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Calibration protocol № 1-BY/04/2022 dated April 26, 2022

Date when calibrated	from April 5, 2022 till April 15, 2022.
Item calibrated	Dosimetric gamma-radiation facility UDG-PM9000 №002.
Customer	UAB Polimaster Europe, Ežero g. 4, Didžiasalio k., Nemėžio sen. LT-13264 Vilnius, Lietuva.
Organization, that performed the calibration	Polimaster Ltd., 112-3n, room 53, Bogdanovicha str., Minsk, 220040, Belarus.
Method of calibration	Calibration of UDG-PM9000 facility gamma-radiation fields is performed in terms of air kerma using the direct measurements method. Calibration is executed according to own draft calibration procedure.
Calibration is performed by using	PTW series electrometer UNIDOS^{webline} type T10021 № 000759 with cavity ionization chambers: - TM32005 (TK-30) № 000097; - TM32002 (LS-01) № 000498; - TM32003 (LS-10) № 000163. The above measuring equipment has established degrees of equivalence to the reference values of GET 8-2011 National Standard of Russian Federation confirmed by a calibration certificate.
Calibration results including uncertainty	Results of calibration (including expanded uncertainty) are presented in tables (**1 - 7**) in this calibration certificate. Ambient dose equivalent rates $\dot{H}^*(10)$ and personal dose equivalent rates $\dot{H}_p(10)$ are also given in the tables. These values are received using multiplication of measured air kerma rate values by the conversation coefficients $h^*(10)_K$ and $h_p(10)_K$. The conversation coefficients for radionuclides ^{241}Am, ^{137}Cs and ^{60}Co are given in the Annex «A» to this calibration protocol.

Additional information	Fields sizes of UDG-RM9000 calibration facility, recommended half-life periods for radionuclide sources and conversation coefficients to operational quantities are given in the Annex «A» to this calibration protocol.
Geometric conditions during calibration	Calibration of UDG-PM9000 calibration facility under conditions of collimated gamma beams is carried out in terms of air kerma on the axis of gamma radiation beam at distances from 0.5 m to 6.5 m measured from the center of the active part of the source positioned in the collimator. Distance adjustment was carried out using UDG-PM9000 facility scale.
Environmental conditions during calibration	- air temperature from 19.6 ºC to 20.8 ºC; - air pressure from 96.65 to 100.74 kPa; - relative humidity from 40.4 % to 47.8 %.

Signature of the person who has performed the calibration

(signature)

Valiantsin Zubarau
(decryption of signature)

1. UDG-PM9000 facility air kerma rates

1.1. Air kerma rate, ambient dose equivalent rate and personal dose equivalent rate of gamma radiation from ^{137}Cs source of type ИГИ-Ц-8-2 № 150 (collimator № 2), the results of measurements are dated April 20, 2022

Table 1

Distance from center of active part of a source to operating point R, m	Air kerma rate $\dot{K}_a$, Gy/s	Expanded uncertainty $U(\dot{K}_a)$, %	Ambient dose equivalent rate $\dot{H}^*(10)$, Sv/s	Expanded uncertainty $U(\dot{H}^*(10))$, %	Personal dose equivalent rate $\dot{H}_p(10)$, Sv/s	Expanded uncertainty $U(\dot{H}_p(10))$, %
0.5	$2.671 \cdot 10^{-3}$	3.0	$3.232 \cdot 10^{-3}$	3.6	$3.232 \cdot 10^{-3}$	3.6
0.7	$1.325 \cdot 10^{-3}$	3.0	$1.604 \cdot 10^{-3}$	3.6	$1.604 \cdot 10^{-3}$	3.6
1.0	$6.376 \cdot 10^{-4}$	3.0	$7.715 \cdot 10^{-4}$	3.6	$7.715 \cdot 10^{-4}$	3.6
1.4	$3.214 \cdot 10^{-4}$	3.0	$3.889 \cdot 10^{-4}$	3.6	$3.889 \cdot 10^{-4}$	3.6
2.0	$1.551 \cdot 10^{-4}$	3.0	$1.877 \cdot 10^{-4}$	3.6	$1.877 \cdot 10^{-4}$	3.6
3.0	$6.788 \cdot 10^{-5}$	3.0	$8.214 \cdot 10^{-5}$	3.6	$8.214 \cdot 10^{-5}$	3.6
4.0	$3.789 \cdot 10^{-5}$	3.0	$4.584 \cdot 10^{-5}$	3.6	$4.584 \cdot 10^{-5}$	3.6
5.0	$2.411 \cdot 10^{-5}$	3.0	$2.918 \cdot 10^{-5}$	3.6	$2.918 \cdot 10^{-5}$	3.6
6.0	$1.670 \cdot 10^{-5}$	3.0	$2.020 \cdot 10^{-5}$	3.6	$2.020 \cdot 10^{-5}$	3.6
6.5	$1.422 \cdot 10^{-5}$	3.0	$1.721 \cdot 10^{-5}$	3.6	$1.721 \cdot 10^{-5}$	3.6

1.2. Air kerma rate, ambient dose equivalent rate and personal dose equivalent rate of gamma radiation from ^{137}Cs source of type ИГИ-Ц-4-6 № 8Х4 (collimator № 1), the results of measurements are dated April 20, 2022

Table 2

Distance from center of active part of a source to operating point R, m	Air kerma rate $\dot{K}_a$, Gy/s	Expanded uncertainty $U(\dot{K}_a)$, %	Ambient dose equivalent rate $\dot{H}^*(10)$, Sv/s	Expanded uncertainty $U(\dot{H}^*(10))$, %	Personal dose equivalent rate $\dot{H}_p(10)$, Sv/s	Expanded uncertainty $U(\dot{H}_p(10))$, %
0.5	$1.111 \cdot 10^{-5}$	3.0	$1,344 \cdot 10^{-5}$	3.6	$1,344 \cdot 10^{-5}$	3.6
0.7	$5.586 \cdot 10^{-6}$	3.0	$6.759 \cdot 10^{-6}$	3.6	$6.759 \cdot 10^{-6}$	3.6
1.0	$2.706 \cdot 10^{-6}$	3.0	$3,274 \cdot 10^{-6}$	3.6	$3,274 \cdot 10^{-6}$	3.6
1.4	$1.369 \cdot 10^{-6}$	3.0	$1,656 \cdot 10^{-6}$	3.6	$1,656 \cdot 10^{-6}$	3.6
2.0	$6.636 \cdot 10^{-7}$	3.0	$8,029 \cdot 10^{-7}$	3.6	$8,029 \cdot 10^{-7}$	3.6
3.0	$2.901 \cdot 10^{-7}$	3.1	$3.511 \cdot 10^{-7}$	3.7	$3.511 \cdot 10^{-7}$	3.7
4.0	$1.618 \cdot 10^{-7}$	3.1	$1.958 \cdot 10^{-7}$	3.7	$1.958 \cdot 10^{-7}$	3.7
5.0	$1.031 \cdot 10^{-7}$	3.1	$1.247 \cdot 10^{-7}$	3.7	$1.247 \cdot 10^{-7}$	3.7
6.0	$7.119 \cdot 10^{-8}$	3.1	$8.614 \cdot 10^{-8}$	3.7	$8.614 \cdot 10^{-8}$	3.7
6.5	$6.066 \cdot 10^{-8}$	3.1	$7.340 \cdot 10^{-8}$	3.7	$7.340 \cdot 10^{-8}$	3.7

Signature of the person who has performed the calibration _____ (signature) Valiantsin Zubarau (decryption of signature)

1.3. Air kerma rate, ambient dose equivalent rate and personal dose equivalent rate of gamma radiation from ^{137}Cs source of type ИГИ-Ц-3-10 № 054 (collimator № 3, cell № 2), the results of measurements are dated April 20, 2022

Table 3

Distance from center of active part of a source to operating point R, m	Air kerma rate $\dot{K}_a$, Gy/s	Expanded uncertainty $U(\dot{K}_a)$, %	Ambient dose equivalent rate $\dot{H}^*(10)$, Sv/s	Expanded uncertainty $U(\dot{H}^*(10))$, %	Personal dose equivalent rate $\dot{H}_p(10)$, Sv/s	Expanded uncertainty $U(\dot{H}_p(10))$, %
0.5	$1.689 \cdot 10^{-7}$	3.1	$2{,}044 \cdot 10^{-7}$	3.7	$2{,}044 \cdot 10^{-7}$	3.7
0.7	$8{,}460 \cdot 10^{-8}$	3.1	$1{,}024 \cdot 10^{-7}$	3.7	$1{,}024 \cdot 10^{-7}$	3.7
1.0	$4{,}082 \cdot 10^{-8}$	3.1	$4{,}939 \cdot 10^{-8}$	3.7	$4{,}939 \cdot 10^{-8}$	3.7
1.4	$2{,}048 \cdot 10^{-8}$	3.1	$2{,}478 \cdot 10^{-8}$	3.7	$2{,}478 \cdot 10^{-8}$	3.7
2.0	$9{,}964 \cdot 10^{-9}$	3.1	$1{,}206 \cdot 10^{-8}$	3.7	$1{,}206 \cdot 10^{-8}$	3.7
3.0	$4{,}373 \cdot 10^{-9}$	3.1	$5{,}291 \cdot 10^{-9}$	3.7	$5{,}291 \cdot 10^{-9}$	3.7
4.0	$2{,}447 \cdot 10^{-9}$	3.1	$2{,}961 \cdot 10^{-9}$	3.7	$2{,}961 \cdot 10^{-9}$	3.7
5.0	$1{,}553 \cdot 10^{-9}$	3.1	$1.879 \cdot 10^{-9}$	3.7	$1.879 \cdot 10^{-9}$	3.7
6.0	$1{,}088 \cdot 10^{-9}$	3.1	$1{,}316 \cdot 10^{-9}$	3.7	$1{,}316 \cdot 10^{-9}$	3.7

1.4. Air kerma rate, ambient dose equivalent rate and personal dose equivalent rate of gamma radiation from ^{137}Cs source of type ИГИ-Ц-3-8 № 4СА (collimator № 3, cell № 1), the results of measurements are dated April 20, 2022

Table 4

Distance from center of active part of a source to operating point R, m	Air kerma rate $\dot{K}_a$, Gy/s	Expanded uncertainty $U(\dot{K}_a)$, %	Ambient dose equivalent rate $\dot{H}^*(10)$, Sv/s	Expanded uncertainty $U(\dot{H}^*(10))$, %	Personal dose equivalent rate $\dot{H}_p(10)$, Sv/s	Expanded uncertainty $U(\dot{H}_p(10))$, %
0.5	$3.647 \cdot 10^{-8}$	3.1	$4.413 \cdot 10^{-8}$	3.7	$4.413 \cdot 10^{-8}$	3.7
0.7	$1.828 \cdot 10^{-8}$	3.1	$2.212 \cdot 10^{-8}$	3.7	$2.212 \cdot 10^{-8}$	3.7
1.0	$8.833 \cdot 10^{-9}$	3.1	$1.069 \cdot 10^{-8}$	3.7	$1.069 \cdot 10^{-8}$	3.7
1.4	$4.462 \cdot 10^{-9}$	3.1	$5.399 \cdot 10^{-9}$	3.7	$5.399 \cdot 10^{-9}$	3.7
2.0	$2.173 \cdot 10^{-9}$	3.1	$2.629 \cdot 10^{-9}$	3.7	$2.629 \cdot 10^{-9}$	3.7
3.0	$9.365 \cdot 10^{-10}$	3.1	$1.133 \cdot 10^{-9}$	3.7	$1.133 \cdot 10^{-9}$	3.7
4.0	$5.319 \cdot 10^{-10}$	3.1	$6.435 \cdot 10^{-10}$	3.7	$6.435 \cdot 10^{-10}$	3.7
5.0	$3.348 \cdot 10^{-10}$	3.1	$4.051 \cdot 10^{-10}$	3.7	$4.051 \cdot 10^{-10}$	3.7

Signature of the person who has performed the calibration _____ (signature) Valiantsin Zubarau (decryption of signature)

1.5. Air kerma rate, ambient dose equivalent rate and personal dose equivalent rate of gamma radiation from ^{137}Cs source of type Cs7.P03 № 0159/09 (collimator № 3, cell № 5), the results of measurements are dated April 20, 2022

Table 5

Distance from center of active part of a source to operating point R, m	Air kerma rate $\dot{K}_a$, Gy/s	Expanded uncertainty $U(\dot{K}_a)$, %	Ambient dose equivalent rate $\dot{H}^*(10)$, Sv/s	Expanded uncertainty $U(\dot{H}^*(10))$, %	Personal dose equivalent rate $\dot{H}_p(10)$, Sv/s	Expanded uncertainty $U(\dot{H}_p(10))$, %
0.5	$7.838 \cdot 10^{-9}$	3.1	$9.484 \cdot 10^{-9}$	3.7	$9.484 \cdot 10^{-9}$	3.7
0.7	$3.964 \cdot 10^{-9}$	3.1	$4.796 \cdot 10^{-9}$	3.7	$4.796 \cdot 10^{-9}$	3.7
1.0	$1.912 \cdot 10^{-9}$	3.1	$2.313 \cdot 10^{-9}$	3.7	$2.313 \cdot 10^{-9}$	3.7
1.4	$9.553 \cdot 10^{-10}$	3.1	$1.156 \cdot 10^{-9}$	3.7	$1.156 \cdot 10^{-9}$	3.7
2.0	$4.640 \cdot 10^{-10}$	3.3	$5.614 \cdot 10^{-10}$	3.8	$5.614 \cdot 10^{-10}$	3.8
3.0	$2.018 \cdot 10^{-10}$	3.3	$2.441 \cdot 10^{-10}$	3.9	$2.441 \cdot 10^{-10}$	3.9

1.6. Air kerma rate, ambient dose equivalent rate and personal dose equivalent rate of gamma radiation from ^{60}Co source of type ГИК-2-8 № Т68 (collimator № 3, cell № 4), the results of measurements are dated April 20, 2022

Table 6

Distance from center of active part of a source to operating point R, m	Air kerma rate $\dot{K}_a$, Gy/s	Expanded uncertainty $U(\dot{K}_a)$, %	Ambient dose equivalent rate $\dot{H}^*(10)$, Sv/s	Expanded uncertainty $U(\dot{H}^*(10))$, %	Personal dose equivalent rate $\dot{H}_p(10)$, Sv/s	Expanded uncertainty $U(\dot{H}_p(10))$, %
0.5	$2.660 \cdot 10^{-8}$	3.1	$3.085 \cdot 10^{-8}$	3.7	$3.059 \cdot 10^{-8}$	3.7
0.7	$1.325 \cdot 10^{-8}$	3.1	$1.537 \cdot 10^{-8}$	3.7	$1.524 \cdot 10^{-8}$	3.7
1.0	$6.395 \cdot 10^{-9}$	3.1	$7.418 \cdot 10^{-9}$	3.7	$7.354 \cdot 10^{-9}$	3.7
1.4	$3.260 \cdot 10^{-9}$	3.1	$3.782 \cdot 10^{-9}$	3.7	$3.749 \cdot 10^{-9}$	3.7
2.0	$1.573 \cdot 10^{-9}$	3.2	$1.825 \cdot 10^{-9}$	3.8	$1.809 \cdot 10^{-9}$	3.8
3.0	$6.861 \cdot 10^{-10}$	3.2	$7.959 \cdot 10^{-10}$	3.8	$7.891 \cdot 10^{-10}$	3.8

1.7. Air kerma rate, ambient dose equivalent rate and personal dose equivalent rate of gamma radiation from ^{241}Am source of type ИГИА-3м № 179 (collimator № 3, cell № 3), the results of measurements are dated April 20, 2022

Table 7

Distance from center of active part of a source to operating point R, m	Air kerma rate $\dot{K}_a$, Gy/s	Expanded uncertainty $U(\dot{K}_a)$, %	Ambient dose equivalent rate $\dot{H}^*(10)$, Sv/s	Expanded uncertainty $U(\dot{H}^*(10))$, %	Personal dose equivalent rate $\dot{H}_p(10)$, Sv/s	Expanded uncertainty $U(\dot{H}_p(10))$, %
0.5	$1{,}456 \cdot 10^{-8}$	3.3	$2{,}534 \cdot 10^{-8}$	3.9	$2{,}752 \cdot 10^{-8}$	3.9
0.7	$7{,}365 \cdot 10^{-9}$	3.3	$1{,}282 \cdot 10^{-8}$	3.9	$1{,}392 \cdot 10^{-8}$	3.9
1.0	$3{,}615 \cdot 10^{-9}$	3.4	$6{,}290 \cdot 10^{-9}$	3.9	$6{,}833 \cdot 10^{-9}$	3.9
1.4	$1{,}846 \cdot 10^{-9}$	3.4	$3{,}212 \cdot 10^{-9}$	3.9	$3{,}489 \cdot 10^{-9}$	3.9
2.0	$8{,}758 \cdot 10^{-10}$	3.9	$1{,}524 \cdot 10^{-9}$	4.3	$1{,}655 \cdot 10^{-9}$	4.3

Signature of the person who has performed the calibration _____ (signature) Valiantsin Zubarau (decryption of signature)

1.8. The actual value of the air kerma rate $\dot{K}_A$, Gy/s, at the position of the effective center of the ionization chamber (operating point) is determined by the formula

$$\dot{K}_A = N_{A0} \cdot M_0 \cdot k_{PT0} \cdot \prod_i k_{i0}$$

1.9. Typical uncertainty budget for assessing the accuracy of a measurement result:

Input value	Description	Meaning	Degrees of variance number	Relative standard uncertainty value u_r, %	
				type «A»	type «B»
N_{A0}	Calibration factor for the reference electrometer entered into the reference electrometer	Certificate	100	-	(1.3 - 1.5)
M_0	Electrometer readings minus electrometer readings when measuring current leakage and ambient radiation	Average electrometer readings	(6 - 15)	(0.00 – 0.98)	-
T_i	Ambient air temperature under measurement conditions	Thermometer readings	30	-	0.02
P_i	Atmospheric pressure at the level of the operating point	Barometer readings	30	-	0.006
k_{10}	The difference between the temperature inside the ionization chamber and the thermometer readings	1	10	-	0.20
k_{20}	Long-term stability of the reference electrometer	1	10	-	0.17
k_{30}	Non-linearity of scales and mismatch of electrometer modes when switching modes	1	30	-	0.29
k_{40}	Resolution of the scale of indications of the reference electrometer	1	30	-	(0.00 - 0.03)
k_{50}	Transition from air kerma units to ambient or personal dose equivalent units	1	30	-	(0.0 - 1.0)
k_{60}	Orientation of the ionization chamber in the beam - uncertainty in the exact positioning of the reference and calibrated devices due to the inclination and (or) rotation of the ionization chamber relative to the measuring plane in the beam	1	10	-	0.10
k_{100}	The difference between the effective and geometric centers of the ionization chamber, in case the ionization chamber has a relatively large volume. Depends on the distance «source - ionization chamber» and the volume of the chamber	1	10	-	0.58
k_{120}	Difference in energy between the radiation used to calibrate the reference electrometer and the reference radiation used to calibrate	1	10	-	0.10
k_{130}	Beam inhomogeneity. A small ionization chamber determines the change in kerma power over the beam cross-sectional area	1	30	-	0.10
Standard uncertainty for types «A» and «B», %				(0.00 – 0.98)	(1.49 – 1.94)
Total standard uncertainty, %				(1.5 – 2.1)	
Degrees of variance effective number				(98 – 143)	
Expanded uncertainty, % (k = 2, P = 95 %)				(3.0 – 4.3)	

The expanded uncertainty is obtained by multiplying the combined standard uncertainty by a coverage factor k = 2 corresponding to a confidence interval of approximately 95 % assuming a normal distribution. The evaluation of uncertainty is conducted according to the «Guide to the expression of uncertainty in measurement (GUM)».

Signature of the person who has performed the calibration _____ (signature) Valiantsin Zubarau (decryption of signature)

ANNEX «A»

to the calibration protocol
(mandatory application)

Additional information

A1. Diameters of UDG-PM9000 calibration facility for gamma radiation beams, non-uniformity less than ±3.0 %:

- for collimator № 1 at 2.0 m distance from center of active part of a source to operating point – 0.60 m;
- for collimator № 2 at 1.0 m distance from center of active part of a source to operating point – 0.14 m;
- for collimator № 3 at 2.0 m distance from center of active part of a source to operating point – 0.60 m.

A2. Calculation of air kerma rates at the distances, which are not specified in the tables, is recommended to carry out taking into account the values for the closest distance, which is specified in the tables, and using the inverse square law. In this case it is also necessary to take into account air attenuation of gamma radiation. The recommended values for linear air attenuation coefficients at 20 °C air temperature and 101.3 kPa air pressure, are:

- $22.577 \cdot 10^{-3}$ m^{-1} (for ^{241}Am);
- $9.332 \cdot 10^{-3}$ m^{-1} (for ^{137}Cs);
- $6.848 \cdot 10^{-3}$ m^{-1} (for ^{60}Co).

A3. The recommended half-life periods of radionuclides:

- 1925.19 days (for ^{60}Co)*;
- 10975.5 days (for ^{137}Cs)*;
- 158004 days (for ^{241}Am)*.

* - *reference data are given in the document «Monographie BIPM-5 – Table of radionuclides».*

A4. Transition from air kerma rate to ambient dose equivalent rate $\dot{H}^*(10)$ and personal dose equivalent rate $\dot{H}_p(10)$ of gamma radiation is recommended to carry out using conversation coefficients specified in the document ISO 4037-3:2019:

$$\dot{H}^*(10) = h^*(10)_K \cdot \dot{K}_a \qquad \dot{H}_p(10) = h_p(10)_K \cdot \dot{K}_a$$

where:

$h^*(10)_K$ = 1.16 Sv/Gy	and	$h_p(10)_K$ = 1.15 Sv/Gy	- for ^{60}Co
$h^*(10)_K$ = 1.21 Sv/Gy	and	$h_p(10)_K$ = 1.21 Sv/Gy	- for ^{137}Cs
$h^*(10)_K$ = 1.74 Sv/Gy	and	$h_p(10)_K$ = 1.89 Sv/Gy	- for ^{241}Am

Signature of the person who has performed the calibration _____ (signature) Valiantsin Zubarau (decryption of signature)

Signature of the person who has checked the calibration protocol _____ (signature) Sergey Sergeev (decryption of signature)

End of protocol

1) Partial reproduction of the protocol is not allowed without the permission of Polimaster Ltd.
2) Calibration results apply only to the calibration objects specified in the protocol.

Республиканское унитарное предприятие
«БЕЛОРУССКИЙ ГОСУДАРСТВЕННЫЙ ИНСТИТУТ МЕТРОЛОГИИ»
(БелГИМ)
Republican unitary enterprise «Belarussian state institute of metrology» (BelGIM)

Свидетельство о калибровке
Calibration certificate

СТБ ISO 9001

БГЦА	BY/112 5.0100 ГОСТ ISO/IEC 17025
BSCA	

Номер свидетельства / Certificate number: BY 01 № 607 - 48
Дата калибровки / Date when calibrated: с 06.10.2021 по 08.10.2021
Страница / Page: 1 из / of 3

Объект калибровки / Item calibrated: Дозиметр клинический серии PTW UNIDOS^{webline} type T10021 №000759 с ионизационными камерами TM32002 №000498, TM32003 №000163 и TM32005 №000097.
Наименование эталона / средства измерения / идентификация
Description of measurement standard / measuring instrument / identification

Заказчик / Customer: ООО «Полимастер», 220040, г. Минск, ул. Богдановича, 112-3и, каб. 53.
Информация о заказчике, адрес/ Name of the customer, address

Калибровочное клеймо-наклейка / Calibration mark: 072943
порядковый номер / serial number

Метод калибровки / Method of calibration: По мощности кермы в воздухе калибровка камер ионизационных выполнена в полях фотонного излучения от радионуклидных источников гамма-излучения (E_γ = 59,54 кэВ для ^{241}Am, E_γ = 661,66 кэВ для ^{137}Cs и E_γ = 1252,87 кэВ (средняя) для ^{60}Co) методом замещения в опорных точках эталонных ионизационных камер из состава Национального эталона кермы в воздухе и мощности кермы в воздухе НЭ РБ 7-01 в соответствии с методикой калибровки МРП МК 100055197.183-2021.
Наименование метода / идентификация
Name of the method / identification

Начальник отдела — Кийко А.Н. (Ф.И.О)
Дата выдачи / Date of issue: 11.10.2021

МП
Для документов

Свидетельство о калибровке
Calibration certificate

Номер свидетельства BY 01 № 607 - 48 Дата калибровки с 06.10.2021 по 08.10.2021 Страница 2 из 3
Certificate number Date when calibrated Page of

Калибровка выполнена с помощью
Calibration is performed by using

эталонного дозиметра клинического серии PTW UNIDOS^{webline} T10021 №000670 с ионизационными камерами TM32002 №0093 и Exradin A5 №XY150091, входящего в состав Национального эталона единицы кермы в воздухе и мощности кермы в воздухе НЭ РБ 7-01, имеющего прослеживаемость к Государственному первичному эталону единиц кермы в воздухе, мощности кермы в воздухе, экспозиционной дозы, мощности экспозиционной дозы и потока энергии рентгеновского и гамма-излучений ГЭТ 8-2019 Российской Федерации; эквивалентность НЭ РБ 7-01 подтверждена дополнительными сличениями COOMET №445/DE/08 (COOMET.RI(I)-S1 in KCDB).

Наименование эталонов и их статус / идентификация / доказательство прослеживаемости
Description of the reference measurement standards / identification / evidence of traceability

Условия калибровки
Calibration conditions

температура окружающей среды:	от 18,5 °C до 20,3 °C,
атмосферное давление:	от 100,5 до 101,4 кПа,
относительная влажность воздуха:	от 25,6 % до 47,4 %,
внешний радиационный фон:	не более 0,17 мкЗв/ч.

Условия окружающей среды и другие влияющие факторы
Environmental conditions and other influence parameters

Результаты калибровки, включая неопределённость
Calibration results including uncertainty

Калибровочные коэффициенты и значения расширенной неопределённости для ионизационной камеры **TM32002 №000498** (полярность, напряжение питания: **positive, 400 V**):

Качество излучения	Поддиапазон измерения	Энергия фотонного излучения E_γ, кэВ	Калибровочный коэффициент N_A, Гр/Кл	Расширенная неопределённость $U_r(N_A)$, %
S-Am	Low	59,54	$2{,}508 \cdot 10^4$	3,0
S-Cs	Low	661,66	$2{,}489 \cdot 10^4$	2,7
	Med		$2{,}500 \cdot 10^4$	2,7
S-Co	Low	1252,87	$2{,}460 \cdot 10^4$	2,7

Калибровочные коэффициенты и значения расширенной неопределённости для ионизационной камеры **TM32003 №000163** (полярность, напряжение питания: **positive, 400 V**):

Качество излучения	Поддиапазон измерения	Энергия фотонного излучения E_γ, кэВ	Калибровочный коэффициент N_A, Гр/Кл	Расширенная неопределённость $U_r(N_A)$, %
S-Cs	Low	661,66	$3{,}085 \cdot 10^3$	2,7
	Med		$3{,}093 \cdot 10^3$	2,7
S-Co	Low	1252,87	$3{,}031 \cdot 10^3$	2,8

Калибровочные коэффициенты и значения расширенной неопределённости для ионизационной камеры **TM32005 №000097** (полярность, напряжение питания: **positive, 400 V**):

Качество излучения	Поддиапазон измерения	Энергия фотонного излучения E_γ, кэВ	Калибровочный коэффициент N_A, Гр/Кл	Расширенная неопределённость $U_r(N_A)$, %
S-Cs	Low	661,66	$1{,}105 \cdot 10^6$	2,6
	Med		$1{,}101 \cdot 10^6$	2,6

Свидетельство о калибровке
Calibration certificate

Номер свидетельства BY 01 № 607 - 48 Дата калибровки с 06.10.2021 по 08.10.2021 Страница 3 из 3
Certificate number Date when calibrated Page of

Расширенная неопределенность получена путем умножения суммарной стандартной неопределенности на коэффициент охвата k =2, соответствующего уровню доверия приблизительно равному 95 % при допущении нормального распределения. Оценивание неопределенности проведено в соответствии с «Руководством по выражению неопределенности в измерениях (GUM)».

The expanded uncertainty is obtained by multiplying the combined standard uncertainty by a coverage factor k = 2 corresponding to a confidence interval of approximately 95 % assuming a normal distribution. The evaluation of uncertainty is conducted according to the «Guide to the expression of uncertainty in measurement (GUM)».

Дополнительная информация: межкалибровочный интервал (рекомендуемый) – не более 24 месяцев

Additional information

состояние объекта калибровки / регулировка и/или ремонт объекта калибровки до его калибровки /condition of the item of calibration / adjustments or repair of the item of calibration before calibrated/

Подпись лица, выполнившего калибровку — Ведущий инженер, Пархимчик А.О.

Signature of the person who has performed calibration — Должность, Ф.И.О \ Function, name

Подпись лица, выполнившего калибровку — Инженер 1-ой категории, Климченя В.А.

Signature of the person who has performed calibration — Должность, Ф.И.О \ Function, name

Место проведения калибровки Старовиленский тракт, 93, 220053, г. Минск / Starovilensky trakt, 93, 220053, Minsk, Belarus
Place of calibration Тел /Phone.: 354-65-04; факс/ fax: 244-99-38 , e-Mail: info@belgim.by