Radiation Metrology Laboratory 22.10.2024

Customer
Polimaster Europe UAB
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Reference
Order: Artūras Solovjovas, contract 17.3.2023

This certificate MN/200/23 replaces certificate MN/71B/23. References to Appendix C of the Mutual Recognition Arrangement (CIPM MRA) have been removed, since uncertainties presented are smaller than in STUK's CIPM MRA capabilities.

Calibrated instrument
Dosimetric gamma radiation facility UDG-PM9000 Sn. 002.

Calibration date
17.-19.4.2023

Calibration instruments

Instrument	Manufacturer	Type	Serial
Electrometer	Keithley	6517B	4431242
30 cc ionization chamber	PTW	TM23361	0433
800 cc ionization chamber	Exradin	A6	XQ200282
10 l ionization chamber	PTW	TM320003	083

Method of calibration

Gamma radiation fields of the UDG-PM9000 facility were measured in terms of air kerma rate using an electrometer and different ionization chambers from STUK. Ionization chambers were positioned in the center of irradiation fields so that the center point of the chambers was at the irradiation distance and the rod of the chambers were perpendicular to the beam. Results of the calibration are given in the tables 1-8.

Calibration distances were measured with UDG-PM9000 facility scale from a center of the source activity to the center of the ionization chamber used. The uncertainties from the irradiation distance measurement, chamber positioning or field uniformities are not considered here.

Laboratory Engineer Jan Morelius

STUK maintains the national metrological standards for ionising radiation required to ensure the reliability of radiation measurements (Act on Radiation and Nuclear Safety Authority 1164/2022). STUK is a member in the IAEA/WHO Network for Secondary Standard Dosimetry Laboratories (SSDLs).

Calibration results

Table 1. Results from the ^{137}Cs source IGI-C-8-2 in a container № 2. Results of measurements are dated on 17.4.2023.

Distance [m]	Air kerma rate [Gy/s]	Expanded uncertainty (k=2) [%]
0.50	2.623E-03	2.0
0.70	1.295E-03	2.0
1.00	6.213E-04	2.0
1.40	3.112E-04	2.0
2.00	1.513E-04	2.0
3.00	6.574E-05	2.0
4.00	3.658E-05	2.0
5.00	2.326E-05	2.0
6.00	1.609E-05	2.0
6.50	1.371E-05	2.0

Table 2. Results from the ^{137}Cs source IGI-C-8-2 in a container № 2 with a 100×attenuator attached. Results of measurements are dated on 17.4.2023.

Distance [m]	Air kerma rate [Gy/s]	Expanded uncertainty (k=2) [%]
1.00	6.261E-06	2.0
2.00	1.468E-06	2.0
4.00	3.529E-07	2.0

Table 3. Results from the ^{137}Cs source IGI-C-4-6 in a container № 1. Results of measurements are dated on 18.4.2023.

Distance [m]	Air kerma rate [Gy/s]	Expanded uncertainty (k=2) [%]
0.50	1.082E-05	2.0
0.70	5.422E-06	2.0
1.00	2.625E-06	2.0
1.40	1.332E-06	2.0
2.00	6.493E-07	2.0
3.00	2.851E-07	2.0
4.00	1.588E-07	2.0
5.00	1.008E-07	2.0
6.00	6.977E-08	2.0
6.50	5.955E-08	2.0

Table 4. Results from the ^{137}Cs source IGI-C-3-10 in a container № 3. Results of measurements are dated on 18.4.2023

Distance [m]	Air kerma rate [Gy/s]	Expanded uncertainty (k=2) [%]
0.50	1.662E-07	2.0
0.70	8.302E-08	2.0
1.00	4.030E-08	2.0
1.40	2.031E-08	2.0
2.00	9.881E-09	2.0
3.00	4.343E-09	2.0
4.00	2.414E-09	2.0
5.00	1.536E-09	2.0

Table 5. Results from the ^{137}Cs source IGI-C-3-8 in a container № 3. Results of measurements are dated on 18.4.2023

Distance [m]	Air kerma rate [Gy/s]	Expanded uncertainty (k=2) [%]
0.50	3.580E-08	2.0
0.70	1.787E-08	2.0
1.00	8.674E-09	2.0
1.40	4.366E-09	2.0
2.00	2.136E-09	2.0
3.00	9.394E-10	2.0
4.00	5.220E-10	2.2
5.00	3.331E-10	2.2

Table 6. Results from the ^{137}Cs source Cs7.P03 in a container № 3. Results of measurements are dated on 18.4.2023

Distance [m]	Air kerma rate [Gy/s]	Expanded uncertainty (k=2) [%]
0.50	7.693E-09	2.0
0.70	3.809E-09	2.2
1.00	1.856E-09	2.2
1.40	9.530E-10	2.2
2.00	4.606E-10	2.5
3.00	2.011E-10	2.5

Table 7. Results from the ^{60}Co source GIK-2-8 in a container № 3.
Results of measurements are dated on 19.4.2023

Distance [m]	Air kerma rate [Gy/s]	Expanded uncertainty (k=2) [%]
0.50	2.345E-08	2.0
0.70	1.170E-08	2.0
1.00	5.674E-09	2.0
1.40	2.882E-09	2.0
2.00	1.392E-09	2.2
3.00	6.100E-10	2.2

Table 8. Results from the ^{241}Am source IGIA-3M in a container № 3.
Results of measurements are dated on 19.4.2023

Distance [m]	Air kerma rate [Gy/s]	Expanded uncertainty (k=2) [%]
0.50	1.426E-08	2.5
0.70	7.198E-09	2.5
1.00	3.510E-09	2.5
1.40	1.810E-09	2.5
2.00	8.734E-10	2.5

Environmental conditions

During the calibration temperature and air pressure was constantly monitored. There were no rapid changes during the calibration. Room temperature was 17.4 – 18.6 °C and air pressure was 99.6 – 100.4 kPa. The ionization current was constantly normalized to reference conditions 20 °C and 101.325 kPa during the measurements. Relative humidity was 52 – 58 %RH and no humidity correction was applied.

Radiation qualities and traceability

Calibration results are metrologically traceable to the International System of Units (SI) through the Finnish national standard TM32002 sn. 0260. The Finnish national standard is calibrated at NPL (National Physics Laboratory, United Kingdom). The ICRU report 90 recommendations are included in the calibration results. All the uncertainties are expressed according to JCGM 100:2008 GUM. The expanded uncertainty of the calibration factor with coverage factor k = 2 corresponds to 95 % confidence level for normal distribution. The results of the calibration and uncertainties represent the condition of the instrument during the calibration and the long-term stability of the calibrated instrument is not considered here.

References

International Organization for Standardization. Radiological protection - *X and gamma reference radiation for calibrating dosemeters and doserate meters and for determining their response as a function of photon energy – Part 1: Radiation characteristics and production methods.* International standard ISO 4037-1, Geneva, Switzerland, 2019.

International Organization for Standardization. *X and gamma reference radiation for calibrating dose-meters and doserate meters and for determining their response as a function of photon energy – Part 3: Calibration of area and personal dosemeters and the measurement of their response as a function of energy and angle of incidence.* International standard ISO 4037-3, Geneva, Switzerland, 2019.

Joint Committee for Guides in Metrology (JCGM), JCGM 100:2008 GUM 1995 with minor corrections. *Evaluation of measurement data – Guide to the expression of uncertainty in measurement*. First edition, September 2008.

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Laboratorioinsinööri Jan Morelius
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