

CALIBRATION CERTIFICATE

No. 21000xxxx



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Calibration Object

Radiation Dosimeter
Electrometer [REF] TM10052 [SN] 180xxx

Detector [REF] TM31021 [SN] 143xxx
Detector Type Ionization Chamber

Manufacturer PTW-Freiburg

Customer Customer name + address

Order No. AU200xxxx
Order Date 2020-11-11



Calibration Results

Measuring Quantity Absorbed Dose to Water (D_w)
Detector Calibration Factor $N_{D,w} = 5.799 \cdot 10^8 \text{ Gy / C}$
Electrometer Calibration Factor $k_{elec} = 1.000 \pm 0.50 \%$

Beam Quality Correction	Beam Quality	Correction Factor k_Q	Uncertainty
	^{60}Co	1.000	1.1 %

Reference Conditions
Beam Quality: ^{60}Co
Temperature: 293.2 K (20°C)
Air Pressure: 1013.25 hPa
Relative Humidity: 50%
Chamber Voltage / Polarity: + 400 V
Potential at the chamber thimble: + 400 V
Potential at the Central Electrode: 0 V
Ion Collection Efficiency: 100 %

Calibration Date **2021-01-01**

Freiburg, 2021-01-13

PTW-Freiburg
Physikalisch-Technische
Werkstätten Dr. Pychlau GmbH

Calibration Conditions and Set-up

Climatic Conditions	Temperature Range: (294.2 ± 3) K / (21 ± 3) °C Air Pressure Range: (1000 ± 50) hPa Rel. Humidity Range: (40 ± 20) %																						
Beam Quality and Geometry	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">Quality</th> <th style="text-align: left;">Filter [mm]</th> <th style="text-align: left;">HVL [mm]</th> <th style="text-align: left;">SDD [cm]</th> <th style="text-align: left;">Size [cm]</th> </tr> </thead> <tbody> <tr> <td>⁶⁰Co</td> <td style="text-align: center;">-</td> <td style="text-align: center;">-</td> <td style="text-align: center;">100</td> <td style="text-align: center;">10 x 10</td> </tr> </tbody> </table> <table border="0" style="width: 100%;"> <tr> <td style="width: 30%;">Quality:</td> <td>Beam qualities according to DIN 6809-5 / DIN 6809-4</td> </tr> <tr> <td>Filter:</td> <td>Total filtration (inherent and additional filters)</td> </tr> <tr> <td>HVL:</td> <td>Half value layer at the point of measurement</td> </tr> <tr> <td>SDD:</td> <td>Distance between radiation source and reference point</td> </tr> <tr> <td>Size:</td> <td>Field size at reference point, diam. = Field Diameter</td> </tr> <tr> <td>Reference depth:</td> <td>5 g cm⁻² H₂O</td> </tr> </table>	Quality	Filter [mm]	HVL [mm]	SDD [cm]	Size [cm]	⁶⁰ Co	-	-	100	10 x 10	Quality:	Beam qualities according to DIN 6809-5 / DIN 6809-4	Filter:	Total filtration (inherent and additional filters)	HVL:	Half value layer at the point of measurement	SDD:	Distance between radiation source and reference point	Size:	Field size at reference point, diam. = Field Diameter	Reference depth:	5 g cm ⁻² H ₂ O
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Detector Arrangement	Chamber axis perpendicular to radiation beam axis Line on chamber stem faced towards the radiation source Reference point position at stated measuring depth / distance to the radiation source (For further information see manual and data sheet of detector.)																						
Dose and Dose Rate	Absorbed Dose To Water : min.: 5.0 · 10 ⁻² Gy / max.: 5.0 Gy Absorbed Dose To Water rate : min.: 50 mGy/min / max.: 300 mGy/min																						
Polarity Effect	≤ 0.80 % (not accounted for in the detector calibration factor)																						
Saturation Correction Factor	k _S = 1.000																						
Leakage	Negligible during calibration																						

Remarks

1. The uncertainty stated corresponds to the double standard deviation (k=2). The standard deviation was calculated according to ISO GUM from the partial uncertainties arising from the standard used, the calibration procedure, the environmental conditions and short time effects of the object of measurement. The uncertainties stated are composed of the uncertainties of the calibration procedure and those of the specimen during calibration. A share for the long-term instability of the object under calibration is not included.
2. The calibration is traceable to national standards of the German National Laboratory, PTB, Braunschweig. This calibration certificate may not be reproduced other than in full except with the permission of the issuing laboratory. This certificate is valid only with the ionization chamber showing the intact sticker with the certificate number. Calibration factors of chambers having been opened for repair are not comparable to previous calibrations. Calibration certificates without signature are not valid.
3. Please take note of the polarity definition by the electrometer manufacturer. For PTW electrometers the voltage to be set is equal to the chamber voltage value.
4. The components of the calibration object fully comply with the respective specifications given in the data sheet and user manual.
5. The calibration factor presented in this certificate can be equally used for Absorbed-Dose-To-Water determination with dosimetry protocols IAEA TRS 398, AAPM TG-51 and DIN 6800-2. However, it must be guaranteed that the reference temperature given in this certificate is in agreement with the reference temperature of the chosen dosimetry protocol. In the case of disagreement of reference temperatures an appropriate correction of the presented calibration factor with respect to the dosimetry protocols reference temperature must be applied.