus to surface distance in case of absorbed dose to water calibrations)
- d** radiation field diameter at the plane of the chamber (or at the phantom surface in case of absorbed dose to water calibrations)