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CALIBRATION REPORT

on a therapy ionisation chamber for

MEDIUM-ENERGY KILOVOLTAGE X-RAYS

Client	ClientA_Name 200 Street Name Suburb NSW 2020
Ionisation chamber	PTW 30013, serial number 5122
Period of tests	12/02/2021
Previous calibration	Not previously calibrated at ARPANSA
Test and report by	Duncan Butler
Report date	2021-10-07
Direct inquiries to	Chris Oliver
Tel: (03) 9433 2333	**Email:** psdl@arpansa.gov.au

Signed: ____________________ (Authorised Signatory) Date:

Duncan Butler, Director, Primary Standards Dosimetry Laboratory

per C-M Larsson, CEO of ARPANSA

NATA
WORLD RECOGNISED ACCREDITATION

Accredited for compliance with ISO/IEC 17025 - Calibration. The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards

NATA Accredited Laboratory Number: 14433

CIPM MRA

This certificate is consistent with the capabilities that are included in Appendix C of the MRA drawn up by the CIPM. Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement certificates for the quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org).

GENERAL COMMENTS

Chamber description - PTW 30013

Accessories Supplied
- Buildup cap

Preliminary Inspection
- The ionisation chamber had no obvious damage or faults on receipt.

Calibration Coefficient
- The calibration coefficient is the number by which the charge from the chamber, in nC, must be multiplied to obtain the air kerma [1]. The calibration factor for the electrometer must also be taken into account when measuring the charge from the chamber.

Calibration Coefficients for Medium-Energy X-ray (MEX) Qualities in Air
- The calibration coefficients for the chamber for each X-ray beam quality from the Gulmay Comet X-ray generator were determined by comparison with the ARPANSA Medium Energy Free-Air Chamber, which is the Australian primary standard of air kerma for medium energy X-rays.
- The Gulmay Comet X-ray generator is constant potential and the X-ray tube has a tungsten target.

Recombination Correction Measurement
- Not measured.

Polarity Correction Measurement
- Not measured.

Notes
- The ionisation chamber was tested in accordance with ARPANSA Standard Operational Procedure ARPANSA-SOP-0816 Version 7.

References

[1] AAPM protocol for 40-300 kV x-ray beam dosimetry in radiotherapy and radiobiology, C.-M. Ma, Chair, C. W. Coffey, L. A. DeWerd, C. Liu, R. Nath, S. M. Seltzer, J. P. Seuntjens, Med. Phys. **28** (6) 868-893, 2001

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Air Kerma Calibration Certificate - Medium-Energy X-rays

Client	ClientA_Name
Ionisation chamber	PTW 30013, serial number 5122
Polarising voltage	-250 V on the guard electrode
Collected charge polarity	Positive (Central Electrode Negative)
Reference point	The geometrical centre of the cavity
Geometry	Mark on chamber stem facing the radiation source Chamber stem vertically upwards, cable down Horizontal radiation beam Source-detector distance 100 cm Circular beam of diameter 10 cm
Build-up	Build-up cap removed except where stated. Calibrated free in air.
Polarity and recombination	Corrections not applied
Reference conditions	20°C, 101.325 kPa and 50% humidity
Measurement date(s)	12/02/2021

Uncertainties (U) are given at a confidence level of approximately 95% (k=2)

Table 1: Subset of air kerma calibration coefficients

Beam code	Tube voltage	Added filter	Added filter	HVL	HVL	Nominal effective energy [1]	Nominal air kerma rate	NK [2]	U
	kV	mm Al	mm Cu	mm Al	mm Cu	keV	mGy/s	mGy/nC	%
NXA50	50	4.0		2.39	0.08	30	0.4	45.75	1.4
NXA70	70	4.0		3.19	0.11	34	0.8	46.29	1.4
NXB100	100	4.5		4.74	0.18	42	1.5	46.66	1.4
NXC120	120	6.0		6.38	0.28	49	1.8	46.87	1.4
NXD140	140	9.0		8.44	0.45	58	1.8	47.05	1.4
NXE150	150	4.0	0.5		0.84	72	1.4	47.31	1.4
NXF200	200	4.0	1.0		1.63	95	1.6	47.47	1.4
NXG250	250	4.0	1.6		2.57	120	1.8	47.5	1.4
NXH280	280	4.0	3.0		3.5	147	1.4	47.53	1.4
NXH300	300	4.0	3.0		3.7	153	1.7	47.54	1.4

[1] The energy of a monoenergetic beam with the same HVL in mm of Cu

[2] The air kerma calibration coefficient

* With buildup cap on

Calibrated by Duncan Butler

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Table 2: Complete set of air kerma calibration coefficients for all MEX beams

Beam code	Tube voltage	Added filter	Added filter	HVL	HVL	Nominal effective energy [1]	Nominal air kerma rate	NK [2]	U
	kV	mm Al	mm Cu	mm Al	mm Cu	keV	mGy/s	mGy/nC	%
NXA40	40	4.0		1.9	0.06	27	0.2	45.07	1.4
NXJ40	40	0.5		0.57		18	1.9	50.86	1.4
NXK40	40	1.0		0.93		21	1.0	48.48	1.4
NXJ50	50	0.5		0.68		20	2.7	50.14	1.4
NXK50	50	1.0		1.12		23	1.6	48.1	1.4
NXB50	50	4.5		2.53	0.08	31	0.3	45.49	1.4
NXA50	50	4.0		2.39	0.08	30	0.4	45.75	1.4
NXK60	60	1.0		1.29		24	2.1	47.89	1.4
NXA60	60	4.0		2.81	0.1	32	0.6	46.12	1.4
NXJ60	60	0.5		0.79		21	3.4	49.66	1.4
NXA70	70	4.0		3.19	0.11	34	0.8	46.29	1.4
NXB70	70	4.5		3.39	0.12	35	0.7	46.22	1.4
NXJ70	70	0.5		0.9		22	4.1	49.27	1.4
NXC70	70	6.0		3.95	0.14	38	0.5	45.97	1.4
NXK70	70	1.0		1.46		25	2.6	47.71	1.4
NXA80	80	4.0		3.62	0.13	36	1.1	46.44	1.4
NXJ80	80	0.5		1.02		23	4.7	48.95	1.4
NXK80	80	1.0		1.64		27	3.1	47.59	1.4
NXJ90	90	0.5		1.15		25	5.4	48.73	1.4
NXK90	90	1.0		1.84		28	3.7	47.5	1.4
NXA90	90	4.0		4.04	0.15	38	1.4	46.57	1.4
NXJ100	100	0.5		1.3		26	6.0	48.55	1.4
NXC100	100	6.0		5.49	0.22	45	1.2	46.66	1.4
NXD100	100	9.0		6.61	0.29	49	0.8	46.61	1.4
NXK100	100	1.0		2.05		30	4.2	47.49	1.4
NXB100	100	4.5		4.74	0.18	42	1.5	46.66	1.4
NXE120	120	4.0	0.5	10.31	0.63	65	0.7	47.04	1.4
NXB120	120	4.5		5.56	0.23	46	2.2	46.82	1.4
NXC120	120	6.0		6.38	0.28	49	1.8	46.87	1.4
NXD120	120	9.0		7.59	0.37	54	1.2	46.93	1.4
NXC140	140	6.0		7.2	0.34	53	2.4	46.98	1.4
NXB140	140	4.5		6.33	0.28	50	3.0	46.9	1.4
NXD140	140	9.0		8.44	0.45	58	1.8	47.05	1.4
NXF140	140	4.0	1.0		1.03	79	0.6	47.09	1.4
NXE140	140	4.0	0.5		0.77	70	1.2	47.22	1.4
NXC150	150	6.0		7.58	0.38	55	2.8	47.01	1.4
NXF150	150	4.0	1.0		1.13	81	0.9	47.28	1.4
NXE150	150	4.0	0.5		0.84	72	1.4	47.31	1.4
NXG150	150	4.0	1.6		1.38	89	0.4	46.89	1.4

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Beam code	Tube voltage	Added filter	Added filter	HVL	HVL	Nominal effective energy [1]	Nominal air kerma rate	NK [2]	U
	kV	mm Al	mm Cu	mm Al	mm Cu	keV	mGy/s	mGy/nC	%
NXD200	200	9.0		10.53	0.73	70	2.8	47.24	1.4
NXF200	200	4.0	1.0		1.63	95	1.6	47.47	1.4
NXE200	200	4.0	0.5		1.21	83	2.2	47.44	1.4
NXH200	200	4.0	3.0		2.54	120	0.6	47.17	1.4
NXG200	200	4.0	1.6		2.0	105	1.2	47.43	1.4
NXF250	250	4.0	1.0		2.14	107	2.3	47.52	1.4
NXI250	250	4.0	5.0		3.6	150	0.7	47.28	1.4
NXH250	250	4.0	3.0		3.16	137	1.2	47.48	1.4
NXG250	250	4.0	1.6		2.57	120	1.8	47.5	1.4
NXE250	250	4.0	0.5		1.61	93	3.0	47.51	1.4
NXI280	280	4.0	5.0		3.93	160	0.9	47.41	1.4
NXH280	280	4.0	3.0		3.5	147	1.4	47.53	1.4
NXG280	280	4.0	1.6		2.88	128	2.0	47.5	1.4
NXF280	280	4.0	1.0		2.43	115	2.5	47.56	1.4
NXI300	300	4.0	5.0		4.15	167	1.1	47.39	1.4
NXG300	300	4.0	1.6		3.1	134	2.4	47.48	1.4
NXH300	300	4.0	3.0		3.7	153	1.7	47.54	1.4
NXH320	320	4.0	3.0		3.9	159	1.6	47.37	1.4
NXI320	320	4.0	5.0		4.34	173	1.1	47.26	1.4
NXG250*	250	4.0	1.6		2.57	120	1.8	47.5	1.4
NXH280*	280	4.0	3.0		3.5	147	1.4	47.53	1.4
NXH300*	300	4.0	3.0		3.7	153	1.7	47.54	1.4

[1] The energy of a monoenergetic beam with the same HVL in mm of Cu

[2] The air kerma calibration coefficient

* With buildup cap on