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PAPER

Conversion coefficients from total air kerma to the newly proposed ICRU/ICRP operational quantities for radiation protection for photon reference radiation qualities

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Abstract

The International Commission on Radiation Units and Measurements (ICRU) has recently proposed a set of new operational quantities for radiation protection. ICRU supplied conversion coefficients for mono-energetic photons but not for photon reference radiation qualities defined by the International Organization for Standardization (ISO) in ISO 4037 and by the International Electrotechnical Commission (IEC) in IEC 61267. Therefore, in this work, conversion coefficients from total air kerma to the newly proposed operational quantities are averaged for photon reference radiation qualities. Also, parameters necessary to determine the influence of the air density on the conversion coefficients are determined. Finally, the impact of the newly proposed quantities upon the response of dosemeters is investigated.

1. Introduction

In its report number 57 on operational quantities used in radiological protection [1], the International Commission on Radiation Units and Measurements (ICRU) published conversion coefficients for those quantities for mono-energetic particles (photons, electrons, and neutrons). However, over the years, ICRU has developed new definitions of operational quantities in radiation protection and has published corresponding values of conversion coefficients from fluence to the newly proposed quantities for mono-energetic particles of several types (photons, electrons, neutrons, and others) as well as conversion coefficients from total air kerma to the new quantities for photons [2–4]. The corresponding report ICRU 95 has been jointly published by ICRU and ICRP (International Commission on Radiological Protection) in 2020 [5].

In this work, data for spectrum averaged conversion coefficients from total air kerma to the new quantities are calculated for the x- and gamma radiation qualities defined by the international standards ISO 4037 [6–9] and IEC 61267 [10], using the methods described earlier [11] to determine the corresponding conversion coefficients for the current operational quantities according to ICRU 57 [1]. Furthermore, the influence of the air density on the spectral distributions and consequently on the conversion coefficients is determined by applying the exponential attenuation law for photons to the spectra. Subsequently, the conversion coefficients are calculated for air densities from $\rho = 0.96$ kg m^{-3} to $\rho = 1.32$ kg m^{-3} (i.e. -20 % to $+10$ % from reference air density, $\rho_{\mathrm{ref}} = 1.1974$kg m^{-3}, covering the range of standard test conditions recommended by ISO [8]) to obtain the corresponding correction factors for the conversion coefficients that have been calculated [12].

As mentioned above, the same methods described in earlier publications of one of the authors are used and only the conversion coefficients for mono-energetic particles for the newly proposed operational quantities are applied instead of those according to ICRU 57. Therefore, several formulas and descriptions have been adopted from the author's previous publications [11, 12].

2. Quantities considered

The new operational quantities are as follows [5]:
• estimates of the effective dose for the protection against stochastic effects and, accordingly, in the unit Sv:

* ambient dose, H^*, and
* personal dose, H_p, depending on the direction of incidence, Ω;

• estimates of the dose to the lens of the eye for the protection against the tissue effects (often deterministic) and, accordingly, in the unit Gy:

* directional absorbed dose in the lens of the eye, $D'_\mathrm{lens}(\Omega)$, depending on, Ω,
* personal absorbed dose in the lens of the eye, $D_\mathrm{p\,lens}$, depending on Ω;

• estimates of the dose to local skin for the protection against the tissue effects (often deterministic) and, accordingly, in the unit Gy:

* directional absorbed dose in local skin, $D'_\mathrm{local\,skin}(\Omega)$, depending on Ω, defined in a slab,
* personal absorbed dose in local skin, $D_\mathrm{p\,local\,skin}$, depending on Ω, for the trunk of the body defined in a slab,
* personal absorbed dose in local skin, $D_\mathrm{p\,local\,skin}$, depending on Ω, for the extremities defined in a pillar,
* personal absorbed dose in local skin, $D_\mathrm{p\,local\,skin}$, depending on Ω, for the finger defined in a rod.

The corresponding values of conversion coefficients from total air kerma, K_a, to these quantities are denoted accordingly with small symbols instead of capital ones, i.e. $h^*{}_K = H^*/K_\mathrm{a}$ and $h_{\mathrm{p}K} = H_\mathrm{p}/K_\mathrm{a}$ for example.

The numerical values of conversion coefficients for $d'_{\mathrm{lens}K}$ and $d_{\mathrm{p\,lens}K}$ are identical for the same particle type, energy and direction or angle of incidence. The symbol used is $d_{\mathrm{lens}K}$.

Accordingly, the numerical values of conversion coefficients for $d'_{\mathrm{local\,skin}\,K}$ and $d_{\mathrm{p\,local\,skin}\,K}$, the latter for exposure of the slab phantom, are identical for the same particle type, energy and direction or angle of incidence. The symbol used is $d_{\mathrm{local\,skin}\,K}$.

For $d_{\mathrm{local\,skin}\,K}$, additional indices describe the calibration phantom considered: $d_{\mathrm{local\,skin}\,K\,\mathrm{slab}}$, $d_{\mathrm{local\,skin}\,K\,\mathrm{pillar}}$ and $d_{\mathrm{local\,skin}\,K\,\mathrm{rod}}$ denote the quantity $D_\mathrm{p\,local\,skin}$ on the slab, the pillar and the rod respectively.

Finally, table 1 shows an overview of all quantities for which values are determined in this work.

All values presented in this paper are based on data calculated using the kerma-approximation method, i.e. during an irradiation charged particle equilibrium must be assured, e.g. by placing a sufficiently thick plate made of polymethyl methacrylate (PMMA) in front of the object to be irradiated. For details, see ISO 4037–3 [8].

3. Conversion coefficients

3.1. Calculation of spectrum averaged conversion coefficients

Spectrum averaged values of the conversion coefficients, $c_K(E_i;\alpha)$, from total air kerma to quantity C for radiation quality R are obtained by averaging the spectra with the corresponding conversion coefficients for msono-energetic photons. The spectra are available in binned form and the averaging is performed by a sum over all bins:

$$c_K(\mathrm{R};\alpha) = \frac{\sum_{i=1}^{N}\{\Phi(\mathrm{R};E_i)\cdot k_\Phi(E_i)\cdot c_K(E_i;\alpha)\}}{\sum_{i=1}^{N}\{\Phi(\mathrm{R};E_i)\cdot k_\Phi(E_i)\}} \tag{1}$$

where N is the number of energy channels of the spectrum,

$\Phi(\mathrm{R};E_i)$ is the spectral fluence of the radiation quality R, at photon energy E_i.

$c_K(E_i;\alpha)$ is the conversion coefficient from total air kerma to the operational quantity calculated using the kerma-approximation method at photon energy E_i.

$k_\Phi(E_i)$ is the conversion coefficient from photon fluence to total air kerma for photon energy E_i given by $k_\Phi(E_i) = K_\mathrm{a}/\Phi = (\mu_\mathrm{en}/\rho)\cdot E_i/(1-g)$ with the energy absorption coefficient, (μ_en/ρ), and fraction of radiative losses in air, g, for energy E_i. The values for (μ_en/ρ) are from the literature [14, 15] with renormalized Scofield photoeffect cross sections from ICRU report 90 [13] and actual values for g [16]. These values for

Table 1. Symbols used for the conversion coefficients and further quantities.

Quantity	Physical identity	Name of conversion coefficient
h^*_K	H^*/K_a	Total air kerma to ambient dose
$h_{pK}(\alpha)$	$H_p(\alpha)/K_a$	Total air kerma to personal dose
$d_{lensK}(\alpha)$	$D'_{lens}(\alpha)/K_a = D_{p\,lens}(\alpha)/K_a$	Total air kerma to directional absorbed dose in the lens of the eye total air kerma to personal absorbed dose in the lens of the eye
$d_{local\ skin\ K}(\alpha)_{slab}$	$D'_{local\ skin}(\alpha)/K_a = D_{p\,local\ skin}(\alpha)/K_a$	Total air kerma to directional absorbed dose in local skin total air kerma to personal absorbed dose in local skin on the slab phantom
$d_{local\ skin\ K}(\alpha)_{pillar}$	$D_{p\,local\ skin}(\alpha)/K_a$	Total air kerma to personal absorbed dose in local skin on the pillar phantom
$d_{local\ skin\ K}(\alpha)_{rod}$	$D_{p\,local\ skin}(\alpha)/K_a$	Total air kerma to personal absorbed dose in local skin on the rod phantom
k_Φ	K_a/Φ	Fluence to total air kerma
$(1-g)$		One minus the fraction of radiative losses in air
$\left(\frac{\mu_{en,\ not\_renorm.}}{\mu_{en,renorm.}}\right)$		Energy absorption coefficient based on not renormalized photoeffect cross sections divided by energy absorption coefficient based on renormalized photoeffect cross sections (taken from ICRU 90 [13])

Table 2. Sources for the spectra used.

Type of radiation quality	Radiation qualities and abbreviation[a]	Source of spectra
X radiation qualities with high voltages up to 300 kV	Low air kerma rate series: L-10 up to L-240 Narrow spectrum series: N-10 up to N-300 Wide spectrum series: W-60 up to W-300 High air kerma rate series: H-10 up to H-300	Catalogue of x-ray spectra [17]
X radiation qualities with high voltages above 300 kV	Narrow spectrum series: N-350 up to N-400 High air kerma rate series: H-350 up to H-400	Ankerhold [18]
Gamma radiation qualities from radioactive sources	Photons from ^{137}Cs and ^{60}Co: S-Cs and S-Co	EGSnrc code package [19]
Gamma radiation qualities from nuclear reactions	Photons from the de-excitation of ^{12}C and ^{16}O: R-C and R-F	Behrens *et al* [20]
X radiation qualities used for medical diagnostics with high voltages up to 150 kV	RQR qualities according to IEC 61267 [10]: RQR-2 up to RQR-10	Büermann [21]

[a] Where available, the abbreviations are taken from ISO 4037–1 [7], otherwise from the corresponding reference given in col. 3.

$k_\Phi(E_i)$ deviate from those presumed in ISO 4037 [5–7] as there, no renormalized photoeffect cross sections were used while in the new ICRU/ICRP report and, therefore, also in this paper, renormalized cross sections are used. For that reason and for information purposes, the value $(1-g)$ and the ratio $(\mu_{en,not\_renormalized}/\mu_{en,renormalized})$ have also been determined and are given in the results section.

The sources of the x and gamma radiation spectra, $\Phi(R;E_i)$, are given in table 2. All data for $c_K(E_i;\alpha)$ as well as for $k_\Phi(E_i)$ are taken for mono-energetic photons from the new ICRU/ICRP report 95 [5]: the data for $c_K(E_i;\alpha)$ and $k_\Phi(E_i)$ are taken from the new ICRU/ICRP report, all calculated using the kerma-approximation method. In the cases of h^*_K and $h_{pK}(\alpha)$ below 10 keV, the data determined not using the kerma-approximation method are used as no data using the kerma- approximation method were available and the conversion coefficients $h^*_K(E_i)$ and $h_{pK}(E_i;\alpha)$ are assumed to smoothly tend to zero at 3 keV. Furthermore, for $d_{local\ skin\ K}(E_i;\alpha)_{slab}$ below 10 keV the data determined for the pillar phantom are used as no data were available for the slab. Both methods are justified as for these photon energies the size of the backscattering phantom is not relevant as long as it exceeds the continuous slowing down approximation (CSDA) range of secondary electrons which is approximately 2.5 μm in tissue for 10 keV electrons. Furthermore, corresponding data for 10 keV deviate by less than 1 %, i.e. the data for $h^*_K(E_i)$ and $h_{pK}(E_i;\alpha)$ with and without the kerma- approximation method as well as the data for $d_{local\ skin\ K}(E_i;\alpha)_{slab}$ and $d_{local\ skin\ K}(E_i;\alpha)_{pillar}$ at 10 keV deviate less than 1 %.

The following interpolation methods are used to obtain values for photon energies E_i between the discrete photon energies:

• for $h^*{}_K(E_i)$ and $h_{pK}(E_i;\alpha)$, for all energies, a natural cubic spline interpolation is used;
• for all other conversion coefficients $c_K(E_i;\alpha)$ a natural cubic spline interpolation is used up to 100 keV photon energy and above 100 keV a linear-logarithmic interpolation, i.e. a straight line in a linear-logarithmic diagram is used in order to avoid oscillations;
• for $k_\Phi(E_i)$ a logarithmic-logarithmic interpolation, i.e. a straight line in a double logarithmic diagram is used, except between 50 keV and 80 keV a natural cubic spline interpolation is used in order to better follow the curvature.

The fluence spectra used, see table 2, partly contain negative fluence values due to small oscillations of the deconvolution at photon energies where the real fluence usually is zero. These negative fluences are not set to zero but fully considered as they balance with corresponding fluence at similar photon energies and as they do not significantly contribute to the sums in equation (1) [17].

3.2. Validation of the calculations

In order to make sure the interpolations and averaging of the spectra are properly achieved, both authors have determined corresponding values of conversion coefficients independently. The corresponding results are numerically equal apart from minor rounding effects well below 1 % or in the last significant digit and can be neglected; in conclusion, the differences are well within the uncertainties stated in the tables of results, see below.

Conversion coefficients for the ambient dose, $h^*{}_K(\mathrm{R})$, as well as for the personal dose for different incident directions α, $h_{pK}(\mathrm{R};\alpha)$ in a calibration distance of 1 m, here reported in table A2, are numerically equal to a previous publication [22] in which the mono-energetic conversion coefficients calculated with full electron transport from [5] were used. At photon energies below 400 keV this choice yields no noticeable difference in the results.

3.3. Results

The resulting values for the conversion coefficients, $c_K(\mathrm{R};\alpha)$, as well as the fluence weighted mean energy, $E(\mathrm{R})$, the kerma coefficient, $k_\Phi(\mathrm{R})$, the radiative loss correction in air, $(1-g)(\mathrm{R})$, and the ratio $(\mu_{\mathrm{en,not\_renormalized}}/\mu_{\mathrm{en,renormalized}})(\mathrm{R})$ are listed in appendix A in tables (A1)–(A7) for a distance of 1.0 m between the radiation source and the point of test and in appendix B in tables (B1)–(B7) for a distance of 2.5 m. In tables B1–B7, i.e. for a distance of 2.5 m, values are only given in case they deviate from those at 1.0 m by more than 0.2 %. This is also the case for the mean energies. The deviations occur because the additional air path of 1.5 m results in scattering and absorption of—especially low energy—photons. This, in turn, hardens the photon spectra, i.e. the mean energy increases. Significant deviations occur at small energies and at large angles of incidence. This is due to the fact that here the conversion coefficients $c_K(E_i;\alpha)$ or $k_\Phi(E_i)$ strongly depend on the photon energy.

From the tables, it is obvious that the data for $h^*{}_K$ and $h_{pK}(0°)$ are equal as the corresponding values for mono-energetic photons are equal. Anyway, two separate columns are given for these quantities in tables (A2) and (B2) to clearly demonstrate that these different quantities have the same values.

The shape of the x-ray spectra affects the actual value of the conversion coefficient, (especially below 30 kV tube voltage). Therefore, before applying the values, it must be ensured that the spectra used in the laboratory that is willing to apply the values from this work are sufficiently similar to the ones used in this work, see table 2, i.e. matched reference radiation fields according to ISO 4037 are used. For matched fields a laboratory needs to operate their facility using the exact conditions given in clause 4 of ISO 4037–1 [6] like the high voltage and inherent filtration of the x-ray tube, the additional filtration and others. Otherwise, the laboratory needs to determine the conversion coefficients for their own spectra either by determining the conversion coefficients using spectrometry, or the required value is measured directly using secondary standard dosimeters, i.e. they use characterized reference radiation fields according to ISO 4037–1 [6]. The energy dependences of the conversion coefficients of the quantities considered in this work are different to those of the quantities treated in ISO 4037–1. Therefore, the exact requirements for the high voltage, inherent tube filtration and additional filtration to produce the x-ray spectra may deviate from the requirements given in ISO 4037–1. Further details can be found in subsection 4.2 of ISO 4037–1. Alternatively, x-ray spectrometry needs to be undertaken and the conversion coefficients to be determined by applying equation (1), i.e. characterized reference radiation fields according to ISO 4037 are used. Details and hints regarding spectrometry can be found in ISO 4037–4 [9].

Figures (1)–(3) show the conversion coefficients from total air kerma to three different dose quantities. Data are shown for the mono-energetic photons taken from ICRU [5] and interpolated as described in the bullets in subsection 3.1, plotted as lines, as well as data for radiation qualities, plotted as symbols at the mean energies of the corresponding spectra, averaged according to equation (1). Data for normal radiation incidence ($\alpha = 0°$) as well as for rotational incidence (ROT) are presented. The different radiation qualities have different degrees of filtration with decreasing filter thickness from the L, N, W, H to the RQR series, see figure 4. Thus, the spectra of the L series are narrowest, i.e. similar to mono-energetic photons, while the spectra of the RQR series are broadest. The spectra of the S and R series are dominated by one or a few mono-energetic photon energies. Thus, as expected, the values for the L, S and R series lie almost on the lines for mono-energetic photons, while the values for the N, W, H and RQR series lie further below the lines the less filtration the series have, i.e. the broader the corresponding spectra are. The reason for this is, especially for broad spectra like the RQR series, that the conversion coefficients for mono-energetic photons from the left and right of the spectrum's mean energy contribute to the averaging according to equation (1) and lead to lower mean values, see e.g. the curve for $\alpha = 0°$ in figure 1. If the values for mono-energetic photons are not strongly dependent on energy (see e.g. the curve for $\alpha = 0°$ in figure 3), the averaging according to equation (1) does not lead to significantly lower values than for mono-energetic photons. Therefore, almost all symbols in figure 3 nearly match the lines. Thus, the corresponding conversion coefficient, in this case $d_{\text{local skin }K}(0°)_{\text{rod}}$, can be approximated by the value for the respective spectrum's mean energy. This is not the case if the values for mono-energetic photons strongly depend on the energy, see e.g. Figure 1.

3.4. Values for air kerma, K_a, and conversion coefficients to the operational quantities, c_K: ICRU 90 vs ISO 4037

To be clear: the values for air kerma, K_a, the kerma coefficient, k_Φ, and the conversion coefficients, c_K, according to this work are based on total air kerma according to ICRU 90 [13], $K_{\text{a,ICRU90}}$, i.e., using renormalized cross sections for the mass energy absorption coefficients or air, (μ_{en}/ρ). However, in the current version of ISO 4037-3 [8] all values are based on not renormalized cross sections and total air kerma, $K_{\text{a,total}}$. What is even more different is that in the outdated but still often used version of ISO 4037-3 as of 1999, all values are based on collision air kerma, $K_{\text{a,col}}$, and also on not renormalized cross sections.

To obtain $K_{\text{a,ISO2019}}$ and $c_{K,\text{ISO2019}}$, alternative values which are compatible with the values in ISO 4037-3 [8], from the values for $K_{\text{a,ICRU90}}$ and $c_{K,\text{ICRU90}}$ stated in this work the following equations need to be used:

$$K_{\text{a,ISO2019}} = K_{\text{a,ICRU90}} \cdot k_{\text{ISO2019,ICRU90}} \quad \text{and} \quad c_{K,\text{ISO2019}} = \frac{c_{K,\text{ICRU90}}}{k_{\text{ISO2019,ICRU90}}}$$

with $k_{\text{ISO2019,ICRU90}} = \dfrac{K_{\text{a,total}}}{K_{\text{a,ICRU90}}} = \dfrac{\left(\frac{\mu_{\text{en}}}{\rho}\right)_{\text{not\_renormalized}}}{\left(\frac{\mu_{\text{en}}}{\rho}\right)_{\text{renormalized}}}$.

To obtain corresponding values which are compatible with the values in the outdated ISO 4037-3 as of 1999, the following equations need to be used:

$$K_{\text{a,ISO1999}} = \{K_{\text{a,ICRU90}} \cdot k_{\text{ISO2019,ICRU90}} \cdot (1-g)\}$$
$$\text{and} \quad c_{K,\text{ISO1999}} = \frac{c_{K,\text{ICRU90}}}{\{k_{\text{ISO2019,ICRU90}} \cdot (1-g)\}}$$

with g being the fraction of the kinetic energy transferred to charged particles that is subsequently lost on average in radiative processes (bremsstrahlung, in-flight annihilation, and fluorescence radiations) as the charged particles slow to rest in the material (air) [13].

Thus, of course, the values for the operational quantities, C, are independent of the scheme used, be it according to ICRU90, ISO1999 or ISO2019 as the corresponding corrections cancel each other out during the multiplication leading to the operational quantity:

$$C = K_a \cdot c_K$$

with C either being H or D.

3.5. Impact of the newly proposed quantities

The impact of the newly proposed quantities is investigated by the calculation of the ratio of the conversion coefficients for the newly proposed and the current operational quantities, see figure 5. This ratio represents the response of a dosemeter with respect to the newly proposed quantities while the dosemeter is assumed to have an ideal response of unity with respect to the current quantities.

From the top of figure 5 it is obvious that, for whole body and area dosemeters, a simple change of the calibration factor can be sufficient (depending on the dosemeter's response with respect to the current quantities) to fulfill at least the minimum performance requirements according to IEC 62387 [23] or IEC 61526 [24], i.e. a response within 0.71 and 1.67 between 80 keV and 1.25 MeV; possibly even between about 50 keV and 7 MeV.

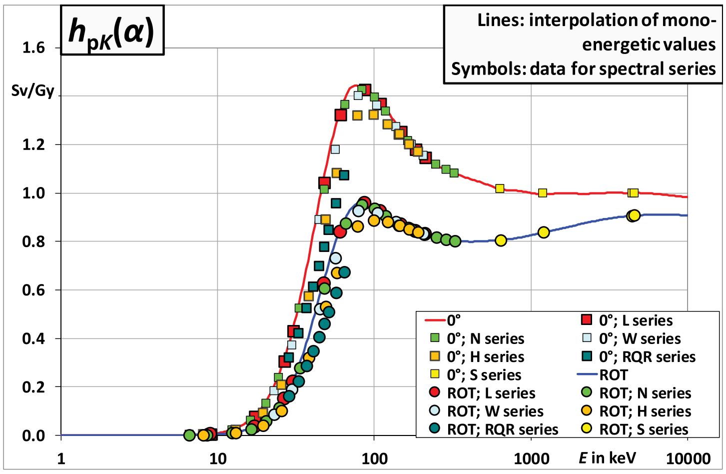

Figure 1. Conversion coefficients from total air kerma to personal dose for normal radiation incidence ($\alpha = 0°$, red upper curve) as well as for rotational incidence (ROT, blue lower curve) for mono-energetic values taken from ICRU [5], interpolated as described in the text, lines, as well as values averaged over radiation qualities, symbols.

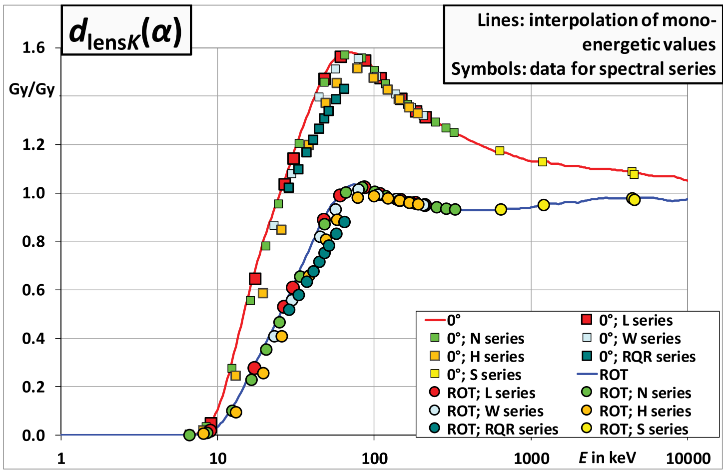

Figure 2. Conversion coefficients from total air kerma to directional and personal absorbed dose in the lens of the eye for normal radiation incidence ($\alpha = 0°$, red upper curve) as well as for rotational incidence (ROT, blue lower curve) for mono-energetic values taken from ICRU [5], interpolated as described in the text, lines, as well as values averaged over radiation qualities, symbols.

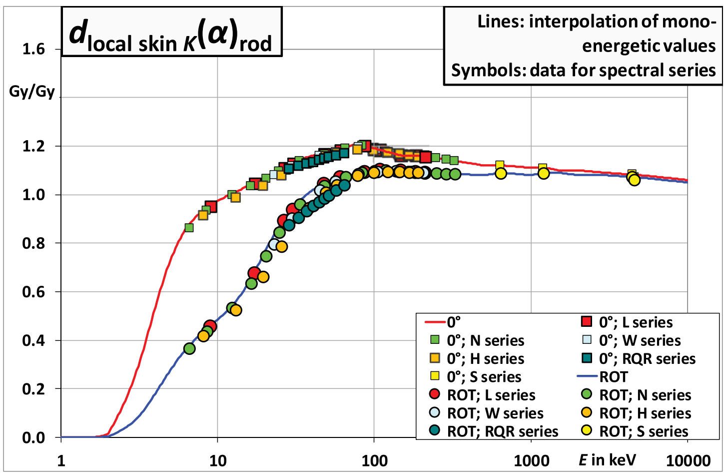

Figure 3. Conversion coefficients from total air kerma to personal absorbed dose in local skin on the rod phantom for normal radiation incidence ($\alpha = 0°$, red upper curve) as well as for rotational incidence (ROT, blue lower curve) for mono-energetic values taken from ICRU [5], interpolated as described in the text, lines, as well as values averaged over radiation qualities, symbols.

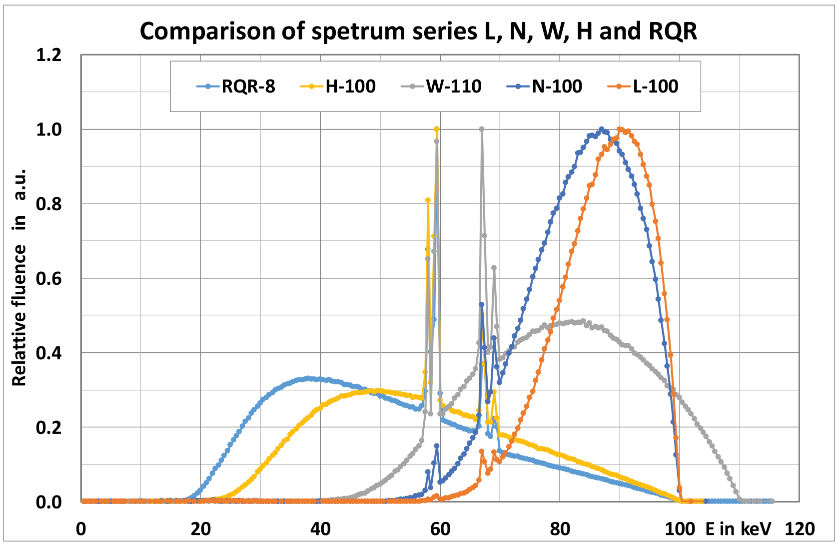

Figure 4. Comparison of spectra of the L, N, H, W and RQR series with 100 keV endpoint energy (only in the W series 100 keV endpoint energy is not available, therefore, 110 keV was chosen). The degree of filtration is largest for the L series and smallest for the RQR series [17, 21].

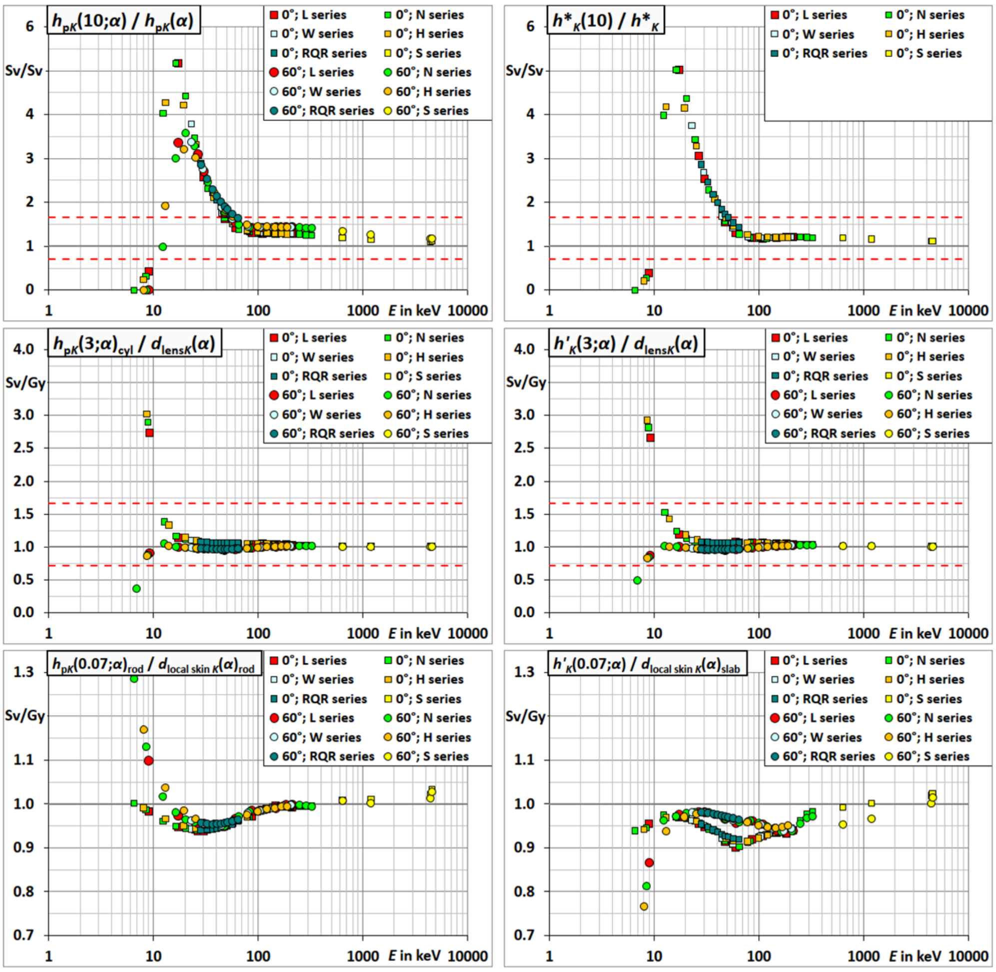

Figure 5. Ratio of conversion coefficients for the current operational quantities and the newly proposed for personal dose, top, absorbed dose in the lens of the eye, middle, and absorbed dose in local skin, bottom. On the left the quantities for individual monitoring and on the right the quantities for area monitoring are treated. This ratio represents the response of a dosemeter with respect to the newly proposed quantities while the dosemeter is assumed to have an ideal response of unity with respect to the current quantities. The data for the current quantities were taken from ISO [8] and, for very low energies, from the corresponding references in ISO [11, 17]. Grey line: unity; dashed red lines: response limits according to IEC 62387 [23] or IEC 61526 [24]

The middle part of figure 5 shows that, for eye lens dosemeters, above about 13 keV possibly no change of the calibration factor is required to fulfill the relevant IEC standard.

The bottom part of figure 5 reveals that, for local skin dosemeters, possibly no change is necessary at all. The strong difference between the graphs for $h_{pK}(0.07;\alpha)_{\mathrm{rod}}/d_{\mathrm{local\ skin}\ K}(\alpha)_{\mathrm{rod}}$ and $h'_K(0.07;\alpha)/d_{\mathrm{local\ skin}\ K}(\alpha)_{\mathrm{slab}}$ below about 20 keV have their reason in different interpolation methods used for $h_{pK}(0.07;\alpha)_{\mathrm{rod}}$ and $h'_K(0.07;\alpha)$, see the corresponding references given in ISO 4037–3 [8].

For all types of dosemeters, the following applies: if one wants to reach a more or less perfect response, i.e. unity, or one wants to fulfill the relevant IEC standard in a broader energy range, or the dosmeter's response with respect to the current quantities is rather disadvantageous, either the algorithm to determine the dose from the detector's signal(s) or, more likely, the detector's housing and/or filter material will need to be changed.

4. Correction factors to account for air densities apart from the reference air density

4.1. Method

The spectrum of low energy photon radiation qualities depends on the air density during an irradiation as, for example, a larger air density results in more absorption and scattering between the radiation source (usually an x-ray tube) and the point of test. Therefore, the spectra of all radiation qualities with a mean energy below 40 keV are calculated for air densities from $\rho = 0.96$ kg m^{-3} to $\rho = 1.32$ kg m^{-3} by applying the exponential attenuation law for photons. As a basis, the spectra at reference conditions, i.e. at $\rho_{\mathrm{ref}} = 1.1974$ kg m^{-3}, are used. From the resulting spectra at different air densities the conversion coefficients $h(\rho)$ and $d(\rho)$ have been calculated. The corresponding correction factor is given by

$$k(\rho, h) = \frac{h(\rho)}{h(\rho_{\mathrm{ref}})} \quad (2.1)$$

or

$$k(\rho, d) = \frac{d(\rho)}{d(\rho_{\mathrm{ref}})} \quad (2.2)$$

where ρ is the considered air density, ρ_{ref} is the reference air density, and $h(\rho_{\mathrm{ref}})$ or $d(\rho_{\mathrm{ref}})$ is the conversion coefficient calculated in the previous section, i.e. given in tables (A1)–(A7). The corresponding correction factor for the quantity total air kerma is

$$k(\rho, K_{\mathrm{a}}) = \frac{K_{\mathrm{a}}(\rho)}{K_{\mathrm{a}}(\rho_{\mathrm{ref}})} \quad (2.3)$$

The dependence of the conversion coefficients on the air density is approximately linear resulting in

$$k(\rho, h) = 1 + m(d_{\mathrm{air}})\cdot(\rho - \rho_{\mathrm{ref}}) \quad (3.1)$$

or

$$k(\rho, d) = 1 + m(d_{\mathrm{air}})\cdot(\rho - \rho_{\mathrm{ref}}) \quad (3.2)$$

where $m(d_{\mathrm{air}})$ is the slope for an air path d_{air} between the source and the point of test. For the quantity total air kerma, K_{a}, the following equation applies

$$k(\rho, K_{\mathrm{a}}) = 1 + m(d_{\mathrm{air}})\cdot(\rho - \rho_{\mathrm{ref}})\cdot(1 - \frac{d_{\mathrm{MC}}}{d_{\mathrm{air}}}) \quad (3.3)$$

where d_{MC} is the distance between the source and the monitor chamber to determine the total air kerma during an actual irradiation, see ISO 4037–2 [8].

The slope for both the total air kerma and the conversion coefficient $m(d_{\mathrm{air}})$ depends approximately linearly on the distance d_{air}

$$m(d_{\mathrm{air}}) = m\,(1.0\ \mathrm{m}) + m_d\cdot\,(d_{\mathrm{air}} - 1.0\ \mathrm{m}) \quad (4)$$

where $m(1.0$ m$)$ is the slope for $d_{\mathrm{air}} = 1.0$ m and m_d is the slope of the slope $m(d_{\mathrm{air}})$.

From the parameters $m(1.0\ \text{m})$ and m_d, a correction factor for the air density during an irradiation, ρ_{irr}, finally results in (by inserting equation 6 into equation 5.1)

$$k\left(\rho_{\text{irr}}, h\right) = 1 + \left\{m(1.0\ \text{m}) + m_d\left(d_{\text{air}} - 1.0\ \text{m}\right)\right\} \cdot \left(\rho_{\text{irr}} - \rho_{\text{ref}}\right) \tag{5.1}$$

or

$$k(\rho_{\text{irr}}, d) = 1 + \left\{m(1.0\ \text{m}) + m_d \cdot \left(d_{\text{air}} - 1.0\ \text{m}\right)\right\} \cdot \left(\rho_{\text{irr}} - \rho_{\text{ref}}\right) \tag{5.2}$$

for the conversion coefficients h or d, and to (by inserting equation 6 into equations 5.2 or 5.3)

$$k(\rho_{\text{in}}, K_{\text{a}}) = 1 + \left\{m(1.0\ \text{m}) + m_d \cdot \left(d_{\text{air}} - 1.0\ \text{m}\right)\right\} \cdot \left(\rho_{\text{in}} - \rho_{\text{ref}}\right) \cdot \left(1 - \frac{d_{\text{MC}}}{d_{\text{air}}}\right) \tag{5.3}$$

for the total air kerma K_{a}. The approximation via the slopes $m(1.0\ \text{m})$ and m_d results in errors not larger than 1 % for the ranges of air densities specified in the tables of results (see below).

As the operational quantities are given by the product $H = K_{\text{a}} \cdot h$ or $D = K_{\text{a}} \cdot d$, the corresponding correction factor is given by the product of the two contributions:

$$k(\rho_{\text{irr}}, H) = k(\rho_{\text{irr}}, K_{\text{a}}) \cdot k(\rho_{\text{irr}}, h) \tag{6.1}$$

or

$$k(\rho_{\text{irr}}, D) = k(\rho_{\text{irr}}, K_{\text{a}}) \cdot k(\rho_{\text{irr}}, d) \tag{6.2}$$

The dose during an irradiation finally results from the dose under reference conditions in

$$K_{\text{a}}(\rho_{irr}) = k(\rho_{\text{irr}}, K_{\text{a}}) \cdot K_{\text{a}}(\rho_{\text{ref}}) \tag{7.1}$$

for total air kerma K_{a} and in

$$H(\rho_{\text{irr}}) = k(\rho_{\text{irr}}, H) \cdot H(\rho_{\text{ref}}) = k(\rho_{\text{irr}}, K_{\text{a}}) \cdot K_{\text{a}}(\rho_{\text{ref}}) \cdot k(\rho_{\text{irrr}}, h) \cdot h(\rho_{\text{ref}}) \tag{7.2}$$

or

$$D(\rho_{\text{irr}}) = k(\rho_{\text{irr}}, D) \cdot D(\rho_{\text{ref}}) = k(\rho_{\text{irr}}, K_{\text{a}}) \cdot K_{\text{a}}(\rho_{\text{ref}}) \cdot k(\rho_{\text{irr}}, d) \cdot d(\rho_{\text{ref}}) \tag{7.3}$$

for the operational quantity H or D. Further details and examples for the calculation of the correction factors were outlined in a previous publication [12]. Reproduced from [12] by permission of Oxford University Press.

4.2. Results for the factors to account for air densities apart from the reference air density

Some typical values of the correction factors, $k(\rho)$, are shown in figure 6. It can be seen that the correction of the influence of the ambient conditions is more important for the measurand air kerma, K_{a}, than for the quantity personal dose, H_{p}. This is due to the fact that the correction factor for the personal dose, $k(\rho, H_{\text{p}})$, results from the product of the correction factors for both, the quantity air kerma, $k(\rho, K_{\text{a}})$, and the conversion coefficient from air kerma to the personal dose, $k(\rho, h_{\text{p}K})$: $k(\rho, H_{\text{p}}) = k(\rho, K_{\text{a}}) \cdot k(\rho, h_{\text{p}K})$. As can be seen from figure 6, these two correction factors compensate in part. Furthermore, the correction factor is closer to unity the larger the spectrum's mean energy as the absorption and scattering of photons decreases with rising energy.

The parameters $m(1.0\ \text{m})$ and m_d to determine $m(d_{\text{air}})$ according to equation (4) are given for low energy photon reference radiation qualities in appendix C in tables (C1a)–(C7b) for the total air kerma, $K_{\text{a}}(\text{R})$, the kerma coefficient, $k_{\Phi}(\text{R})$, and the conversion coefficients, $c(\text{R};\alpha)$. The parameters are only given for those radiation qualities where the conversion coefficient itself is at least 0.0005 Sv Gy^{-1} or 0.0005 Gy Gy^{-1}, for h and d, respectively.

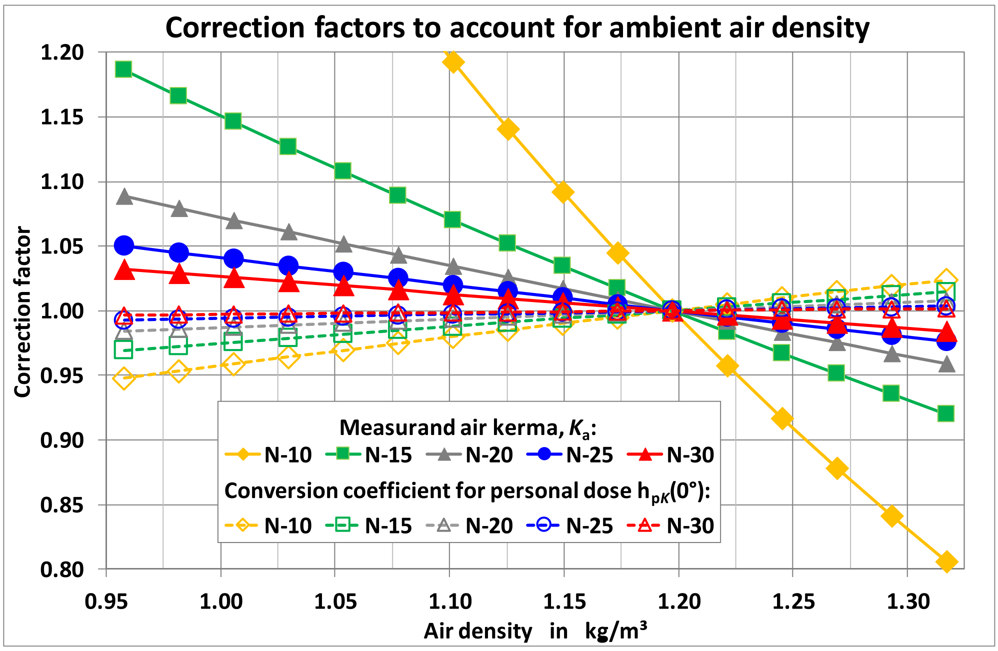

Figure 6. Dependence of the correction factors to account for air density, ρ, for some radiation qualities and for two different spectrum properties, see legend. The data are given for $d_{air} = 2.5$ m and $d_{MC} = 0.23$ m.

5. Summary

In this work, a complete data set necessary to perform accurate photon irradiations in terms of the newly proposed operational quantities in radiation protection is presented:

- conversion coefficients as well as correction factors for other radiation field characteristics, e.g. the mean energy or the total air kerma, ready for adoption in ISO 4037–3 [8] and
- correction factors for these conversion coefficients and radiation field characteristics to account for the actual air density during an irradiation, ready for adoption in ISO 4037–4 [9].
- Finally, the impact of the newly proposed quantities on the response of dosemeters is investigated for both individual and area monitoring as well as for normal and oblique radiation incidences.

All data are presented in the Appendices, see below. For convenience, the same data are available on the journal's website as supplementary data files in ASCII format compiled in a single zip file (available online at stacks.iop.org/JRP/42/011519/mmedia).

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Appendix A. Tabulated results for a distance of 1.0 m between the radiation source and the point of test

Table A1 provides data for the fluence weighted mean energy, E(R), the kerma coefficient (i.e. total air kerma using the divided by photon fluence), k_Φ(R), one minus radiative losses in air, $(1-g)$(R), and the ratio $(\mu_{en,not\_renormalized}/\mu_{en,renormalized})$(R) for reference radiation qualities R. Tables (A2)–(A7) provide data for the conversion coefficients, $c_K(\mathrm{R};\alpha)$, for the coefficients listed in table 1.

All values presented are based on data calculated using the kerma-approximation method, i.e. during an irradiation, charged particle equilibrium must be assured.

Appendix B. Tabulated results for a distance of 2.5 m between the radiation source and the point of test

Table B1 provides data for the fluence weighted mean energy, $E(\mathrm{R})$, the kerma coefficient, $k_{\Phi}(\mathrm{R})$, one minus radiative losses in air, $(1-g)(\mathrm{R})$, and the ratio $(\mu_{\mathrm{en,not\_renormalized}}/\mu_{\mathrm{en,renormalized}})(\mathrm{R})$ for reference radiation qualities R. Tables (B2)–(B7) provide data for the conversion coefficients $c_K(\mathrm{R};\alpha)$, for the coefficients listed in table 1. No data for the RQR radiation qualities are given for 2.5 m between the radiation source and the point of test as no corresponding spectra are available.

All values presented are based on data calculated using the kerma-approximation method, i.e. during an irradiation, charged particle equilibrium must be assured.

Appendix C. Tabulated parameters to determine the correction factors to account for air densities apart from reference air density

Tables (C1a)–(C7a) provide values for $m(1\ \mathrm{m})$ and tables (C1b)–(C7b) provide values for m_d for the determination of the air density correction, see equations (2) and following, as well as the corresponding text for details.

Table A1. Fluence weighted mean energy, $E(\mathrm{R})$, kerma coefficient, $k_\Phi(\mathrm{R})$, one minus radiative losses in air, $(1-g)(\mathrm{R})$, and the ratio $(\mu_{\mathrm{en,not\_renormalized}}/\mu_{\mathrm{en,renormalized}})(\mathrm{R})$ for photon reference radiation qualities, R. The values are valid for a distance of 1.0 m between the radiation source and the point of test.

	fluence weighted mean energy, $E(\mathrm{R})$	kerma coefficient, $k_\Phi(\mathrm{R})$	one minus radiative losses in air, $(1-g)(\mathrm{R})$	ratio $(\mu_{\mathrm{en,not\_renormalized}}/\mu_{\mathrm{en,renormalized}})(\mathrm{R})$
Radiation quality R	[keV]	[pGy cm^2]	[1]	[1]
L-10	8.99	9.41	0.9998	1.0270
L-20	17.33	2.377	0.9997	1.0260
L-30	26.66	0.944	0.9996	1.0246
L-35	30.43	0.728	0.9996	1.0239
L-55	47.8	0.3486	0.9995	1.0182
L-70	60.6	0.2928	0.9996	1.0123
L-100	86.8	0.3302	0.9996	1.0053
L-125	109.4	0.414	0.9995	1.0030
L-170	148.5	0.595	0.9995	1.0013
L-210	184.6	0.777	0.9994	1.0003
L-240	211.4	0.915	0.9993	1.0000
N-10	8.50	10.78	0.9998	1.0270
N-15	12.37	4.98	0.9997	1.0266
N-20	16.29	2.794	0.9997	1.0262
N-25	20.32	1.733	0.9996	1.0257
N-30	24.62	1.149	0.9996	1.0251
N-40	33.27	0.624	0.9996	1.0232
N-60	47.9	0.3577	0.9995	1.0183
N-80	65.2	0.2928	0.9996	1.0107
N-100	83.3	0.3211	0.9996	1.0059
N-120	100.4	0.3784	0.9996	1.0037
N-150	118.2	0.455	0.9995	1.0025
N-200	164.8	0.676	0.9994	1.0008
N-250	207.3	0.894	0.9993	1.0000
N-300	248.4	1.108	0.9992	1.0000
N-350	288.1	1.317	0.9991	1.0000
N-400	326.6	1.516	0.9990	1.0000
W-30	22.95	1.381	0.9996	1.0250
W-40	29.77	0.819	0.9996	1.0242
W-60	44.8	0.401	0.9995	1.0197
W-80	56.5	0.3232	0.9995	1.0148
W-110	79.1	0.3178	0.9996	1.0071
W-150	104.2	0.403	0.9995	1.0037
W-200	137.5	0.546	0.9995	1.0017
W-250	172.3	0.716	0.9994	1.0006
W-300	205.4	0.885	0.9993	1.0000
H-10	8.05	12.35	0.9998	1.0271
H-20	13.06	5.09	0.9997	1.0267
H-30	19.48	2.268	0.9997	1.0260
H-40	25.37	1.283	0.9996	1.0253
H-60	37.96	0.581	0.9996	1.0225
H-80	48.8	0.408	0.9996	1.0188
H-100	57.3	0.3555	0.9996	1.0154
H-150	78.0	0.3419	0.9996	1.0085
H-200	99.3	0.405	0.9995	1.0048
H-250	121.5	0.492	0.9995	1.0028
H-280	143.2	0.589	0.9995	1.0016
H-300	144.6	0.591	0.9995	1.0015
H-350	167.2	0.701	0.9994	1.0008
H-400	189.7	0.812	0.9993	1.0003

(Continued.)

Table A1. (Continued.)

Radiation quality R	fluence weighted mean energy, $E(\mathrm{R})$ [keV]	kerma coefficient, $k_{\Phi}(\mathrm{R})$ [pGy cm^2]	one minus radiative losses in air, $(1-g)(\mathrm{R})$ [1]	ratio $(\mu_{\mathrm{en,not\_renormalized}}/\mu_{\mathrm{en,renormalized}})(\mathrm{R})$ [1]
S-Cs	639	3.006	0.9982	1.0000
S-Co	1197	5.120	0.9967	1.0000
R-C	4437	13.06	0.9854	1.0000
R-F	4573	12.05	0.9837	1.0000
RQR-2[a]	28.44	0.921	0.9996	1.0245
RQR-3[a]	32.59	0.747	0.9996	1.0238
RQR-4[a]	36.71	0.627	0.9996	1.0229
RQR-5[a]	40.5	0.554	0.9996	1.0219
RQR-6[a]	44.3	0.500	0.9996	1.0208
RQR-7[a]	47.9	0.460	0.9996	1.0197
RQR-8[a]	51.1	0.434	0.9996	1.0186
RQR-9[a]	56.8	0.402	0.9996	1.0166
RQR-10[a]	64.4	0.3820	0.9996	1.0140

[a] Radiation quality defined in IEC 61267 [10]

Table A2. Conversion coefficients for the ambient dose, $h^*_K(\mathrm{R})$, as well as for the personal dose for different irradiation geometries, $h_{pK}(\mathrm{R};\alpha)$, for photon reference radiation qualities, R, in Sv/Gy. The values are valid for a distance of 1.0 m between the radiation source and the point of test. The standard uncertainties ($k = 1$) are in the order of $5\cdot10^{-4}$ or $\pm$ 2 %, whatever is larger.

Radiation quality R	$h^*_K(\mathrm{R})$ for $d_{\mathrm{air}} = 1.0$ m [Sv/Gy]	$h_{pK}(\mathrm{R};\alpha)$ for $d_{\mathrm{air}} = 1.0$ m [Sv/Gy] for $\alpha =$											
		0°	15°	30°	45°	60°	75°	90°	180°	ROT	ISO	SS-ISO	IS-ISO
L-10	0.0053	0.0053	0.0053	0.0050	0.0043	0.0036	0.0026	0.0016	0.0020	0.0029	0.0025	0.0026	0.0024
L-20	0.0783	0.0783	0.0767	0.0715	0.0625	0.0489	0.0334	0.0205	0.0078	0.0343	0.0280	0.0283	0.0271
L-30	0.3065	0.3065	0.3007	0.2829	0.2510	0.2046	0.1444	0.0903	0.0758	0.1497	0.1179	0.1198	0.1158
L-35	0.4302	0.4302	0.4234	0.3984	0.3534	0.2915	0.2114	0.1344	0.1373	0.2209	0.1738	0.1777	0.1702
L-55	1.0420	1.0420	1.0250	0.9766	0.8753	0.7427	0.5752	0.3998	0.5691	0.6255	0.5013	0.5132	0.4835
L-70	1.3215	1.3215	1.3075	1.2405	1.1224	0.9670	0.7617	0.5456	0.8245	0.8378	0.6764	0.6918	0.6576
L-100	1.4252	1.4252	1.4133	1.3427	1.2297	1.0731	0.8601	0.6355	0.9802	0.9565	0.7725	0.7924	0.7443
L-125	1.3701	1.3701	1.3446	1.2800	1.1860	1.0410	0.8492	0.6303	0.9540	0.9231	0.7561	0.7808	0.7366
L-170	1.2514	1.2514	1.2322	1.1903	1.1011	0.9714	0.8039	0.6093	0.8993	0.8696	0.7193	0.7411	0.6955
L-210	1.1803	1.1803	1.1759	1.1299	1.0536	0.9382	0.7840	0.6006	0.8674	0.8421	0.6989	0.7153	0.6732
L-240	1.1470	1.1470	1.1477	1.0974	1.0308	0.9245	0.7777	0.5987	0.8525	0.8287	0.6892	0.7044	0.6651
N-10	0.0039	0.0039	0.0040	0.0038	0.0033	0.0028	0.0021	0.0013	0.0017	0.0023	0.0020	0.0021	0.0019
N-15	0.0219	0.0219	0.0216	0.0198	0.0168	0.0132	0.0093	0.0056	0.0033	0.0097	0.0082	0.0085	0.0081
N-20	0.0611	0.0611	0.0599	0.0556	0.0484	0.0379	0.0260	0.0159	0.0063	0.0267	0.0219	0.0222	0.0213
N-25	0.1298	0.1298	0.1270	0.1190	0.1051	0.0833	0.0572	0.0352	0.0179	0.0588	0.0472	0.0474	0.0458
N-30	0.2357	0.2357	0.2309	0.2171	0.1925	0.1556	0.1088	0.0677	0.0500	0.1124	0.0890	0.0900	0.0871
N-40	0.5222	0.5222	0.5150	0.4851	0.4305	0.3574	0.2642	0.1705	0.1929	0.2781	0.2192	0.2244	0.2133
N-60	1.0139	1.0139	0.9990	0.9502	0.8516	0.7227	0.5596	0.3883	0.5508	0.6080	0.4872	0.4985	0.4702
N-80	1.3639	1.3639	1.3485	1.2804	1.1616	1.0045	0.7935	0.5726	0.8733	0.8757	0.7066	0.7240	0.6873
N-100	1.4256	1.4256	1.4134	1.3429	1.2280	1.0706	0.8559	0.6308	0.9734	0.9520	0.7684	0.7881	0.7412
N-120	1.3933	1.3933	1.3727	1.3047	1.2045	1.0552	0.8554	0.6337	0.9662	0.9374	0.7638	0.7869	0.7412
N-150	1.3369	1.3369	1.3114	1.2542	1.1616	1.0207	0.8362	0.6239	0.9379	0.9069	0.7452	0.7697	0.7253
N-200	1.2148	1.2148	1.2030	1.1602	1.0766	0.9538	0.7930	0.6045	0.8830	0.8555	0.7088	0.7278	0.6837
N-250	1.1514	1.1514	1.1510	1.1017	1.0337	0.9262	0.7785	0.5990	0.8545	0.8304	0.6904	0.7060	0.6662
N-300	1.1164	1.1164	1.1140	1.0706	1.0083	0.9099	0.7713	0.5992	0.8413	0.8163	0.6808	0.6986	0.6589
N-350	1.0949	1.0949	1.0869	1.0535	0.9919	0.8989	0.7674	0.6018	0.8354	0.8081	0.6765	0.6973	0.6561
N-400	1.0802	1.0802	1.0696	1.0407	0.9813	0.8928	0.7671	0.6062	0.8323	0.8034	0.6761	0.6975	0.6564
W-30	0.1831	0.1831	0.1793	0.1684	0.1491	0.1198	0.0832	0.0516	0.0342	0.0859	0.0683	0.0689	0.0666
W-40	0.3723	0.3723	0.3663	0.3448	0.3059	0.2516	0.1823	0.1160	0.1160	0.1906	0.1503	0.1533	0.1467
W-60	0.8879	0.8879	0.8750	0.8309	0.7430	0.6280	0.4829	0.3308	0.4550	0.5218	0.4168	0.4266	0.4024
W-80	1.1772	1.1772	1.1626	1.1043	0.9961	0.8540	0.6686	0.4740	0.7007	0.7326	0.5895	0.6034	0.5715
W-110	1.4021	1.4021	1.3879	1.3182	1.2042	1.0479	0.8365	0.6130	0.9411	0.9263	0.7485	0.7679	0.7244
W-150	1.3604	1.3604	1.3383	1.2762	1.1778	1.0323	0.8392	0.6230	0.9438	0.9164	0.7489	0.7721	0.7275

(Continued.)

Table A2. (Continued.)

Radiation quality R	$h^*_K(\mathrm{R})$ for $d_{\mathrm{air}} = 1.0$ m [Sv/Gy]	$h_{\mathrm{p}K}(\mathrm{R};\alpha)$ for $d_{\mathrm{air}} = 1.0$ m [Sv/Gy] for $\alpha =$											
		0°	15°	30°	45°	60°	75°	90°	180°	ROT	ISO	SS-ISO	IS-ISO
W-200	1.2741	1.2741	1.2550	1.2064	1.1177	0.9856	0.8133	0.6135	0.9094	0.8801	0.7263	0.7481	0.7035
W-250	1.2004	1.2004	1.1917	1.1451	1.0670	0.9487	0.7911	0.6040	0.8764	0.8499	0.7047	0.7229	0.6805
W-300	1.1545	1.1545	1.1507	1.1048	1.0353	0.9273	0.7797	0.6005	0.8568	0.8316	0.6915	0.7087	0.6680
H-10	0.0030	0.0030	0.0031	0.0029	0.0026	0.0022	0.0016	0.0010	0.0015	0.0018	0.0016	0.0017	0.0016
H-20	0.0233	0.0233	0.0230	0.0212	0.0183	0.0144	0.0100	0.0061	0.0034	0.0104	0.0088	0.0090	0.0085
H-30	0.0923	0.0923	0.0904	0.0845	0.0744	0.0592	0.0409	0.0252	0.0145	0.0422	0.0340	0.0343	0.0331
H-40	0.2086	0.2086	0.2048	0.1924	0.1703	0.1383	0.0982	0.0618	0.0515	0.1021	0.0810	0.0822	0.0790
H-60	0.5746	0.5746	0.5659	0.5354	0.4771	0.3989	0.2999	0.1996	0.2476	0.3199	0.2541	0.2599	0.2462
H-80	0.8891	0.8891	0.8772	0.8320	0.7467	0.6342	0.4897	0.3391	0.4749	0.5312	0.4254	0.4354	0.4121
H-100	1.0811	1.0811	1.0683	1.0141	0.9151	0.7842	0.6131	0.4341	0.6353	0.6714	0.5395	0.5524	0.5224
H-150	1.3190	1.3190	1.3019	1.2383	1.1309	0.9823	0.7850	0.5726	0.8659	0.8619	0.6989	0.7177	0.6779
H-200	1.3231	1.3231	1.3050	1.2465	1.1464	1.0033	0.8139	0.6037	0.9082	0.8889	0.7264	0.7471	0.7043
H-250	1.2823	1.2823	1.2672	1.2131	1.1221	0.9885	0.8112	0.6091	0.9046	0.8802	0.7236	0.7438	0.7007
H-280	1.2398	1.2398	1.2278	1.1770	1.0937	0.9690	0.8023	0.6079	0.8910	0.8652	0.7143	0.7339	0.6913
H-300	1.2426	1.2426	1.2301	1.1794	1.0960	0.9706	0.8037	0.6089	0.8936	0.8670	0.7159	0.7357	0.6928
H-350	1.2015	1.2015	1.1914	1.1444	1.0673	0.9505	0.7931	0.6060	0.8771	0.8505	0.7048	0.7242	0.6820
H-400	1.1721	1.1721	1.1630	1.1194	1.0468	0.9363	0.7862	0.6050	0.8659	0.8391	0.6975	0.7169	0.6751
S-Cs	1.0158	1.0158	1.0181	0.9938	0.9509	0.8838	0.7886	0.6518	0.8368	0.8058	0.6982	0.7130	0.6770
S-Co	0.9971	0.9971	0.9949	0.9819	0.9499	0.9029	0.8276	0.7116	0.8631	0.8376	0.7423	0.7591	0.7271
R-C	1.0000	1.0000	0.9975	0.9898	0.9722	0.9454	0.9043	0.8363	0.9219	0.9055	0.8443	0.8558	0.8308
R-F	0.9974	0.9974	0.9948	0.9864	0.9709	0.9454	0.9075	0.8485	0.9244	0.9096	0.8553	0.8649	0.8420
RQR-2[a]	0.3201	0.3201	0.3147	0.2961	0.2626	0.2151	0.1548	0.0981	0.0928	0.1615	0.1275	0.1298	0.1244
RQR-3[a]	0.4208	0.4208	0.4142	0.3907	0.3470	0.2872	0.2115	0.1371	0.1512	0.2230	0.1764	0.1802	0.1714
RQR-4[a]	0.5239	0.5239	0.5158	0.4877	0.4344	0.3623	0.2710	0.1795	0.2170	0.2884	0.2291	0.2341	0.2221
RQR-5[a]	0.6121	0.6121	0.6032	0.5709	0.5097	0.4278	0.3236	0.2178	0.2785	0.3468	0.2762	0.2824	0.2678
RQR-6[a]	0.6978	0.6978	0.6881	0.6518	0.5835	0.4925	0.3758	0.2564	0.3418	0.4050	0.3235	0.3309	0.3136
RQR-7[a]	0.7788	0.7788	0.7685	0.7283	0.6536	0.5541	0.4259	0.2939	0.4036	0.4613	0.3691	0.3776	0.3578
RQR-8[a]	0.8467	0.8467	0.8359	0.7925	0.7127	0.6064	0.4687	0.3263	0.4574	0.5095	0.4082	0.4178	0.3956
RQR-9[a]	0.9571	0.9571	0.9452	0.8966	0.8094	0.6925	0.5400	0.3808	0.5475	0.5891	0.4734	0.4848	0.4587
RQR-10[a]	1.0726	1.0726	1.0587	1.0055	0.9118	0.7847	0.6182	0.4417	0.6471	0.6753	0.5448	0.5588	0.5283

[a] Radiation quality defined in IEC 61267 [10]

Table A3. Conversion coefficients for the maximum absorbed dose in the complete lens for left and right irradiations for different irradiation geometries, $d_{\mathrm{lens}K}(\mathrm{R};\alpha)$, for photon reference radiation qualities, R, in Gy/Gy. The values are valid for a distance of 1.0 m between the radiation source and the point of test. The standard uncertainties ($k = 1$) are in the order of $5{\cdot}10^{-4}$ or $\pm$ 2 %, whatever is larger.

Radiation quality R	$d_{\mathrm{lens}K}(\mathrm{R};\alpha)$ for $d_{\mathrm{air}} = 1.0$ m [Gy/Gy] for $\alpha =$							
	0°	15°	30°	45°	60°	75°	90°	ROT
L-10	0.0496	0.0484	0.0455	0.0396	0.0300	0.0175	0.0067	0.0160
L-20	0.6466	0.6418	0.6281	0.6057	0.5687	0.5021	0.3941	0.2764
L-30	1.0381	1.0438	1.0413	1.0284	1.0002	0.9515	0.8592	0.5278
L-35	1.1427	1.1527	1.1519	1.1421	1.1140	1.0714	0.9847	0.6065
L-55	1.4722	1.4853	1.4995	1.4997	1.4902	1.4397	1.3599	0.8861
L-70	1.5634	1.5779	1.6022	1.6022	1.5922	1.5377	1.4748	0.9877
L-100	1.5494	1.5595	1.5791	1.5792	1.5643	1.5375	1.4860	1.0224
L-125	1.4738	1.4797	1.4983	1.4984	1.4894	1.4745	1.4286	0.9954
L-170	1.3904	1.4004	1.4116	1.4202	1.4104	1.4012	1.3684	0.9695
L-210	1.3385	1.3485	1.3656	1.3757	1.3584	1.3555	1.3257	0.9579
L-240	1.3150	1.3250	1.3366	1.3506	1.3309	1.3265	1.3045	0.9495
N-10	0.0318	0.0312	0.0293	0.0254	0.0190	0.0108	0.0040	0.0102
N-15	0.2723	0.2683	0.2571	0.2370	0.2064	0.1587	0.0970	0.1006
N-20	0.5549	0.5499	0.5361	0.5133	0.4761	0.4115	0.3110	0.2307
N-25	0.7805	0.7779	0.7666	0.7462	0.7142	0.6515	0.5450	0.3546
N-30	0.9523	0.9548	0.9489	0.9332	0.9049	0.8505	0.7524	0.4670
N-40	1.2040	1.2171	1.2161	1.2088	1.1845	1.1413	1.0569	0.6552
N-60	1.4564	1.4696	1.4832	1.4829	1.4724	1.4215	1.3433	0.8730
N-80	1.5685	1.5885	1.6067	1.6067	1.5968	1.5492	1.4871	1.0039
N-100	1.5560	1.5694	1.5870	1.5871	1.5734	1.5441	1.4903	1.0235
N-120	1.5032	1.5083	1.5304	1.5304	1.5169	1.4977	1.4519	1.0063
N-150	1.4486	1.4567	1.4711	1.4734	1.4664	1.4534	1.4098	0.9867
N-200	1.3645	1.3746	1.3887	1.3981	1.3846	1.3786	1.3474	0.9637
N-250	1.3184	1.3284	1.3399	1.3537	1.3346	1.3298	1.3075	0.9503
N-300	1.2907	1.2976	1.3032	1.3219	1.3020	1.2932	1.2806	0.9407
N-350	1.2665	1.2698	1.2778	1.2966	1.2776	1.2677	1.2564	0.9353
N-400	1.2473	1.2519	1.2614	1.2773	1.2613	1.2514	1.2372	0.9319
W-30	0.8647	0.8647	0.8561	0.8381	0.8078	0.7494	0.6473	0.4102
W-40	1.0764	1.0841	1.0809	1.0693	1.0424	0.9943	0.9032	0.5593
W-60	1.3960	1.4103	1.4190	1.4174	1.4042	1.3553	1.2754	0.8196
W-80	1.5091	1.5247	1.5417	1.5414	1.5310	1.4805	1.4104	0.9336
W-110	1.5532	1.5668	1.5861	1.5861	1.5732	1.5392	1.4845	1.0151
W-150	1.4802	1.4889	1.5055	1.5067	1.4971	1.4788	1.4320	0.9953
W-200	1.4061	1.4153	1.4290	1.4353	1.4251	1.4154	1.3786	0.9747
W-250	1.3530	1.3629	1.3761	1.3866	1.3715	1.3657	1.3366	0.9603
W-300	1.3198	1.3288	1.3387	1.3532	1.3351	1.3286	1.3076	0.9501
H-10	0.0206	0.0202	0.0191	0.0165	0.0122	0.0068	0.0024	0.0066
H-20	0.2450	0.2418	0.2331	0.2176	0.1932	0.1550	0.1046	0.0945
H-30	0.5857	0.5827	0.5717	0.5518	0.5198	0.4630	0.3735	0.2582
H-40	0.8489	0.8499	0.8417	0.8244	0.7937	0.7372	0.6392	0.4091
H-60	1.1970	1.2078	1.2090	1.2017	1.1807	1.1330	1.0475	0.6598
H-80	1.3719	1.3860	1.3951	1.3921	1.3769	1.3285	1.2513	0.8090
H-100	1.4544	1.4694	1.4826	1.4812	1.4682	1.4213	1.3502	0.8898
H-150	1.5162	1.5286	1.5469	1.5472	1.5366	1.5015	1.4446	0.9832
H-200	1.4744	1.4853	1.5019	1.5048	1.4943	1.4713	1.4244	0.9878
H-250	1.4262	1.4364	1.4516	1.4573	1.4452	1.4303	1.3910	0.9791
H-280	1.3876	1.3971	1.4102	1.4189	1.4051	1.3939	1.3613	0.9690
H-300	1.3877	1.3972	1.4105	1.4189	1.4054	1.3953	1.3622	0.9694
H-350	1.3545	1.3630	1.3746	1.3859	1.3707	1.3616	1.3345	0.9600
H-400	1.3294	1.3371	1.3480	1.3609	1.3449	1.3365	1.3131	0.9532

(Continued.)

Table A3. (Continued.)

Radiation quality R	$d_{\mathrm{lens}K}(\mathrm{R};\alpha)$ for $d_{\mathrm{air}} = 1.0$ m [Gy/Gy] for $\alpha =$							
	0°	15°	30°	45°	60°	75°	90°	ROT
S-Cs	1.1712	1.1734	1.1910	1.2111	1.2010	1.1733	1.1732	0.9337
S-Co	1.1276	1.1366	1.1466	1.1579	1.1543	1.1366	1.1374	0.9528
R-C	1.0854	1.0854	1.0908	1.0955	1.0954	1.0800	1.0800	0.9783
R-F	1.0758	1.0774	1.0765	1.0823	1.0819	1.0719	1.0713	0.9731
RQR-2[a]	1.0221	1.0276	1.0230	1.0096	0.9818	0.9309	0.8366	0.5201
RQR-3[a]	1.0981	1.1063	1.1033	1.0926	1.0677	1.0181	0.9269	0.5788
RQR-4[a]	1.1673	1.1769	1.1767	1.1680	1.1456	1.0966	1.0082	0.6339
RQR-5[a]	1.2191	1.2296	1.2321	1.2248	1.2041	1.1550	1.0693	0.6772
RQR-6[a]	1.2652	1.2768	1.2813	1.2751	1.2559	1.2070	1.1240	0.7175
RQR-7[a]	1.3065	1.3190	1.3252	1.3200	1.3021	1.2538	1.1734	0.7546
RQR-8[a]	1.3386	1.3515	1.3594	1.3550	1.3379	1.2904	1.2124	0.7848
RQR-9[a]	1.3873	1.4003	1.4111	1.4079	1.3921	1.3465	1.2731	0.8332
RQR-10[a]	1.4302	1.4430	1.4562	1.4544	1.4407	1.3988	1.3309	0.8827

[a] Radiation quality defined in IEC 61267 [10]

Table A4. Conversion coefficients for the directional absorbed dose in local skin as well as for the personal absorbed dose in local skin on the slab phantom for different irradiation geometries, $d_{\text{local skin }K}(\text{R};\alpha)_{\text{slab}}$, for photon reference radiation qualities, R, in Gy/Gy. The values are valid for a distance of 1.0 m between the radiation source and the point of test. The standard uncertainties ($k = 1$) are in the order of $5{\cdot}10^{-4}$ or $\pm$ 2 %, whatever is larger.

Radiation quality R	$d_{\text{local skin }K}(\text{R};\alpha)_{\text{slab}}$ for $d_{\text{air}} = 1.0$ m [Gy/Gy] for $\alpha =$					
	0°	15°	30°	45°	60°	75°
L-10	0.9511	0.9491	0.9448	0.9289	0.8979	0.7994
L-20	1.0454	1.0457	1.0456	1.0357	1.0259	0.9996
L-30	1.2106	1.2043	1.2051	1.1892	1.1621	1.1151
L-35	1.2890	1.2797	1.2790	1.2594	1.2205	1.1596
L-55	1.6341	1.6242	1.6139	1.5698	1.5024	1.3703
L-70	1.7617	1.7517	1.7329	1.6914	1.6126	1.4657
L-100	1.7297	1.7233	1.7139	1.6812	1.6152	1.5035
L-125	1.6428	1.6424	1.6375	1.6192	1.5690	1.4784
L-170	1.5247	1.5246	1.5319	1.5220	1.5009	1.4397
L-210	1.4609	1.4608	1.4635	1.4608	1.4556	1.4103
L-240	1.4236	1.4236	1.4257	1.4271	1.4299	1.3926
N-10	0.9363	0.9340	0.9277	0.9086	0.8692	0.7500
N-15	0.9876	0.9863	0.9854	0.9739	0.9598	0.9142
N-20	1.0292	1.0291	1.0289	1.0188	1.0083	0.9798
N-25	1.0862	1.0856	1.0858	1.0752	1.0638	1.0336
N-30	1.1622	1.1584	1.1590	1.1455	1.1255	1.0854
N-40	1.3445	1.3346	1.3316	1.3098	1.2647	1.1919
N-60	1.6175	1.6075	1.5969	1.5557	1.4891	1.3609
N-80	1.7693	1.7593	1.7411	1.7001	1.6219	1.4798
N-100	1.7410	1.7336	1.7229	1.6882	1.6200	1.5034
N-120	1.6752	1.6733	1.6660	1.6435	1.5866	1.4883
N-150	1.6088	1.6084	1.6078	1.5916	1.5498	1.4676
N-200	1.4927	1.4927	1.4979	1.4916	1.4784	1.4252
N-250	1.4280	1.4279	1.4305	1.4313	1.4330	1.3947
N-300	1.3787	1.3787	1.3844	1.3900	1.4010	1.3721
N-350	1.3410	1.3410	1.3496	1.3582	1.3753	1.3552
N-400	1.3150	1.3150	1.3246	1.3341	1.3532	1.3442
W-30	1.1243	1.1221	1.1225	1.1104	1.0945	1.0593
W-40	1.2498	1.2428	1.2420	1.2244	1.1920	1.1366
W-60	1.5492	1.5392	1.5303	1.4942	1.4326	1.3177
W-80	1.6896	1.6796	1.6650	1.6243	1.5519	1.4165
W-110	1.7411	1.7338	1.7210	1.6862	1.6162	1.4940
W-150	1.6489	1.6467	1.6423	1.6209	1.5701	1.4768
W-200	1.5491	1.5488	1.5520	1.5407	1.5136	1.4463
W-250	1.4769	1.4769	1.4806	1.4763	1.4666	1.4169
W-300	1.4264	1.4263	1.4305	1.4313	1.4327	1.3941
H-10	0.9172	0.9144	0.9057	0.8824	0.8336	0.6928
H-20	0.9808	0.9794	0.9773	0.9642	0.9446	0.8834
H-30	1.0488	1.0477	1.0473	1.0358	1.0217	0.9840
H-40	1.1366	1.1335	1.1333	1.1199	1.1001	1.0595
H-60	1.3667	1.3583	1.3541	1.3291	1.2843	1.2038
H-80	1.5397	1.5300	1.5205	1.4871	1.4268	1.3165
H-100	1.6299	1.6202	1.6084	1.5717	1.5051	1.3834
H-150	1.6968	1.6903	1.6794	1.6471	1.5825	1.4643
H-200	1.6403	1.6367	1.6319	1.6090	1.5603	1.4646
H-250	1.5753	1.5735	1.5723	1.5575	1.5245	1.4483
H-280	1.5214	1.5205	1.5217	1.5128	1.4922	1.4301
H-300	1.5224	1.5217	1.5233	1.5144	1.4937	1.4320
H-350	1.4742	1.4738	1.4772	1.4731	1.4629	1.4125
H-400	1.4377	1.4376	1.4424	1.4417	1.4390	1.3978

(Continued.)

Table A4. (Continued.)

Radiation quality R	$d_{\text{local skin }K}(\text{R};\alpha)_{\text{slab}}$ for $d_{\text{air}} = 1.0$ m [Gy/Gy] for $\alpha =$					
	0°	15°	30°	45°	60°	75°
S-Cs	1.2136	1.2136	1.2238	1.2337	1.2634	1.2909
S-Co	1.1606	1.1606	1.1706	1.1806	1.2021	1.2317
R-C	1.0947	1.0947	1.1048	1.1048	1.1148	1.1372
R-F	1.0890	1.0890	1.0943	1.0943	1.0995	1.1137
RQR-2[a]	1.2155	1.2098	1.2093	1.1933	1.1656	1.1158
RQR-3[a]	1.2769	1.2701	1.2681	1.2488	1.2142	1.1525
RQR-4[a]	1.3374	1.3298	1.3264	1.3034	1.2627	1.1894
RQR-5[a]	1.3869	1.3788	1.3739	1.3483	1.3029	1.2205
RQR-6[a]	1.4329	1.4243	1.4180	1.3903	1.3406	1.2505
RQR-7[a]	1.4747	1.4658	1.4583	1.4288	1.3755	1.2788
RQR-8[a]	1.5078	1.4988	1.4905	1.4598	1.4037	1.3024
RQR-9[a]	1.5578	1.5491	1.5396	1.5077	1.4481	1.3406
RQR-10[a]	1.6016	1.5936	1.5838	1.5520	1.4910	1.3801

[a] Radiation quality defined in IEC 61267 [10]

Table A5. Conversion coefficients for the personal absorbed dose in local skin on the pillar phantom for different irradiation geometries, $d_{\text{local skin }K}(\text{R};\alpha)_{\text{pillar}}$, for photon reference radiation qualities, R, in Gy/Gy. The values are valid for a distance of 1.0 m between the radiation source and the point of test. The standard uncertainties ($k = 1$) are in the order of $5{\cdot}10^{-4}$ or $\pm$ 2 %, whatever is larger.

Radiation quality R	$d_{\text{local skin }K}(\text{R};\alpha)_{\text{pillar}}$ for $d_{\text{air}} = 1.0$ m [Gy/Gy] for $\alpha =$													
	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	ROT
L-10	0.9558	0.9532	0.9501	0.9356	0.9014	0.7983	0.2501	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.4388
L-20	1.0515	1.0560	1.0516	1.0456	1.0358	1.0162	0.7169	0.1359	0.0248	0.0057	0.0015	0.0006	<0.0005	0.5512
L-30	1.1962	1.1950	1.1904	1.1853	1.1695	1.1475	0.9961	0.5116	0.2524	0.1430	0.1022	0.0808	0.0713	0.7161
L-35	1.2557	1.2479	1.2461	1.2380	1.2181	1.1983	1.0656	0.6299	0.3637	0.2285	0.1704	0.1397	0.1282	0.7855
L-55	1.4241	1.4384	1.4048	1.4286	1.3986	1.3958	1.2942	0.9666	0.6939	0.5366	0.4278	0.3866	0.3995	1.0229
L-70	1.4639	1.4672	1.4429	1.4515	1.4370	1.4433	1.3477	1.0545	0.7922	0.6435	0.5395	0.4873	0.4990	1.0930
L-100	1.4346	1.4069	1.4259	1.3963	1.3944	1.4052	1.3327	1.0835	0.8550	0.7008	0.6240	0.5589	0.5548	1.1014
L-125	1.3795	1.3639	1.3790	1.3658	1.3588	1.3689	1.3107	1.0803	0.8669	0.7182	0.6380	0.5821	0.5747	1.0857
L-170	1.3122	1.3117	1.3132	1.3197	1.3189	1.3300	1.2801	1.0789	0.8776	0.7496	0.6573	0.6107	0.5914	1.0695
L-210	1.2732	1.2804	1.2804	1.2829	1.2831	1.3004	1.2578	1.0725	0.8750	0.7569	0.6748	0.6269	0.6173	1.0553
L-240	1.2531	1.2609	1.2609	1.2612	1.2648	1.2827	1.2458	1.0668	0.8800	0.7673	0.6869	0.6409	0.6356	1.0490
N-10	0.9395	0.9368	0.9313	0.9132	0.8716	0.7492	0.2087	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.4234
N-15	0.9977	0.9951	0.9962	0.9856	0.9679	0.9186	0.4550	0.0155	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.4858
N-20	1.0370	1.0392	1.0369	1.0291	1.0180	0.9937	0.6535	0.0962	0.0150	0.0032	0.0008	<0.0005	<0.0005	0.5336
N-25	1.0872	1.0943	1.0868	1.0843	1.0738	1.0535	0.8117	0.2437	0.0721	0.0280	0.0157	0.0109	0.0091	0.5929
N-30	1.1541	1.1577	1.1507	1.1479	1.1344	1.1127	0.9350	0.4151	0.1792	0.0935	0.0641	0.0496	0.0432	0.6688
N-40	1.2902	1.2822	1.2783	1.2724	1.2498	1.2323	1.1075	0.6972	0.4294	0.2836	0.2150	0.1804	0.1704	0.8288
N-60	1.4164	1.4274	1.3975	1.4171	1.3887	1.3851	1.2824	0.9512	0.6795	0.5226	0.4172	0.3754	0.3858	1.0115
N-80	1.4648	1.4576	1.4447	1.4404	1.4320	1.4398	1.3473	1.0645	0.8088	0.6595	0.5622	0.5049	0.5113	1.0991
N-100	1.4418	1.4151	1.4309	1.4025	1.4013	1.4119	1.3359	1.0829	0.8505	0.6972	0.6181	0.5530	0.5495	1.1032
N-120	1.3993	1.3792	1.3969	1.3773	1.3709	1.3811	1.3188	1.0811	0.8630	0.7108	0.6331	0.5739	0.5687	1.0909
N-150	1.3605	1.3493	1.3599	1.3532	1.3484	1.3584	1.3022	1.0801	0.8703	0.7278	0.6430	0.5901	0.5782	1.0814
N-200	1.2926	1.2961	1.2967	1.3016	1.3013	1.3154	1.2691	1.0759	0.8764	0.7534	0.6659	0.6188	0.6039	1.0625
N-250	1.2558	1.2631	1.2631	1.2639	1.2674	1.2848	1.2474	1.0673	0.8801	0.7667	0.6855	0.6396	0.6335	1.0500
N-300	1.2323	1.2365	1.2365	1.2366	1.2479	1.2621	1.2334	1.0588	0.8945	0.7879	0.7022	0.6623	0.6583	1.0446
N-350	1.2151	1.2165	1.2159	1.2170	1.2337	1.2450	1.2233	1.0539	0.9071	0.8052	0.7173	0.6825	0.6777	1.0415
N-400	1.2033	1.2037	1.2015	1.2059	1.2229	1.2332	1.2169	1.0553	0.9155	0.8158	0.7330	0.7010	0.6918	1.0405
W-30	1.1208	1.1259	1.1188	1.1160	1.1040	1.0830	0.8722	0.3291	0.1263	0.0614	0.0405	0.0308	0.0266	0.6309
W-40	1.2211	1.2183	1.2135	1.2085	1.1906	1.1707	1.0201	0.5550	0.3019	0.1855	0.1369	0.1123	0.1036	0.7469
W-60	1.3874	1.3931	1.3700	1.3832	1.3553	1.3481	1.2407	0.8922	0.6211	0.4646	0.3671	0.3267	0.3317	0.9677
W-80	1.4392	1.4426	1.4196	1.4291	1.4097	1.4115	1.3131	1.0037	0.7389	0.5860	0.4840	0.4353	0.4444	1.0525
W-110	1.4431	1.4237	1.4307	1.4113	1.4067	1.4164	1.3373	1.0768	0.8391	0.6870	0.6025	0.5407	0.5404	1.1002
W-150	1.3852	1.3696	1.3819	1.3688	1.3639	1.3739	1.3115	1.0774	0.8603	0.7137	0.6313	0.5750	0.5667	1.0859

(Continued.)

Table A5. (Continued.)

Radiation quality R	$d_{\text{local skin }K}(\text{R};\alpha)_{\text{pillar}}$ for $d_{\text{air}} = 1.0$ m [Gy/Gy] for $\alpha =$													
	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	ROT
W-200	1.3258	1.3222	1.3272	1.3275	1.3252	1.3369	1.2856	1.0782	0.8739	0.7416	0.6541	0.6046	0.5900	1.0720
W-250	1.2837	1.2876	1.2888	1.2913	1.2919	1.3070	1.2633	1.0730	0.8772	0.7563	0.6715	0.6244	0.6131	1.0591
W-300	1.2564	1.2617	1.2619	1.2633	1.2686	1.2842	1.2477	1.0663	0.8842	0.7708	0.6867	0.6426	0.6352	1.0511
H-10	0.9193	0.9162	0.9081	0.8854	0.8352	0.6922	0.1712	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.4057
H-20	0.9886	0.9868	0.9857	0.9741	0.9515	0.8875	0.4188	0.0253	0.0030	0.0006	<0.0005	<0.0005	<0.0005	0.4771
H-30	1.0531	1.0554	1.0517	1.0449	1.0308	0.9986	0.6727	0.1572	0.0488	0.0213	0.0133	0.0099	0.0085	0.5525
H-40	1.1283	1.1305	1.1250	1.1202	1.1062	1.0838	0.8592	0.3379	0.1503	0.0834	0.0589	0.0472	0.0427	0.6399
H-60	1.2865	1.2864	1.2747	1.2763	1.2536	1.2372	1.1020	0.6891	0.4305	0.2973	0.2288	0.1976	0.1940	0.8335
H-80	1.3742	1.3754	1.3578	1.3641	1.3415	1.3345	1.2215	0.8681	0.6033	0.4543	0.3650	0.3238	0.3263	0.9550
H-100	1.4112	1.4092	1.3941	1.3965	1.3784	1.3774	1.2753	0.9539	0.6934	0.5419	0.4486	0.4008	0.4050	1.0158
H-150	1.4235	1.4142	1.4115	1.4054	1.3957	1.4030	1.3228	1.0551	0.8150	0.6653	0.5746	0.5195	0.5202	1.0817
H-200	1.3829	1.3741	1.3771	1.3714	1.3662	1.3761	1.3099	1.0723	0.8498	0.7076	0.6197	0.5658	0.5592	1.0826
H-250	1.3426	1.3376	1.3417	1.3380	1.3355	1.3476	1.2916	1.0750	0.8647	0.7306	0.6448	0.5932	0.5840	1.0744
H-280	1.3111	1.3093	1.3128	1.3108	1.3111	1.3243	1.2758	1.0727	0.8733	0.7462	0.6611	0.6122	0.6028	1.0663
H-300	1.3111	1.3094	1.3134	1.3117	1.3114	1.3247	1.2762	1.0737	0.8735	0.7459	0.6610	0.6119	0.6016	1.0665
H-350	1.2846	1.2850	1.2875	1.2871	1.2904	1.3040	1.2621	1.0693	0.8810	0.7602	0.6749	0.6290	0.6200	1.0593
H-400	1.2650	1.2665	1.2678	1.2687	1.2748	1.2882	1.2516	1.0665	0.8876	0.7719	0.6867	0.6435	0.6348	1.0545
S-Cs	1.1612	1.1523	1.1426	1.1622	1.1725	1.1733	1.1821	1.0697	0.9407	0.8599	0.8066	0.7857	0.7527	1.0310
S-Co	1.1326	1.1213	1.1197	1.1313	1.1412	1.1578	1.1494	1.0587	0.9878	0.9169	0.8790	0.8449	0.8372	1.0385
R-C	1.1152	1.0871	1.0795	1.0924	1.1048	1.0744	1.0876	1.0700	1.0276	0.9705	0.9492	0.9367	0.9409	1.0424
R-F	1.0871	1.0666	1.0746	1.0846	1.0762	1.0647	1.0753	1.0342	0.9971	0.9555	0.9705	0.9281	0.9355	1.0312
RQR-2[a]	1.1939	1.1934	1.1879	1.1836	1.1674	1.1472	0.9821	0.4946	0.2535	0.1509	0.1099	0.0894	0.0819	0.7155
RQR-3[a]	1.2335	1.2328	1.2252	1.2230	1.2041	1.1858	1.0348	0.5770	0.3272	0.2105	0.1578	0.1327	0.1263	0.7649
RQR-4[a]	1.2686	1.2690	1.2582	1.2592	1.2383	1.2223	1.0828	0.6500	0.3935	0.2669	0.2041	0.1753	0.1711	0.8106
RQR-5[a]	1.2946	1.2956	1.2828	1.2855	1.2641	1.2503	1.1182	0.7042	0.4443	0.3120	0.2425	0.2109	0.2085	0.8460
RQR-6[a]	1.3175	1.3181	1.3045	1.3074	1.2864	1.2749	1.1491	0.7523	0.4908	0.3542	0.2798	0.2451	0.2439	0.8782
RQR-7[a]	1.3377	1.3374	1.3238	1.3262	1.3060	1.2967	1.1765	0.7959	0.5339	0.3938	0.3155	0.2778	0.2774	0.9075
RQR-8[a]	1.3530	1.3515	1.3386	1.3401	1.3208	1.3134	1.1979	0.8306	0.5693	0.4267	0.3459	0.3057	0.3059	0.9310
RQR-9[a]	1.3747	1.3716	1.3602	1.3603	1.3424	1.3382	1.2310	0.8865	0.6276	0.4815	0.3971	0.3531	0.3541	0.9684
RQR-10[a]	1.3909	1.3865	1.3772	1.3764	1.3606	1.3600	1.2628	0.9453	0.6919	0.5436	0.4558	0.4084	0.4092	1.0067

[a] Radiation quality defined in IEC 61267 [10]

Table A6. Conversion coefficients for the personal absorbed dose in local skin on the rod phantom for different irradiation geometries, $d_{\text{local skin }K}(\text{R};\alpha)_{\text{rod}}$, for photon reference radiation qualities, R, in Gy/Gy. The values are valid for a distance of 1.0 m between the radiation source and the point of test. The standard uncertainties ($k = 1$) are in the order of $5\cdot10^{-4}$ or $\pm$ 2 %, whatever is larger.

Radiation	$d_{\text{local skin }K}(\text{R};\alpha)_{\text{rod}}$ for $d_{\text{air}} = 1.0$ m [Gy/Gy] for $\alpha =$													
quality R	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	ROT
L-10	0.9526	0.9529	0.9426	0.9213	0.8520	0.6639	0.4245	0.1956	0.0406	0.0015	<0.0005	<0.0005	<0.0005	0.4561
L-20	1.0454	1.0457	1.0392	1.0355	1.0184	0.9457	0.7993	0.6047	0.4068	0.2646	0.1895	0.1540	0.1433	0.6735
L-30	1.1104	1.1098	1.1121	1.0994	1.0907	1.0629	0.9917	0.8842	0.7611	0.6529	0.5793	0.5364	0.5228	0.8918
L-35	1.1282	1.1286	1.1288	1.1188	1.1091	1.0880	1.0262	0.9325	0.8262	0.7317	0.6651	0.6261	0.6140	0.9371
L-55	1.1673	1.1766	1.1758	1.1751	1.1731	1.1545	1.1040	1.0410	0.9619	0.8950	0.8473	0.8213	0.8121	1.0412
L-70	1.1826	1.1840	1.1820	1.1820	1.1799	1.1619	1.1225	1.0710	1.0018	0.9415	0.8983	0.8707	0.8635	1.0690
L-100	1.2013	1.2021	1.1943	1.1940	1.1862	1.1794	1.1515	1.1002	1.0425	0.9859	0.9415	0.9176	0.9099	1.0926
L-125	1.1833	1.1833	1.1828	1.1853	1.1848	1.1750	1.1477	1.1026	1.0453	0.9976	0.9587	0.9372	0.9295	1.0996
L-170	1.1625	1.1614	1.1613	1.1695	1.1694	1.1605	1.1397	1.1080	1.0583	1.0096	0.9766	0.9549	0.9480	1.0988
L-210	1.1600	1.1526	1.1526	1.1552	1.1552	1.1526	1.1326	1.1025	1.0599	1.0173	0.9839	0.9633	0.9578	1.0925
L-240	1.1569	1.1481	1.1480	1.1484	1.1492	1.1488	1.1288	1.0996	1.0600	1.0212	0.9883	0.9682	0.9636	1.0896
N-10	0.9356	0.9359	0.9228	0.8966	0.8168	0.6222	0.3870	0.1696	0.0305	0.0007	<0.0005	<0.0005	<0.0005	0.4376
N-15	0.9974	0.9962	0.9882	0.9805	0.9412	0.8057	0.5892	0.3495	0.1495	0.0540	0.0245	0.0145	0.0117	0.5327
N-20	1.0336	1.0335	1.0259	1.0226	1.0007	0.9138	0.7489	0.5397	0.3368	0.2021	0.1367	0.1073	0.0986	0.6348
N-25	1.0657	1.0656	1.0639	1.0556	1.0433	0.9878	0.8699	0.7064	0.5312	0.3951	0.3160	0.2750	0.2622	0.7475
N-30	1.0948	1.0943	1.0962	1.0840	1.0750	1.0388	0.9537	0.8289	0.6880	0.5686	0.4913	0.4476	0.4338	0.8447
N-40	1.1373	1.1393	1.1384	1.1303	1.1209	1.1020	1.0437	0.9563	0.8575	0.7696	0.7071	0.6709	0.6595	0.9599
N-60	1.1659	1.1738	1.1729	1.1717	1.1690	1.1505	1.1005	1.0365	0.9569	0.8893	0.8409	0.8139	0.8048	1.0371
N-80	1.1903	1.1913	1.1858	1.1857	1.1802	1.1659	1.1305	1.0794	1.0142	0.9524	0.9082	0.8807	0.8735	1.0739
N-100	1.2016	1.2024	1.1939	1.1935	1.1851	1.1779	1.1497	1.0985	1.0405	0.9821	0.9375	0.9128	0.9052	1.0901
N-120	1.1899	1.1902	1.1879	1.1889	1.1867	1.1777	1.1495	1.1014	1.0433	0.9938	0.9528	0.9309	0.9231	1.0980
N-150	1.1768	1.1769	1.1764	1.1810	1.1805	1.1707	1.1455	1.1046	1.0494	1.0008	0.9638	0.9421	0.9346	1.0995
N-200	1.1610	1.1569	1.1569	1.1625	1.1624	1.1565	1.1362	1.1055	1.0593	1.0135	0.9803	0.9592	0.9530	1.0958
N-250	1.1570	1.1486	1.1486	1.1494	1.1502	1.1493	1.1293	1.1000	1.0599	1.0206	0.9878	0.9676	0.9629	1.0900
N-300	1.1500	1.1426	1.1426	1.1427	1.1452	1.1451	1.1251	1.0976	1.0600	1.0249	0.9944	0.9744	0.9706	1.0876
N-350	1.1436	1.1377	1.1377	1.1377	1.1418	1.1418	1.1218	1.0959	1.0600	1.0281	0.9999	0.9799	0.9769	1.0859
N-400	1.1381	1.1336	1.1336	1.1336	1.1391	1.1391	1.1190	1.0945	1.0600	1.0309	1.0046	0.9846	0.9823	1.0845
W-30	1.0801	1.0798	1.0798	1.0696	1.0588	1.0127	0.9108	0.7662	0.6081	0.4806	0.4026	0.3605	0.3472	0.7953
W-40	1.1161	1.1166	1.1172	1.1068	1.0975	1.0703	0.9991	0.8934	0.7740	0.6705	0.6005	0.5603	0.5476	0.9028
W-60	1.1596	1.1665	1.1653	1.1626	1.1579	1.1399	1.0880	1.0185	0.9349	0.8628	0.8111	0.7823	0.7726	1.0197
W-80	1.1765	1.1808	1.1782	1.1775	1.1740	1.1569	1.1135	1.0557	0.9825	0.9179	0.8717	0.8442	0.8360	1.0539
W-110	1.1963	1.1970	1.1905	1.1904	1.1840	1.1742	1.1436	1.0927	1.0323	0.9744	0.9304	0.9053	0.8978	1.0863
W-150	1.1839	1.1842	1.1818	1.1846	1.1822	1.1728	1.1458	1.1009	1.0439	0.9928	0.9533	0.9308	0.9231	1.0958

(Continued.)

Table A6. (Continued.)

Radiation quality R	$d_{\text{local skin }K}(\text{R};\alpha)_{\text{rod}}$ for $d_{\text{air}} = 1.0$ m [Gy/Gy] for $\alpha =$													
	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	ROT
W-200	1.1681	1.1664	1.1661	1.1718	1.1715	1.1634	1.1408	1.1056	1.0548	1.0071	0.9724	0.9508	0.9439	1.0979
W-250	1.1607	1.1552	1.1552	1.1589	1.1591	1.1549	1.1343	1.1034	1.0588	1.0153	0.9819	0.9611	0.9554	1.0939
W-300	1.1556	1.1485	1.1485	1.1502	1.1513	1.1496	1.1295	1.1004	1.0597	1.0204	0.9883	0.9680	0.9632	1.0905
H-10	0.9149	0.9146	0.8983	0.8662	0.7757	0.5779	0.3495	0.1457	0.0228	<0.0005	<0.0005	<0.0005	<0.0005	0.4174
H-20	0.9866	0.9860	0.9773	0.9653	0.9185	0.7739	0.5593	0.3297	0.1455	0.0629	0.0368	0.0269	0.0241	0.5236
H-30	1.0379	1.0374	1.0323	1.0245	1.0009	0.9146	0.7591	0.5666	0.3826	0.2623	0.2022	0.1734	0.1645	0.6625
H-40	1.0779	1.0779	1.0761	1.0672	1.0536	1.0026	0.8944	0.7459	0.5890	0.4674	0.3950	0.3567	0.3447	0.7860
H-60	1.1319	1.1351	1.1346	1.1270	1.1185	1.0939	1.0295	0.9382	0.8343	0.7448	0.6831	0.6481	0.6368	0.9466
H-80	1.1576	1.1620	1.1603	1.1567	1.1509	1.1315	1.0792	1.0071	0.9215	0.8470	0.7944	0.7639	0.7544	1.0097
H-100	1.1717	1.1754	1.1723	1.1704	1.1650	1.1483	1.1030	1.0397	0.9631	0.8949	0.8460	0.8176	0.8089	1.0390
H-150	1.1849	1.1864	1.1831	1.1839	1.1802	1.1676	1.1338	1.0832	1.0195	0.9620	0.9192	0.8941	0.8864	1.0790
H-200	1.1795	1.1793	1.1770	1.1800	1.1776	1.1674	1.1396	1.0963	1.0392	0.9865	0.9474	0.9240	0.9167	1.0902
H-250	1.1727	1.1704	1.1690	1.1723	1.1710	1.1634	1.1390	1.1008	1.0491	1.0005	0.9639	0.9417	0.9350	1.0934
H-280	1.1665	1.1627	1.1619	1.1650	1.1646	1.1590	1.1363	1.1015	1.0537	1.0085	0.9737	0.9523	0.9462	1.0933
H-300	1.1666	1.1629	1.1622	1.1656	1.1653	1.1595	1.1371	1.1024	1.0545	1.0091	0.9742	0.9529	0.9467	1.0942
H-350	1.1607	1.1560	1.1556	1.1582	1.1589	1.1548	1.1333	1.1012	1.0566	1.0145	0.9813	0.9604	0.9550	1.0924
H-400	1.1559	1.1507	1.1505	1.1527	1.1542	1.1513	1.1304	1.1003	1.0581	1.0187	0.9869	0.9663	0.9615	1.0910
S-Cs	1.1202	1.1201	1.1201	1.1201	1.1210	1.1210	1.1101	1.0990	1.0690	1.0489	1.0289	1.0179	1.0178	1.0890
S-Co	1.1088	1.1088	1.1088	1.1171	1.1172	1.1172	1.1070	1.0969	1.0782	1.0581	1.0478	1.0362	1.0362	1.0885
R-C	1.0824	1.0900	1.0900	1.0900	1.0924	1.0824	1.0824	1.0724	1.0624	1.0600	1.0500	1.0424	1.0424	1.0724
R-F	1.0729	1.0780	1.0780	1.0781	1.0781	1.0728	1.0678	1.0618	1.0512	1.0502	1.0398	1.0340	1.0295	1.0617
RQR-2[a]	1.1067	1.1070	1.1075	1.0971	1.0876	1.0558	0.9771	0.8615	0.7319	0.6215	0.5489	0.5079	0.4949	0.8752
RQR-3[a]	1.1183	1.1199	1.1200	1.1109	1.1020	1.0742	1.0022	0.8969	0.7781	0.6761	0.6076	0.5689	0.5565	0.9071
RQR-4[a]	1.1281	1.1307	1.1307	1.1228	1.1149	1.0898	1.0232	0.9270	0.8169	0.7219	0.6571	0.6204	0.6086	0.9345
RQR-5[a]	1.1354	1.1384	1.1382	1.1312	1.1241	1.1006	1.0379	0.9481	0.8441	0.7542	0.6922	0.6568	0.6455	0.9539
RQR-6[a]	1.1423	1.1454	1.1448	1.1387	1.1319	1.1099	1.0509	0.9666	0.8681	0.7823	0.7228	0.6886	0.6778	0.9708
RQR-7[a]	1.1489	1.1520	1.1508	1.1456	1.1390	1.1184	1.0628	0.9834	0.8899	0.8079	0.7505	0.7174	0.7070	0.9861
RQR-8[a]	1.1542	1.1573	1.1557	1.1510	1.1447	1.1252	1.0723	0.9966	0.9071	0.8281	0.7724	0.7402	0.7302	0.9983
RQR-9[a]	1.1623	1.1652	1.1632	1.1597	1.1539	1.1362	1.0878	1.0181	0.9349	0.8613	0.8087	0.7782	0.7687	1.0183
RQR-10[a]	1.1694	1.1720	1.1697	1.1678	1.1630	1.1471	1.1038	1.0412	0.9650	0.8974	0.8484	0.8199	0.8110	1.0400

[a] Radiation quality defined in IEC 61267 [10]

Table A7. Alternative conversion coefficients for the maximum absorbed dose in the sensitive cells of the lens for left and right irradiations for different irradiation geometries, $d_{\mathrm{lens,sens}K}(\mathrm{R};\alpha)$, for photon reference radiation qualities, R, in Gy/Gy. The values are valid for a distance of 1.0 m between the radiation source and the point of test. The standard uncertainties ($k = 1$) are in the order of $5\cdot10^{-4}$ or $\pm$ 2 %, whatever is larger.

Radiation quality R	$d_{\mathrm{lens,sens}K}(\mathrm{R};\alpha)$ for $d_{\mathrm{air}} = 1.0$ m [Gy/Gy] for $\alpha =$							
	0°	15°	30°	45°	60°	75°	90°	ROT
L-10	0.0962	0.0934	0.0853	0.0730	0.0567	0.0355	0.0142	0.0306
L-20	0.7381	0.7315	0.7135	0.6840	0.6347	0.5728	0.4529	0.3166
L-30	1.0763	1.0825	1.0692	1.0641	1.0313	0.9854	0.8859	0.5550
L-35	1.1717	1.1750	1.1723	1.1697	1.1334	1.0933	1.0011	0.6299
L-55	1.4785	1.4782	1.4920	1.5027	1.4936	1.4495	1.3427	0.8921
L-70	1.5586	1.5701	1.5901	1.5929	1.5837	1.5283	1.4694	0.9840
L-100	1.5443	1.5591	1.5636	1.5695	1.5349	1.5330	1.4880	1.0174
L-125	1.4695	1.4796	1.4881	1.4937	1.4728	1.4690	1.4233	0.9994
L-170	1.3915	1.4015	1.4177	1.4051	1.4075	1.3999	1.3521	0.9655
L-210	1.3457	1.3559	1.3683	1.3701	1.3587	1.3558	1.3207	0.9486
L-240	1.3206	1.3346	1.3409	1.3378	1.3429	1.3345	1.3078	0.9419
N-10	0.0644	0.0626	0.0572	0.0489	0.0375	0.0228	0.0087	0.0204
N-15	0.3730	0.3665	0.3464	0.3150	0.2740	0.2188	0.1342	0.1370
N-20	0.6527	0.6459	0.6260	0.5947	0.5466	0.4834	0.3670	0.2715
N-25	0.8526	0.8505	0.8354	0.8105	0.7678	0.7118	0.5967	0.3906
N-30	1.0005	1.0051	0.9905	0.9777	0.9432	0.8941	0.7885	0.4971
N-40	1.2252	1.2320	1.2319	1.2269	1.1950	1.1586	1.0667	0.6746
N-60	1.4613	1.4638	1.4778	1.4847	1.4736	1.4299	1.3300	0.8796
N-80	1.5658	1.5838	1.5914	1.5942	1.5816	1.5366	1.4807	0.9947
N-100	1.5521	1.5689	1.5705	1.5764	1.5437	1.5372	1.4909	1.0165
N-120	1.4971	1.5082	1.5189	1.5233	1.4985	1.4941	1.4502	1.0072
N-150	1.4464	1.4566	1.4654	1.4663	1.4522	1.4480	1.4002	0.9894
N-200	1.3686	1.3787	1.3934	1.3874	1.3834	1.3780	1.3362	0.9569
N-250	1.3238	1.3376	1.3445	1.3406	1.3461	1.3375	1.3097	0.9429
N-300	1.2951	1.3075	1.3088	1.3052	1.3281	1.3074	1.2860	0.9389
N-350	1.2723	1.2808	1.2790	1.2900	1.3061	1.2797	1.2586	0.9368
N-400	1.2487	1.2659	1.2580	1.2756	1.2871	1.2618	1.2377	0.9326
W-30	0.9251	0.9263	0.9113	0.8926	0.8540	0.8014	0.6911	0.4432
W-40	1.1115	1.1166	1.1093	1.1014	1.0674	1.0245	0.9263	0.5844
W-60	1.4037	1.4090	1.4183	1.4209	1.4058	1.3657	1.2665	0.8287
W-80	1.5097	1.5191	1.5321	1.5365	1.5251	1.4788	1.4012	0.9333
W-110	1.5488	1.5649	1.5709	1.5752	1.5502	1.5313	1.4829	1.0086
W-150	1.4770	1.4888	1.4964	1.4992	1.4795	1.4733	1.4262	0.9959
W-200	1.4069	1.4170	1.4297	1.4250	1.4182	1.4127	1.3670	0.9725
W-250	1.3573	1.3686	1.3798	1.3758	1.3738	1.3676	1.3305	0.9540
W-300	1.3244	1.3370	1.3437	1.3392	1.3488	1.3368	1.3080	0.9449
H-10	0.0429	0.0417	0.0382	0.0327	0.0248	0.0147	0.0054	0.0135
H-20	0.3264	0.3211	0.3051	0.2805	0.2469	0.2021	0.1346	0.1241
H-30	0.6685	0.6647	0.6472	0.6208	0.5790	0.5230	0.4194	0.2942
H-40	0.9104	0.9106	0.8972	0.8785	0.8390	0.7871	0.6797	0.4415
H-60	1.2202	1.2261	1.2251	1.2210	1.1951	1.1545	1.0568	0.6780
H-80	1.3816	1.3894	1.3965	1.3970	1.3790	1.3369	1.2485	0.8174
H-100	1.4584	1.4684	1.4771	1.4796	1.4621	1.4231	1.3455	0.8925
H-150	1.5135	1.5256	1.5358	1.5395	1.5217	1.4960	1.4391	0.9815
H-200	1.4726	1.4845	1.4953	1.4953	1.4813	1.4661	1.4170	0.9853
H-250	1.4266	1.4383	1.4489	1.4474	1.4375	1.4277	1.3842	0.9754
H-280	1.3893	1.4012	1.4104	1.4076	1.4046	1.3951	1.3565	0.9653
H-300	1.3894	1.4012	1.4110	1.4078	1.4037	1.3959	1.3565	0.9655
H-350	1.3576	1.3688	1.3764	1.3747	1.3769	1.3656	1.3311	0.9567
H-400	1.3329	1.3446	1.3500	1.3505	1.3562	1.3424	1.3109	0.9504
S-Cs	1.1730	1.1738	1.1928	1.2127	1.2227	1.1832	1.1749	0.9355

(Continued.)

Table A7. (Continued.)

Radiation quality R	$d_{\mathrm{lens,sens}K}(\mathrm{R};\alpha)$ for $d_{\mathrm{air}} = 1.0$ m [Gy/Gy] for $\alpha =$							
	0°	15°	30°	45°	60°	75°	90°	ROT
S-Co	1.1333	1.1450	1.1493	1.1586	1.1692	1.1418	1.1327	0.9524
R-C	1.0900	1.0908	1.1008	1.1046	1.1001	1.0853	1.0900	0.9715
R-F	1.0759	1.0860	1.0722	1.0876	1.0930	1.0706	1.0755	0.9709
RQR-2[a]	1.0637	1.0677	1.0585	1.0477	1.0124	0.9669	0.8655	0.5473
RQR-3[a]	1.1315	1.1373	1.1308	1.1220	1.0908	1.0481	0.9475	0.6021
RQR-4[a]	1.1946	1.2002	1.1973	1.1916	1.1638	1.1217	1.0221	0.6541
RQR-5[a]	1.2419	1.2478	1.2479	1.2438	1.2185	1.1760	1.0792	0.6948
RQR-6[a]	1.2841	1.2910	1.2927	1.2899	1.2666	1.2241	1.1309	0.7321
RQR-7[a]	1.3221	1.3299	1.3328	1.3312	1.3089	1.2673	1.1779	0.7667
RQR-8[a]	1.3516	1.3600	1.3641	1.3634	1.3415	1.3012	1.2153	0.7948
RQR-9[a]	1.3959	1.4052	1.4114	1.4119	1.3911	1.3533	1.2736	0.8403
RQR-10[a]	1.4346	1.4446	1.4527	1.4543	1.4352	1.4013	1.3286	0.8872

[a] Radiation quality defined in IEC 61267 [10]

Table B1. Fluence weighted mean energy, E(R), kerma coefficient, k_Φ(R), one minus radiative losses in air, $(1-g)$(R), and the ratio $(\mu_{\mathrm{en,not\_renormalized}}/\mu_{\mathrm{en,renormalized}})$(R) for photon reference radiation qualities, R. The values are valid for a distance of 2.5 m between the radiation source and the point of test. Data are only given in case the deviation from the data for $d_{\mathrm{air}} = 1.0$ m is larger than 0.2 %.

Radiation quality R	Fluence weighted mean energy, E(R) [keV]	Kerma coefficient, k_Φ(R) [pGy cm^2]	One minus radiative losses in air, $(1-g)$(R) [1]	Ratio $(\mu_{\mathrm{en,not\_renormalized}}/\mu_{\mathrm{en,renormalized}})$(R) [1]
L-10	9.17	8.99	—	—
L-20	17.38	2.37	—	—
L-30	—	—	—	—
L-35	—	—	—	—
L-55	—	—	—	—
L-70	—	—	—	—
L-100	—	—	—	—
L-125	—	—	—	—
L-170	—	—	—	—
L-210	184.2	0.775	—	—
L-240	—	—	—	—
N-10	8.87	9.72	—	—
N-15	12.67	4.69	—	—
N-20	16.49	2.706	—	—
N-25	20.45	1.707	—	—
N-30	24.70	1.140	—	—
N-40	33.34	0.621	—	—
N-60	—	—	—	—
N-80	—	—	—	—
N-100	—	—	—	—
N-120	—	—	—	—
N-150	—	—	—	—
N-200	—	—	—	—
N-250	—	—	—	—
N-300	247.5	1.103	—	—
N-350	—	—	—	—
N-400	—	—	—	—
W-30	23.11	1.357	—	—
W-40	29.90	0.809	—	—
W-60	—	0.400	—	—
W-80	—	—	—	—
W-110	—	—	—	—

(Continued.)

Table B1. (Continued.)

Radiation quality R	Fluence weighted mean energy, E(R) [keV]	Kerma coefficient, k_{Φ}(R) [pGy cm^2]	One minus radiative losses in air, $(1-g)$(R) [1]	Ratio $(\mu_{\mathrm{en,not\_renormalized}}/\mu_{\mathrm{en,renormalized}})$(R) [1]
W-150	104.6	0.404	—	—
W-200	137.9	0.548	—	—
W-250	—	—	—	—
W-300	—	0.883	—	—
H-10	8.65	10.35	—	—
H-20	14.01	4.26	—	—
H-30	20.07	2.047	—	—
H-40	25.75	1.223	—	—
H-60	38.13	0.571	—	—
H-80	48.9	0.403	—	—
H-100	57.4	0.3532	—	—
H-150	—	—	—	—
H-200	—	—	—	—
H-250	—	—	—	—
H-280	—	—	—	—
H-300	145.1	0.593	—	—
H-350	—	—	—	—
H-400	—	—	—	—
S-Cs	—	—	—	—
S-Co	—	—	—	—
R-C	—	—	—	—
R-F	—	—	—	—

Table B2. Conversion coefficients for the ambient dose, $h^*_K(\mathrm{R})$, as well as for the personal dose for different irradiation geometries, $h_{pK}(\mathrm{R};\alpha)$, for photon reference radiation qualities, R, in Sv/Gy. The values are valid for a distance of 2.5 m between the radiation source and the point of test. The standard uncertainties ($k = 1$) are in the order of $5 \cdot 10^{-4}$ or ± 2 %, whatever is larger. Data are only given in case the deviation from the data for $d_{air} = 1.0$ m is larger than 0.2 %.

Radiation quality R	$h^*_K(\mathrm{R})$ for d_{air} = 2.5 m [Sv Gy^{-1}]	$h_{pK}(\mathrm{R};\alpha)$ for d_{air} = 2.5 m [Sv Gy^{-1}] for α =											
		0°	15°	30°	45°	60°	75°	90°	180°	ROT	ISO	SS-ISO	IS-ISO
L-10	0.0058	0.0058	0.0059	0.0055	0.0048	0.0039	0.0029	0.0017	0.0021	0.0032	0.0027	0.0028	0.0026
L-20	0.0789	0.0789	0.0772	0.0720	0.0630	0.0493	0.0337	0.0206	0.0079	0.0346	0.0282	0.0284	0.0273
L-30	—	—	—	—	—	0.2050	0.1447	0.0905	0.0760	0.1500	0.1181	0.1201	0.1161
L-35	—	—	0.4243	0.3992	0.3541	0.2921	0.2119	0.1347	0.1378	0.2215	0.1742	0.1781	0.1705
L-55	—	—	—	—	—	—	—	—	—	—	—	—	—
L-70	—	—	—	—	—	—	—	—	—	—	—	—	—
L-100	—	—	—	—	—	—	—	—	—	—	—	—	—
L-125	—	—	—	—	—	—	—	—	—	—	—	—	—
L-170	—	—	—	—	—	—	—	—	—	—	—	—	—
L-210	—	—	—	—	—	—	—	—	—	—	—	—	—
L-240	—	—	—	—	—	—	—	—	—	—	—	—	—
N-10	0.0049	0.0049	0.0050	0.0046	0.0041	0.0034	0.0025	0.0015	0.0019	0.0027	0.0024	0.0025	0.0023
N-15	0.0244	0.0244	0.0240	0.0220	0.0187	0.0147	0.0103	0.0062	0.0034	0.0107	0.0091	0.0094	0.0089
N-20	0.0643	0.0643	0.0629	0.0585	0.0510	0.0398	0.0273	0.0167	0.0065	0.0280	0.0230	0.0233	0.0223
N-25	0.1327	0.1327	0.1298	0.1217	0.1075	0.0853	0.0585	0.0360	0.0185	0.0602	0.0483	0.0484	0.0468
N-30	0.2381	0.2381	0.2332	0.2193	0.1945	0.1573	0.1100	0.0684	0.0508	0.1137	0.0899	0.0910	0.0880
N-40	0.5250	0.5250	0.5178	0.4877	0.4328	0.3593	0.2658	0.1715	0.1945	0.2799	0.2206	0.2258	0.2145
N-60	—	—	1.0010	0.9521	0.8533	0.7243	0.5608	0.3893	0.5524	0.6095	0.4884	0.4997	0.4714
N-80	—	—	—	—	—	—	—	—	—	—	—	—	—
N-100	—	—	—	—	—	—	—	—	—	—	—	—	—
N-120	—	—	—	—	—	—	—	—	—	—	—	—	—
N-150	—	—	—	—	—	—	—	—	—	—	—	—	—
N-200	—	—	—	—	—	—	—	—	—	—	—	—	—
N-250	—	—	—	—	—	—	—	—	—	—	—	—	—
N-300	—	—	—	—	—	—	—	—	—	—	—	—	—
N-350	—	—	—	—	—	—	—	—	—	—	—	—	—
N-400	—	—	—	—	—	—	—	—	—	—	—	—	—

(Continued.)

Table B2. (Continued.)

Radiation quality R	h^*_K(R) for d_{air} = 2.5 m [Sv Gy^{-1}]	h_{pK}(R;α) for d_{air} = 2.5 m [Sv Gy^{-1}] for α =											
		0°	15°	30°	45°	60°	75°	90°	180°	ROT	ISO	SS-ISO	IS-ISO
W-30	0.1876	0.1876	0.1837	0.1725	0.1528	0.1228	0.0854	0.0529	0.0355	0.0881	0.0700	0.0707	0.0683
W-40	0.3779	0.3779	0.3718	0.3500	0.3105	0.2555	0.1852	0.1179	0.1185	0.1937	0.1527	0.1558	0.1491
W-60	0.8906	0.8906	0.8776	0.8334	0.7453	0.6300	0.4845	0.3320	0.4570	0.5236	0.4182	0.4281	0.4038
W-80	—	—	—	—	—	—	—	—	—	—	—	—	—
W-110	—	—	—	—	—	—	—	—	—	—	—	—	—
W-150	—	—	—	—	—	—	—	—	—	—	—	—	—
W-200	—	—	—	—	—	—	—	—	—	—	—	—	—
W-250	—	—	—	—	—	—	—	—	—	—	—	—	—
W-300	—	—	—	—	—	—	—	—	—	—	—	—	—
H-10	0.0043	0.0043	0.0044	0.0041	0.0036	0.0030	0.0022	0.0013	0.0018	0.0025	0.0022	0.0022	0.0021
H-20	0.0316	0.0316	0.0310	0.0287	0.0248	0.0194	0.0135	0.0082	0.0040	0.0139	0.0116	0.0119	0.0113
H-30	0.1062	0.1062	0.1040	0.0973	0.0857	0.0683	0.0472	0.0291	0.0169	0.0487	0.0391	0.0395	0.0381
H-40	0.2218	0.2218	0.2177	0.2046	0.1812	0.1473	0.1047	0.0659	0.0558	0.1089	0.0863	0.0877	0.0842
H-60	0.5861	0.5861	0.5773	0.5462	0.4867	0.4071	0.3062	0.2039	0.2537	0.3267	0.2596	0.2655	0.2515
H-80	0.9007	0.9007	0.8887	0.8430	0.7565	0.6427	0.4964	0.3439	0.4822	0.5386	0.4313	0.4415	0.4178
H-100	1.0892	1.0892	1.0763	1.0217	0.9220	0.7903	0.6180	0.4377	0.6410	0.6768	0.5439	0.5569	0.5267
H-150	—	—	—	—	—	—	—	—	—	—	—	—	—
H-200	—	—	—	—	—	—	—	—	—	—	—	—	—
H-250	—	—	—	—	—	—	—	—	—	—	—	—	—
H-280	—	—	—	—	—	—	—	—	—	—	—	—	—
H-300	—	—	—	—	—	—	—	—	—	—	—	—	—
H-350	—	—	—	—	—	—	—	—	—	—	—	—	—
H-400	—	—	—	—	—	—	—	—	—	—	—	—	—
S-Cs	—	—	—	—	—	—	—	—	—	—	—	—	—
S-Co	—	—	—	—	—	—	—	—	—	—	—	—	—
R-C	—	—	—	—	—	—	—	—	—	—	—	—	—
R-F	—	—	—	—	—	—	—	—	—	—	—	—	—

Table B3. Conversion coefficients for the maximum absorbed dose in the complete lens for left and right irradiations for different irradiation geometries, $d_{\mathrm{lens}K}(\mathrm{R};\alpha)$, for photon reference radiation qualities, R, in Gy/Gy. The values are valid for a distance of 2.5 m between the radiation source and the point of test. The standard uncertainties ($k = 1$) are in the order of $5 \cdot 10^{-4}$ or $\pm$ 2 %, whatever is larger. Data are only given in case the deviation from the data for $d_{\mathrm{air}} = 1.0$ m is larger than 0.2 %.

Radiation quality R	$d_{\mathrm{lens}K}(\mathrm{R};\alpha)$ for $d_{\mathrm{air}} = 2.5$ m [Gy Gy^{-1}] for $\alpha =$							
	0°	15°	30°	45°	60°	75°	90°	ROT
L-10	0.0578	0.0564	0.0530	0.0462	0.0352	0.0209	0.0082	0.0187
L-20	—	—	—	—	—	0.5032	0.3960	—
L-30	—	—	—	—	—	—	—	—
L-35	—	—	—	—	—	—	—	—
L-55	—	—	—	—	—	—	—	—
L-70	—	—	—	—	—	—	—	—
L-100	—	—	—	—	—	—	—	—
L-125	—	—	—	—	—	—	—	—
L-170	—	—	—	—	—	—	—	—
L-210	—	—	—	—	—	—	—	—
L-240	—	—	—	—	—	—	—	—
N-10	0.0446	0.0436	0.0409	0.0356	0.0269	0.0156	0.0059	0.0144
N-15	0.3021	0.2978	0.2857	0.2643	0.2315	0.1800	0.1118	0.1126
N-20	0.5732	0.5683	0.5545	0.5317	0.4944	0.4292	0.3268	0.2396
N-25	0.7873	0.7849	0.7737	0.7535	0.7218	0.6594	0.5532	0.3588
N-30	0.9547	0.9574	0.9516	0.9360	0.9078	0.8536	0.7558	0.4689
N-40	—	—	—	—	—	—	1.0592	0.6567
N-60	—	—	—	—	—	—	—	—
N-80	—	—	—	—	—	—	—	—
N-100	—	—	—	—	—	—	—	—
N-120	—	—	—	—	—	—	—	—
N-150	—	—	—	—	—	—	—	—
N-200	—	—	—	—	—	—	—	—
N-250	—	—	—	—	—	—	—	—
N-300	—	—	—	—	—	—	—	—
N-350	—	—	—	—	—	—	—	—
N-400	—	—	—	—	—	—	—	—
W-30	0.8721	0.8724	0.8641	0.8463	0.8163	0.7582	0.6565	0.4151
W-40	1.0824	1.0903	1.0873	1.0758	1.0490	1.0012	0.9104	0.5636
W-60	—	—	—	—	—	—	—	—
W-80	—	—	—	—	—	—	—	—
W-110	—	—	—	—	—	—	—	—
W-150	—	—	—	—	—	—	—	—
W-200	—	—	—	—	—	—	—	—
W-250	—	—	—	—	—	—	—	—
W-300	—	—	—	—	—	—	—	—
H-10	0.0364	0.0356	0.0335	0.0290	0.0218	0.0125	0.0047	0.0117
H-20	0.3242	0.3204	0.3097	0.2913	0.2622	0.2151	0.1500	0.1276
H-30	0.6463	0.6435	0.6323	0.6120	0.5793	0.5200	0.4247	0.2884
H-40	0.8762	0.8777	0.8698	0.8529	0.8224	0.7661	0.6675	0.4252
H-60	1.2114	1.2224	1.2237	1.2166	1.1956	1.1476	1.0617	0.6689
H-80	1.3833	1.3977	1.4070	1.4042	1.3891	1.3406	1.2633	0.8168
H-100	1.4609	1.4759	1.4893	1.4880	1.4752	1.4283	1.3573	0.8946
H-150	—	—	—	—	—	—	—	—
H-200	—	—	—	—	—	—	—	—
H-250	—	—	—	—	—	—	—	—
H-280	—	—	—	—	—	—	—	—
H-300	—	—	—	—	—	—	—	—
H-350	—	—	—	—	—	—	—	—
H-400	—	—	—	—	—	—	—	—
S-Cs	—	—	—	—	—	—	—	—
S-Co	—	—	—	—	—	—	—	—
R-C	—	—	—	—	—	—	—	—
R-F	—	—	—	—	—	—	—	—

Table B4. Conversion coefficients for the directional absorbed dose in local skin as well as for the personal absorbed dose in local skin on the slab phantom for different irradiation geometries, $d_{\mathrm{local\ skin}\ K}(\mathrm{R};\alpha)_{\mathrm{slab}}$, for photon reference radiation qualities, R, in Gy/Gy. The values are valid for a distance of 2.5 m between the radiation source and the point of test. The standard uncertainties ($k = 1$) are in the order of $5{\cdot}10^{-4}$ or $\pm$ 2 %, whatever is larger. Data are only given in case the deviation from the data for $d_{\mathrm{air}} = 1.0$ m is larger than 0.2 %.

Radiation quality R	$d_{\mathrm{local\ skin}\ K}(\mathrm{R};\alpha)_{\mathrm{slab}}$ for $d_{\mathrm{air}} = 2.5$ m [Gy Gy^{-1}] for $\alpha =$					
	0°	15°	30°	45°	60°	75°
L-10	0.9550	0.9530	0.9492	0.9341	0.9056	0.8133
L-20	—	—	—	—	—	—
L-30	—	—	—	—	—	—
L-35	—	—	—	—	—	—
L-55	—	—	—	—	—	—
L-70	—	—	—	—	—	—
L-100	—	—	—	—	—	—
L-125	—	—	—	—	—	—
L-170	—	—	—	—	—	—
L-210	—	—	—	—	—	—
L-240	—	—	—	—	—	—
N-10	0.9478	0.9457	0.9410	0.9244	0.8915	0.7881
N-15	0.9916	0.9904	0.9898	0.9786	0.9657	0.9248
N-20	1.0321	1.0322	1.0320	1.0219	1.0115	0.9836
N-25	1.0884	1.0878	1.0879	—	—	—
N-30	—	—	—	—	—	—
N-40	—	—	—	—	—	—
N-60	—	—	—	—	—	—
N-80	—	—	—	—	—	—
N-100	—	—	—	—	—	—
N-120	—	—	—	—	—	—
N-150	—	—	—	—	—	—
N-200	—	—	—	—	—	—
N-250	—	—	—	—	—	—
N-300	—	—	—	—	—	—
N-350	—	—	—	—	—	—
N-400	—	—	—	—	—	—
W-30	1.1275	1.1252	1.1256	1.1134	1.0971	1.0614
W-40	1.2535	1.2463	1.2454	1.2277	1.1948	—
W-60	—	—	—	—	—	—
W-80	—	—	—	—	—	—
W-110	—	—	—	—	—	—
W-150	—	—	—	—	—	—
W-200	—	—	—	—	—	—
W-250	—	—	—	—	—	—
W-300	—	—	—	—	—	—
H-10	0.9412	0.9389	0.9333	0.9153	0.8786	0.7656
H-20	0.9943	0.9933	0.9920	0.9801	0.9643	0.9151
H-30	1.0628	1.0618	1.0617	1.0505	1.0373	1.0031
H-40	1.1473	1.1439	1.1438	1.1303	1.1101	1.0696
H-60	1.3750	1.3665	1.3623	1.3372	1.2922	1.2116
H-80	1.5467	1.5369	1.5273	1.4935	1.4327	1.3216
H-100	1.6344	1.6247	1.6127	1.5759	1.5089	1.3866
H-150	—	—	—	—	—	—
H-200	—	—	—	—	—	—
H-250	—	—	—	—	—	—
H-280	—	—	—	—	—	—
H-300	—	—	—	—	—	—
H-350	—	—	—	—	—	—
H-400	—	—	—	—	—	—
S-Cs	—	—	—	—	—	—
S-Co	—	—	—	—	—	—
R-C	—	—	—	—	—	—
R-F	—	—	—	—	—	—

Table B5. Conversion coefficients for the personal absorbed dose in local skin on the pillar phantom for different irradiation geometries, $d_{\text{local skin }K}(\text{R};\alpha)_{\text{pillar}}$, for photon reference radiation qualities, R, in Gy/Gy. The values are valid for a distance of 2.5 m between the radiation source and the point of test. The standard uncertainties ($k = 1$) are in the order of $5{\cdot}10^{-4}$ or $\pm$ 2 %, whatever is larger. Data are only given in case the deviation from the data for $d_{\text{air}} = 1.0$ m is larger than 0.2 %.

Radiation quality R	$d_{\text{local skin }K}(\text{R};\alpha)_{\text{pillar}}$ for $d_{\text{air}} = 2.5$ m [Gy Gy^{-1}] for $\alpha =$													
	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	ROT
L-10	0.9603	0.9576	0.9553	0.9416	0.9095	0.8122	0.2648	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.4433
L-20	—	—	—	—	—	—	—	0.1376	0.0254	0.0059	0.0016	0.0006	<0.0005	—
L-30	—	—	—	—	—	—	—	—	0.2531	0.1434	0.1025	0.0811	0.0716	—
L-35	—	—	—	—	—	—	—	—	—	0.2291	0.1709	0.1402	0.1286	—
L-55	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-70	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-100	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-125	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-170	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-210	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-240	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-10	0.9521	0.9495	0.9459	0.9306	0.8947	0.7871	0.2398	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.4353
N-15	1.0021	0.9995	1.0010	0.9905	0.9743	0.9301	0.4786	0.0185	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.4909
N-20	1.0397	1.0423	1.0396	1.0321	1.0213	0.9981	0.6661	0.1032	0.0166	0.0036	0.0009	<0.0005	<0.0005	0.5369
N-25	—	—	—	—	—	—	0.8165	0.2497	0.0748	0.0293	0.0165	0.0116	0.0096	0.5952
N-30	—	—	—	—	—	—	—	0.4185	0.1817	0.0952	0.0654	0.0507	0.0442	0.6704
N-40	—	—	—	—	—	—	—	0.6993	0.4315	0.2853	0.2163	0.1817	0.1717	—
N-60	—	—	—	—	—	—	—	—	—	—	—	0.3762	0.3867	—
N-80	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-100	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-120	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-150	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-200	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-250	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-300	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-350	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-400	—	—	—	—	—	—	—	—	—	—	—	—	—	—

(Continued.)

Table B5. Continued

Radiation quality R	$d_{\text{local skin }K}(\text{R};\alpha)_{\text{pillar}}$ for $d_{\text{air}} = 2.5$ m [Gy Gy^{-1}] for $\alpha =$													
	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	ROT
W-30	1.1236	1.1286	1.1215	1.1187	1.1065	1.0854	0.8775	0.3367	0.1308	0.0640	0.0424	0.0323	0.0280	0.6341
W-40	1.2239	1.2210	1.2162	1.2112	1.1931	1.1732	1.0243	0.5612	0.3069	0.1892	0.1398	0.1147	0.1059	0.7502
W-60	—	—	—	—	—	—	—	—	0.6225	0.4659	0.3682	0.3278	0.3328	—
W-80	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W-110	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W-150	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W-200	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W-250	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W-300	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-10	0.9448	0.9421	0.9374	0.9205	0.8812	0.7648	0.2207	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.4283
H-20	1.0028	1.0017	1.0010	0.9906	0.9722	0.9215	0.4837	0.0386	0.0048	0.0010	<0.0005	<0.0005	<0.0005	0.4929
H-30	1.0661	1.0693	1.0651	1.0593	1.0467	1.0196	0.7176	0.1840	0.0587	0.0260	0.0163	0.0122	0.0104	0.5673
H-40	1.1375	1.1396	1.1341	1.1297	1.1160	1.0949	0.8796	0.3581	0.1620	0.0907	0.0643	0.0515	0.0467	0.6503
H-60	1.2926	1.2926	1.2807	1.2828	1.2603	1.2454	1.1133	0.6999	0.4388	0.3037	0.2339	0.2022	0.1986	0.8406
H-80	1.3784	1.3797	1.3619	1.3683	1.3458	1.3394	1.2295	0.8772	0.6105	0.4602	0.3699	0.3283	0.3309	0.9605
H-100	—	—	—	—	—	—	1.2797	0.9593	0.6980	0.5459	0.4521	0.4040	0.4082	1.0192
H-150	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-200	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-250	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-280	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-300	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-350	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-400	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-Cs	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-Co	—	—	—	—	—	—	—	—	—	—	—	—	—	—
R-C	—	—	—	—	—	—	—	—	—	—	—	—	—	—
R-F	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table B6. Conversion coefficients for the personal absorbed dose in local skin on the rod phantom for different irradiation geometries, $d_{\text{local skin }K}(\text{R};\alpha)_{\text{rod}}$, for photon reference radiation qualities, R, in Gy/Gy. The values are valid for a distance of 2.5 m between the radiation source and the point of test. The standard uncertainties ($k = 1$) are in the order of $5\cdot10^{-4}$ or ± 2 %, whatever is larger. Data are only given in case the deviation from the data for $d_{\text{air}} = 1.0$ m is larger than 0.2 %.

Radiation quality R	$d_{\text{local skin }K}(\text{R};\alpha)_{\text{rod}}$ for $d_{\text{air}} = 2.5$ m [Gy Gy^{-1}] for $\alpha =$													
	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	ROT
L-10	0.9572	0.9574	0.9479	0.9280	0.8619	0.6769	0.4368	0.2048	0.0447	0.0020	<0.0005	<0.0005	<0.0005	0.4619
L-20	—	—	—	—	—	—	—	—	0.4078	0.2665	0.1916	0.1561	0.1454	—
L-30	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-35	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-55	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-70	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-100	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-125	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-170	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-210	—	—	—	—	—	—	—	—	—	—	—	—	—	—
L-240	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-10	0.9487	0.9490	0.9381	0.9157	0.8439	0.6541	0.4154	0.1891	0.0379	0.0013	<0.0005	<0.0005	<0.0005	0.4517
N-15	1.0020	1.0008	0.9928	0.9864	0.9501	0.8207	0.6082	0.3688	0.1649	0.0628	0.0292	0.0175	0.0142	0.5420
N-20	1.0359	1.0359	1.0284	1.0251	1.0042	0.9202	0.7589	0.5524	0.3502	0.2137	0.1462	0.1155	0.1064	0.6421
N-25	—	—	—	—	—	0.9898	0.8734	0.7116	0.5379	0.4022	0.3230	0.2817	0.2688	0.7514
N-30	—	—	—	—	—	—	—	0.8306	0.6903	0.5714	0.4944	0.4508	0.4369	—
N-40	—	—	—	—	—	—	—	—	—	—	—	0.6723	0.6609	—
N-60	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-80	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-100	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-120	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-150	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-200	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-250	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-300	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-350	—	—	—	—	—	—	—	—	—	—	—	—	—	—
N-400	—	—	—	—	—	—	—	—	—	—	—	—	—	—

(Continued.)

Table B6. (Continued.)

Radiation quality R	$d_{\text{local skin }K}(\text{R};\alpha)_{\text{rod}}$ for $d_{\text{air}} = 2.5$ m [Gy Gy^{-1}] for $\alpha =$													
	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	ROT
W-30	—	—	—	—	—	1.0148	0.9144	0.7717	0.6152	0.4884	0.4106	0.3683	0.3549	0.7996
W-40	—	—	—	—	—	—	1.0015	0.8969	0.7785	0.6756	0.6058	0.5657	0.5530	0.9057
W-60	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W-80	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W-110	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W-150	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W-200	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W-250	—	—	—	—	—	—	—	—	—	—	—	—	—	—
W-300	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-10	0.9411	0.9415	0.9292	0.9046	0.8280	0.6350	0.3982	0.1772	0.0332	0.0009	<0.0005	<0.0005	<0.0005	0.4433
H-20	1.0010	1.0004	0.9922	0.9835	0.9446	0.8159	0.6120	0.3840	0.1907	0.0923	0.0561	0.0417	0.0375	0.5521
H-30	1.0479	1.0476	1.0433	1.0361	1.0164	0.9397	0.7947	0.6095	0.4268	0.3011	0.2353	0.2031	0.1932	0.6889
H-40	1.0831	1.0831	1.0818	1.0730	1.0607	1.0131	0.9094	0.7652	0.6109	0.4895	0.4162	0.3770	0.3648	0.7999
H-60	1.1350	1.1382	1.1379	1.1308	1.1231	1.1000	1.0372	0.9471	0.8437	0.7541	0.6923	0.6571	0.6458	0.9533
H-80	—	—	—	—	—	1.1348	1.0840	1.0134	0.9288	0.8546	0.8018	0.7713	0.7617	1.0143
H-100	—	—	—	—	—	—	1.1055	1.0431	0.9672	0.8992	0.8503	0.8218	0.8131	1.0415
H-150	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-200	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-250	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-280	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-300	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-350	—	—	—	—	—	—	—	—	—	—	—	—	—	—
H-400	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-Cs	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-Co	—	—	—	—	—	—	—	—	—	—	—	—	—	—
R-C	—	—	—	—	—	—	—	—	—	—	—	—	—	—
R-F	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table B7. Alternative conversion coefficients for the maximum absorbed dose in the sensitive cells of the lens for left and right irradiations for different irradiation geometries, $d_{\text{lens,sens}K}(\text{R};\alpha)$, for photon reference radiation qualities, R, in Gy/Gy. The values are valid for a distance of 2.5 m between the radiation source and the point of test. The standard uncertainties ($k = 1$) are in the order of $5{\cdot}10^{-4}$ or $\pm$ 2 %, whatever is larger. Data are only given in case the deviation from the data for $d_{\text{air}} = 1.0$ m is larger than 0.2 %.

Radiation quality R	$d_{\text{lens,sens}K}(\text{R};\alpha)$ for $d_{\text{air}} = 2.5$ m [Gy Gy^{-1}] for $\alpha =$							
	0°	15°	30°	45°	60°	75°	90°	ROT
L-10	0.1101	0.1069	0.0976	0.0837	0.0654	0.0414	0.0169	0.0352
L-20	0.7366	—	—	—	—	—	0.4543	—
L-30	—	—	—	—	—	—	—	—
L-35	—	—	—	—	—	—	—	—
L-55	—	—	—	—	—	—	—	—
L-70	—	—	—	—	—	—	—	—
L-100	—	—	—	—	—	—	—	—
L-125	—	—	—	—	—	—	—	—
L-170	—	—	—	—	—	—	—	—
L-210	—	—	—	—	—	—	—	—
L-240	—	—	—	—	—	—	—	—
N-10	0.0875	0.0849	0.0776	0.0664	0.0513	0.0319	0.0126	0.0278
N-15	0.4068	0.4001	0.3790	0.3461	0.3028	0.2444	0.1526	0.1509
N-20	0.6700	0.6633	0.6436	0.6126	0.5643	0.5011	0.3836	0.2804
N-25	0.8582	0.8564	0.8415	0.8169	0.7746	0.7191	0.6044	0.3944
N-30	1.0026	1.0073	0.9927	0.9801	0.9458	0.8969	0.7915	0.4989
N-40	—	—	—	—	—	—	—	0.6759
N-60	—	—	—	—	—	—	—	—
N-80	—	—	—	—	—	—	—	—
N-100	—	—	—	—	—	—	—	—
N-120	—	—	—	—	—	—	—	—
N-150	—	—	—	—	—	—	—	—
N-200	—	—	—	—	—	—	—	—
N-250	—	—	—	—	—	—	—	—
N-300	—	—	—	—	—	—	—	—
N-350	—	—	—	—	—	—	—	—
N-400	—	—	—	—	—	—	—	—
W-30	0.9313	0.9329	0.9180	0.8998	0.8616	0.8094	0.6996	0.4478
W-40	1.1169	1.1220	1.1150	1.1073	1.0735	1.0308	0.9329	0.5884
W-60	—	—	—	—	—	—	—	—
W-80	—	—	—	—	—	—	—	—
W-110	—	—	—	—	—	—	—	—
W-150	—	—	—	—	—	—	—	—
W-200	—	—	—	—	—	—	—	—
W-250	—	—	—	—	—	—	—	—
W-300	—	—	—	—	—	—	—	—
H-10	0.0728	0.0706	0.0646	0.0552	0.0424	0.0260	0.0101	0.0230
H-20	0.4151	0.4091	0.3909	0.3628	0.3238	0.2716	0.1880	0.1618
H-30	0.7275	0.7242	0.7068	0.6808	0.6382	0.5812	0.4727	0.3249
H-40	0.9355	0.9362	0.9232	0.9054	0.8661	0.8147	0.7072	0.4571
H-60	1.2342	1.2402	1.2394	1.2355	1.2097	1.1689	1.0706	0.6870
H-80	1.3923	1.4002	1.4077	1.4084	1.3906	1.3486	1.2601	0.8250
H-100	1.4643	1.4745	1.4833	1.4860	1.4686	1.4297	1.3523	0.8970
H-150	—	—	—	—	—	—	—	—
H-200	—	—	—	—	—	—	—	—
H-250	—	—	—	—	—	—	—	—
H-280	—	—	—	—	—	—	—	—
H-300	—	—	—	—	—	—	—	—
H-350	—	—	—	—	—	—	—	—
H-400	—	—	—	—	—	—	—	—
S-Cs	—	—	—	—	—	—	—	—
S-Co	—	—	—	—	—	—	—	—
R-C	—	—	—	—	—	—	—	—
R-F	—	—	—	—	—	—	—	—

Table C1a. Parameter $m(1.0\ \mathrm{m})$ for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96\ \mathrm{kg\ m^{-3}}$ to $\rho = 1.32\ \mathrm{kg\ m^{-3}}$ (see exceptions in the notes) for K_{a} and k_{Φ}. The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for $m(1.0\ \mathrm{m})$ and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho)-1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %.

Radiation quality R	$m(1.0\ \mathrm{m})$ ($\mathrm{m^3\ kg^{-1}}$) for the quantity	
	K_{a}	k_{Φ}
L-10	−0.758	−0.0314
L-20	−0.124	−0.00714
L-30	−0.0468	−0.00137
L-35	−0.0375	−0.00120
N-10	−0.975[a]	−0.0834
N-15	−0.345	−0.0380
N-20	−0.164	−0.0201
N-25	−0.0927	−0.00959
N-30	−0.0587	−0.0042
N-40	−0.0337	−0.00145
W-30	−0.0758	−0.00996
W-40	−0.0458	−0.00542
H-10	−1.26[a]	−0.168
H-20	−0.455	−0.124
H-30	−0.187	−0.0672
H-40	−0.0887	−0.0259
H-60	−0.0368	−0.00606

[a] These values are only valid in the range from $\rho = 1.07\ \mathrm{kg\ m^{-3}}$ to $\rho = 1.32\ \mathrm{kg\ m^{-3}}$.

Table C1b. Parameter m_d for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96\ \mathrm{kg\ m^{-3}}$ to $\rho = 1.32\ \mathrm{kg\ m^{-3}}$ (see exceptions in the notes) for K_{a} and k_{Φ}. The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for $m(1.0\ \mathrm{m})$ and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho)-1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %.

Radiation quality R	m_d ($\mathrm{m^2\ kg^{-1}}$) for the quantity	
	K_{a}	k_{Φ}
L-10	−0.659[a]	−0.0134
L-20	−0.128	−0.0119
L-30	−0.0465	−0.00133
L-35	−0.0373	−0.00117
N-10	−0.687[a]	−0.0117
N-15	−0.287 [b]	−0.0219
N-20	−0.148	−0.0147
N-25	−0.0876	−0.00752
N-30	−0.0580	−0.00415
N-40	−0.0335	−0.00140
W-30	−0.0727	−0.00883
W-40	−0.0444	−0.00473
H-10	−0.660[c]	0.00542
H-20	−0.273 [b]	−0.0650
H-30	−0.125	−0.0314
H-40	−0.0752	−0.0178
H-60	−0.0359	−0.00562

[a] These values are only valid in the range from $\rho = 1.12\ \mathrm{kg\ m^{-3}}$ to $\rho = 1.27\ \mathrm{kg\ m^{-3}}$.
[b] These values are only valid in the range from $\rho = 1.04\ \mathrm{kg\ m^{-3}}$ to $\rho = 1.32\ \mathrm{kg\ m^{-3}}$.
[c] These values are only valid in the range from $\rho = 1.16\ \mathrm{kg\ m^{-3}}$ to $\rho = 1.23\ \mathrm{kg\ m^{-3}}$.

Table C2a. Parameter $m(1.0\ \mathrm{m})$ for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96\ \mathrm{kg\ m^{-3}}$ to $\rho = 1.32\ \mathrm{kg\ m^{-3}}$ for $h^*_K(\mathrm{R})$ and $h_{\mathrm{p}K}(\mathrm{R};\alpha)$. The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for $m(1.0\ \mathrm{m})$ and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho)-1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %.

Radiation quality R	$m(1.0\ \mathrm{m})$ for the quantity $h^*_K(\mathrm{R})$ [$\mathrm{m^3\ kg^{-1}}$]	$m(1.0\ \mathrm{m})$ for the quantity $h_{\mathrm{p}K}(\mathrm{R};\alpha)$ [$\mathrm{m^3\ kg^{-1}}$] for $\alpha =$											
		0°	15°	30°	45°	60°	75°	90°	180°	ROT	ISO	SS-ISO	IS-ISO
L-10	0.0692	0.0692	0.0667	0.0642	0.0617	0.0591	0.057	0.0544	0.0307	0.0551	0.0539	0.0535	0.0532
L-20	0.0109	0.0109	0.0109	0.011	0.0113	0.0114	0.0112	0.0113	0.011	0.0112	0.0110	0.0106	0.0108
L-30	0.00181	0.00181	0.00182	0.00182	0.00182	0.00188	0.00196	0.00201	0.00292	0.00199	0.00196	0.00200	0.00198
L-35	0.00151	0.00151	0.00152	0.00152	0.00152	0.00156	0.00167	0.00173	0.00237	0.00170	0.00169	0.00171	0.00168
N-10	0.174	0.174	0.168	0.162	0.156	0.150	0.145	0.136	0.089	0.141	0.136	0.137	0.135
N-15	0.0672	0.0672	0.0668	0.0668	0.0667	0.0655	0.0641	0.0646	0.0306	0.0623	0.0607	0.0613	0.0617
N-20	0.0306	0.0306	0.0305	0.0309	0.0314	0.0314	0.0309	0.0311	0.0248	0.0308	0.0301	0.0295	0.0297
N-25	0.0137	0.0137	0.0137	0.0138	0.0140	0.0142	0.0143	0.0144	0.0184	0.0143	0.0140	0.0139	0.0140
N-30	0.00572	0.00572	0.00574	0.00575	0.00578	0.00594	0.00612	0.00622	0.00891	0.00617	0.00606	0.00615	0.00614
N-40	0.00177	0.00177	0.00178	0.00179	0.00179	0.00184	0.00196	0.00205	0.0027	0.00201	0.00202	0.00203	0.00198
W-30	0.0138	0.0138	0.0138	0.0138	0.014	0.0143	0.0145	0.0147	0.0198	0.0146	0.0143	0.0144	0.0144
W-40	0.00686	0.00686	0.0069	0.00691	0.00692	0.0071	0.00744	0.00765	0.0101	0.00754	0.0075	0.00758	0.00748
H-10	0.334	0.334	0.324	0.313	0.303	0.292	0.283	0.264	0.191	0.274	0.267	0.269	0.264
H-20	0.215	0.215	0.213	0.214	0.214	0.211	0.207	0.208	0.117	0.203	0.198	0.197	0.199
H-30	0.0929	0.0929	0.0928	0.0932	0.094	0.0945	0.0944	0.0949	0.0997	0.0942	0.0927	0.0922	0.0928
H-40	0.0337	0.0337	0.0338	0.0339	0.0341	0.0347	0.0353	0.0358	0.0438	0.0356	0.0352	0.0353	0.0352
H-60	0.00722	0.00722	0.00724	0.00728	0.00732	0.00749	0.00784	0.0082	0.00997	0.00801	0.00805	0.00809	0.00800

Table C2b. Parameter m_d for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96$ kg m^{-3} to $\rho = 1.32$ kg m^{-3} for h^*_K(R) and $h_{\mathrm{p}K}$(R;α). The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for m(1.0 m) and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho) - 1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %.

Radiation quality R	m_d for the quantity h^*_K (R) [m^2 kg^{-1}]	m_d for the quantity $h_{\mathrm{p}K}$(R;α) [m^2 kg^{-1}] for $\alpha =$											
		0°	15°	30°	45°	60°	75°	90°	180°	ROT	ISO	SS-ISO	IS-ISO
L-10	0.0307	0.0307	0.0295	0.0286	0.0275	0.0262	0.0253	0.0246	0.0119	0.0241	0.0242	0.0234	0.0239
L-20	0.0169	0.0169	0.0168	0.0169	0.0172	0.0172	0.0171	0.0171	0.0157	0.0170	0.0167	0.0164	0.0166
L-30	0.00175	0.00175	0.00176	0.00176	0.00176	0.00182	0.0019	0.00195	0.00282	0.00192	0.00190	0.00194	0.00192
L-35	0.00147	0.00147	0.00149	0.00149	0.00149	0.00153	0.00163	0.00169	0.00232	0.00166	0.00166	0.00168	0.00164
N-10	0.0315	0.0315	0.0300	0.0287	0.0274	0.0259	0.0248	0.0244	0.00779	0.0238	0.0236	0.0227	0.0232
N-15	0.0378	0.0378	0.0378	0.0380	0.0381	0.0376	0.0368	0.0372	0.0176	0.0359	0.0347	0.0352	0.0354
N-20	0.0223	0.0223	0.0223	0.0225	0.0230	0.0230	0.0227	0.0228	0.0195	0.0226	0.0221	0.0216	0.0218
N-25	0.0109	0.0109	0.0109	0.0110	0.0111	0.0113	0.0114	0.0115	0.0154	0.0114	0.0112	0.0111	0.0112
N-30	0.00561	0.00561	0.00563	0.00565	0.00567	0.00583	0.00601	0.0061	0.00867	0.00605	0.00594	0.00603	0.00603
N-40	0.00172	0.00172	0.00173	0.00173	0.00174	0.00178	0.0019	0.00199	0.00262	0.00195	0.00196	0.00197	0.00192
W-30	0.0122	0.0122	0.0122	0.0122	0.0123	0.0126	0.0128	0.0130	0.0177	0.0129	0.0127	0.0128	0.0128
W-40	0.00600	0.00600	0.00603	0.00605	0.00605	0.00622	0.00654	0.00674	0.00900	0.00664	0.0066	0.00668	0.00659
H-10	0.00505	0.00505	0.00348	0.00248	0.00139	0.000201	−0.000227	0.00159	−0.0164	−0.0000629	−0.000552	−0.00155	−0.000719
H-20	0.0989	0.0989	0.0988	0.0995	0.101	0.100	0.0988	0.0997	0.0659	0.0978	0.0957	0.0949	0.0956
H-30	0.0437	0.0437	0.0437	0.0440	0.0445	0.0451	0.0452	0.0456	0.0543	0.0453	0.0445	0.0442	0.0445
H-40	0.0234	0.0234	0.0235	0.0236	0.0237	0.0242	0.0249	0.0253	0.0324	0.0251	0.0248	0.0249	0.0248
H-60	0.00669	0.00669	0.00671	0.00675	0.00679	0.00695	0.00728	0.00763	0.00928	0.00744	0.00748	0.00751	0.00743

Table C3a. Parameter m(1.0 m) for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96$ kg m^{-3} to $\rho = 1.32$ kg m^{-3} for $d_{\mathrm{lens}K}$(R;α). The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for m(1.0 m) and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho)-1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %. The parameters are given for those radiation qualities only, for which the conversion coefficient itself is at least < 0.0005 Sv/Gy.

Radiation quality R	m(1.0 m) for the quantity $d_{\mathrm{lens}K}$(R;α) [m^3 kg^{-1}] for $\alpha =$							
	0°	15°	30°	45°	60°	75°	90°	ROT
L-10	0.103	0.102	0.102	0.103	0.107	0.114	0.124	0.104
L-20	0.00607	0.00614	0.00631	0.00661	0.00715	0.00809	0.00981	0.00738
L-30	0.000563	0.000582	0.000605	0.000631	0.00064	0.00072	0.000845	0.000809
L-35	0.000475	0.000491	0.000499	0.000517	0.000532	0.000581	0.000662	0.000676
N-10	0.263	0.262	0.260	0.262	0.268	0.282	0.301	0.265
N-15	0.0671	0.0673	0.0682	0.0702	0.0740	0.0806	0.0906	0.0719
N-20	0.0215	0.0216	0.0221	0.0230	0.0244	0.0270	0.0312	0.0245
N-25	0.00671	0.00682	0.00702	0.00730	0.00784	0.00873	0.0103	0.00834
N-30	0.00196	0.00203	0.00211	0.00221	0.00231	0.00259	0.00308	0.00274
N-40	0.000563	0.000582	0.000587	0.000611	0.000643	0.000679	0.000762	0.000804
W-30	0.00573	0.00587	0.00607	0.00633	0.00673	0.00752	0.00893	0.00750
W-40	0.00239	0.00246	0.00253	0.00263	0.00274	0.00300	0.00346	0.00333
H-10	0.513	0.511	0.508	0.509	0.519	0.539	0.565	0.514
H-20	0.205	0.206	0.208	0.213	0.223	0.238	0.261	0.219
H-30	0.0672	0.0677	0.0688	0.0707	0.0739	0.0792	0.0873	0.0749
H-40	0.0172	0.0175	0.0179	0.0186	0.0195	0.0213	0.0243	0.0211
H-60	0.00257	0.00262	0.0027	0.0028	0.00293	0.00310	0.00348	0.00362

Table C3b. Parameter m_d for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96$ kg m^{-3} to $\rho = 1.32$ kg m^{-3} for $d_{\mathrm{lens}K}$(R;α). The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for m(1.0 m) and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho)-1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %. The parameters are given for those radiation qualities only, for which the conversion coefficient itself is at least < 0.0005 Sv/Gy.

Radiation quality R	m_d for the quantity $d_{\mathrm{lens}K}$(R;α) [m^2 kg^{-1}] for $\alpha =$							
	0°	15°	30°	45°	60°	75°	90°	ROT
L-10	0.0443	0.0438	0.0439	0.0447	0.0468	0.0511	0.0572	0.0453
L-20	0.0121	0.0122	0.0124	0.0128	0.0134	0.0145	0.0162	0.0136
L-30	0.000548	0.000566	0.000588	0.000613	0.000622	0.000699	0.00082	0.000786
L-35	0.000465	0.000480	0.000488	0.000506	0.00052	0.000568	0.000646	0.000662
N-10	0.0452	0.0446	0.0446	0.0457	0.0486	0.0545	0.0627	0.0466
N-15	0.0351	0.0352	0.0358	0.0371	0.0395	0.0437	0.0501	0.0383
N-20	0.0146	0.0147	0.0150	0.0157	0.0168	0.0186	0.0219	0.0170
N-25	0.00473	0.00483	0.00499	0.00521	0.00564	0.00635	0.00767	0.00611
N-30	0.00196	0.00202	0.00211	0.00220	0.00230	0.00257	0.00306	0.00273
N-40	0.000545	0.000564	0.000568	0.000591	0.000623	0.000657	0.000737	0.000778
W-30	0.00492	0.00504	0.00522	0.00545	0.00579	0.00646	0.00768	0.00650
W-40	0.00197	0.00204	0.00209	0.00218	0.00226	0.00248	0.00286	0.00280
H-10	0.00184	0.00121	0.00145	0.00278	0.00615	0.0132	0.0227	0.00380
H-20	0.0817	0.0822	0.0834	0.0861	0.0905	0.0979	0.109	0.0895
H-30	0.0243	0.0247	0.0253	0.0264	0.0281	0.0310	0.0360	0.0293
H-40	0.00968	0.00992	0.0102	0.0107	0.0113	0.0126	0.0148	0.0128
H-60	0.00234	0.00239	0.00246	0.00255	0.00267	0.00282	0.00316	0.00332

Table C4a. Parameter $m(1.0\text{ m})$ for the simple approximation of $m(d_{\text{air}})$ given in equation (2) for air densities from $\rho = 0.96$ kg m^{-3} to $\rho = 1.32$ kg m^{-3} for $d_{\text{local skin }K}(\text{R};\alpha)_{\text{slab}}$. The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for $m(1.0\text{ m})$ and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho)-1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %.

Radiation quality R	$m(1.0\text{ m})$ for the quantity $d_{\text{local skin }K}(\text{R};\alpha)_{\text{slab}}$ [m^3 kg^{-1}] for $\alpha =$					
	0°	15°	30°	45°	60°	75°
L-10	0.00307	0.00311	0.00355	0.00426	0.00638	0.0128
L-20	0.000736	0.000747	0.000746	0.00076	0.000778	0.000804
L-30	0.000304	0.000290	0.00029	0.000277	0.000232	0.000194
L-35	0.00032	0.000308	0.000302	0.000292	0.000251	0.00020
N-10	0.0116	0.0118	0.0134	0.0164	0.0236	0.0451
N-15	0.00252	0.00259	0.00277	0.00303	0.00396	0.00749
N-20	0.00183	0.00188	0.00190	0.00196	0.00209	0.00269
N-25	0.00132	0.00130	0.00131	0.00130	0.00127	0.00121
N-30	0.000814	0.000778	0.000782	0.000754	0.000659	0.000561
N-40	0.000423	0.000417	0.000404	0.000392	0.000349	0.000275
W-30	0.00167	0.00161	0.00162	0.00158	0.00145	0.00129
W-40	0.00133	0.00129	0.00127	0.00123	0.00108	0.000880
H-10	0.0313	0.0322	0.0363	0.0441	0.0617	0.112
H-20	0.00913	0.00937	0.0101	0.0112	0.0147	0.0267
H-30	0.00761	0.00763	0.00776	0.00793	0.00836	0.0107
H-40	0.00458	0.00447	0.00447	0.00440	0.00409	0.00386
H-60	0.00185	0.00182	0.00179	0.00171	0.00156	0.00126

Table C4b. Parameter m_d for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96$ kg m^{-3} to $\rho = 1.32$ kg m^{-3} for $d_{\mathrm{local\,skin}\,K}(\mathrm{R};\alpha)_{\mathrm{slab}}$. The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for $m(1.0\ \mathrm{m})$ and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho)-1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %.

Radiation quality R	m_d for the quantity $d_{\mathrm{local\,skin}\,K}(\mathrm{R};\alpha)_{\mathrm{slab}}$ [m^2 kg^{-1}] for $\alpha =$					
	0°	15°	30°	45°	60°	75°
L-10	0.000911	0.000910	0.00104	0.00121	0.00190	0.00403
L-20	0.00128	0.00131	0.00132	0.00137	0.00149	0.00191
L-30	0.000297	0.000282	0.000282	0.000270	0.000227	0.000189
L-35	0.000313	0.000303	0.000297	0.000287	0.000247	0.000198
N-10	−0.000705	−0.000780	−0.000844	−0.00112	−0.00114	−0.000956
N-15	0.00142	0.00147	0.00153	0.00164	0.00197	0.00350
N-20	0.00140	0.00143	0.00144	0.00148	0.00155	0.00184
N-25	0.00107	0.00105	0.00105	0.00104	0.000998	0.000896
N-30	0.000812	0.000776	0.00078	0.000752	0.000657	0.000560
N-40	0.000412	0.000406	0.000393	0.000382	0.000341	0.000268
W-30	0.00151	0.00146	0.00147	0.00143	0.00131	0.00115
W-40	0.00118	0.00114	0.00113	0.00109	0.000944	0.000766
H-10	−0.00776	−0.00810	−0.00896	−0.0109	−0.0141	−0.0221
H-20	0.00465	0.00480	0.00490	0.00507	0.00575	0.00901
H-30	0.00417	0.00414	0.00414	0.00413	0.00396	0.00389
H-40	0.00335	0.00325	0.00324	0.00315	0.00283	0.00241
H-60	0.00173	0.00171	0.00167	0.00161	0.00146	0.00118

Table C5a. Parameter $m(1.0\ \mathrm{m})$ for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96\ \mathrm{kg\ m^{-3}}$ to $\rho = 1.32\ \mathrm{kg\ m^{-3}}$ for $d_{\mathrm{local\ skin}\ K}(\mathrm{R};\alpha)_{\mathrm{pillar}}$. The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for $m(1.0\ \mathrm{m})$ and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho){-}1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %.The parameters are given for those radiation qualities only, for which the conversion coefficient itself is at least < 0.0005 Sv/Gy.

Radiation quality R	$m(1.0\ \mathrm{m})$ for the quantity $d_{\mathrm{local\ skin}\ K}(\mathrm{R};\alpha)_{\mathrm{pillar}}$ $(\mathrm{m^3\ kg^{-1}})$ for $\alpha =$													
	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	ROT
L-10	0.00347	0.00346	0.00400	0.00481	0.00669	0.0128	0.0398	—	—	—	—	—	—	0.00742
L-20	0.000635	0.000747	0.000641	0.000740	0.000773	0.000892	0.00373	0.0151	0.0226	0.0268	0.0325	0.0320	0.0297	0.00147
L-30	0.000264	0.000228	0.000249	0.000229	0.000216	0.000222	0.000409	0.00132	0.00225	0.00282	0.00309	0.00324	0.00334	0.000495
L-35	0.000247	0.000221	0.000232	0.000222	0.000208	0.000222	0.000339	0.000976	0.00159	0.00195	0.00209	0.00221	0.00233	0.000460
N-10	0.0124	0.0126	0.0144	0.0175	0.0242	0.0449	0.116	—	—	—	—	—	—	0.0248
N-15	0.00276	0.00281	0.00299	0.00315	0.00421	0.00807	0.0324	0.112	—	—	—	—	—	0.00659
N-20	0.00167	0.00190	0.00171	0.00188	0.00212	0.00304	0.0127	0.0423	0.0578	0.0636	0.0633	—	—	0.00396
N-25	0.00116	0.00125	0.00114	0.00126	0.00126	0.00132	0.00452	0.0154	0.0216	0.0255	0.0285	0.0297	0.0301	0.00250
N-30	0.000719	0.000658	0.000685	0.000666	0.000636	0.000631	0.00144	0.00488	0.00775	0.00952	0.0105	0.0109	0.0112	0.00140
N-40	0.000297	0.000284	0.00028	0.000286	0.000268	0.000289	0.000414	0.00108	0.00168	0.00206	0.00219	0.00233	0.00249	0.000563
W-30	0.00147	0.00144	0.00142	0.00146	0.00143	0.00143	0.00403	0.0135	0.0194	0.0229	0.0248	0.0256	0.0259	0.00299
W-40	0.00107	0.000978	0.00101	0.000986	0.000933	0.000967	0.00175	0.0051	0.00770	0.00912	0.00970	0.0101	0.0104	0.00202
H-10	0.0324	0.0332	0.0376	0.0458	0.0626	0.112	0.255	—	—	—	—	—	—	0.0604
H-20	0.00972	0.0101	0.0106	0.0118	0.0154	0.0281	0.105	0.304	0.328	0.335	—	—	—	0.0225
H-30	0.00704	0.00750	0.00714	0.00765	0.00848	0.0118	0.0423	0.105	0.122	0.129	0.132	0.133	0.133	0.0158
H-40	0.00392	0.00389	0.00380	0.00392	0.00389	0.00427	0.0119	0.0326	0.0419	0.0461	0.0479	0.0487	0.0493	0.00803
H-60	0.00124	0.00123	0.00118	0.00124	0.00119	0.00127	0.00194	0.00479	0.00685	0.00809	0.00852	0.00892	0.00935	0.00240

Table C5b. Parameter m_d for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96$ kg m^{-3} to $\rho = 1.32$ kg m^{-3} for $d_{\mathrm{local\ skin}\ K}(\mathrm{R};\alpha)_{\mathrm{pillar}}$. The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for $m(1.0\ \mathrm{m})$ and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho)-1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %. The parameters are given for those radiation qualities only, for which the conversion coefficient itself is at least < 0.0005 Sv/Gy.

Radiation quality R	m_d for the quantity $d_{\mathrm{local\ skin}\ K}(\mathrm{R};\alpha)_{\mathrm{pillar}}$ [m^2 kg^{-1}] for $\alpha =$													
	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	ROT
L-10	0.00111	0.00108	0.00126	0.00147	0.00205	0.00403	0.0154	—	—	—	—	—	—	0.00253
L-20	0.00118	0.00133	0.00121	0.00135	0.00151	0.0021	0.00778	0.0212	0.0279	0.0318	0.0377	0.0385	0.0372	0.00271
L-30	0.000257	0.000222	0.000242	0.000223	0.00021	0.000217	0.000397	0.00128	0.00218	0.00271	0.00297	0.00312	0.00322	0.000482
L-35	0.000242	0.000217	0.000227	0.000218	0.000204	0.000218	0.000332	0.000952	0.00155	0.0019	0.00204	0.00215	0.00227	0.000451
N-10	−0.000423	−0.000533	−0.000527	−0.000739	−0.000925	−0.000969	0.00969	—	—	—	—	—	—	0.0000753
N-15	0.00149	0.00155	0.00158	0.0016	0.00208	0.00393	0.0171	0.0644	—	—	—	—	—	0.00363
N-20	0.00125	0.00144	0.00127	0.00142	0.00155	0.00208	0.00872	0.0309	0.0436	0.049	0.0521	—	—	0.00294
N-25	0.000932	0.00099	0.000914	0.001	0.000989	0.000973	0.00323	0.012	0.0176	0.0212	0.0239	0.0251	0.0255	0.00198
N-30	0.000716	0.000656	0.000683	0.000663	0.000634	0.000631	0.00144	0.00479	0.00754	0.00922	0.0101	0.0105	0.0108	0.00139
N-40	0.000287	0.000276	0.000271	0.000278	0.000261	0.000281	0.000401	0.00104	0.00162	0.00199	0.00211	0.00224	0.0024	0.000546
W-30	0.00133	0.0013	0.00129	0.00132	0.00128	0.00127	0.00349	0.0117	0.0171	0.0202	0.022	0.0227	0.0231	0.00269
W-40	0.000933	0.00085	0.000881	0.000857	0.000808	0.000841	0.00145	0.00428	0.00667	0.008	0.00853	0.00891	0.00925	0.00177
H-10	−0.00737	−0.00776	−0.00852	−0.0104	−0.0138	−0.0222	−0.0248	—	—	—	—	—	—	−0.0110
H-20	0.00461	0.00502	0.00478	0.00497	0.00601	0.0102	0.046	0.133	0.164	0.172	—	—	—	0.0114
H-30	0.00366	0.0039	0.00361	0.00385	0.00392	0.00441	0.0158	0.0488	0.0623	0.0683	0.0715	0.0724	0.0728	0.00800
H-40	0.00281	0.00273	0.0027	0.00275	0.00264	0.00266	0.00679	0.0215	0.0296	0.0333	0.035	0.0358	0.0363	0.00565
H-60	0.00115	0.00115	0.00109	0.00116	0.0011	0.00118	0.00177	0.00436	0.00628	0.00745	0.00785	0.00824	0.00865	0.00223

Table C6a. Parameter $m(1.0\ \mathrm{m})$ for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96\ \mathrm{kg\ m^{-3}}$ to $\rho = 1.32\ \mathrm{kg\ m^{-3}}$ for $d_{\mathrm{local\ skin}\ K}(\mathrm{R};\alpha)_{\mathrm{rod}}$. The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for $m(1.0\ \mathrm{m})$ and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho)-1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %. The parameters are given for those radiation qualities only, for which the conversion coefficient itself is at least < 0.0005 Sv/Gy.

Radiation quality R	$m(1.0\ \mathrm{m})$ for the quantity $d_{\mathrm{local\ skin}\ K}(\mathrm{R};\alpha)_{\mathrm{rod}}$ $[\mathrm{m^3\ kg^{-1}}]$ for $\alpha =$													
	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	ROT
L-10	0.00363	0.00354	0.00421	0.00541	0.00855	0.0139	0.0202	0.0318	0.0655	0.180	—	—	—	0.00891
L-20	0.000484	0.000495	0.000574	0.000512	0.000697	0.00136	0.00265	0.00472	0.00790	0.0114	0.0141	0.0158	0.0163	0.00267
L-30	0.0000967	0.0000968	0.0000927	0.0000978	0.0000959	0.000146	0.000238	0.000385	0.000600	0.000824	0.000987	0.00109	0.00113	0.000339
L-35	0.0000815	0.0000865	0.0000766	0.0000901	0.0000869	0.00012	0.000174	0.000268	0.000408	0.000557	0.000668	0.000742	0.000769	0.00025
N-10	0.0128	0.0130	0.0153	0.0196	0.0296	0.0434	0.0604	0.0907	0.174	0.364	—	—	—	0.0278
N-15	0.00295	0.00292	0.00292	0.00384	0.00598	0.0118	0.0202	0.0341	0.0624	0.0968	0.113	0.119	0.123	0.0107
N-20	0.00147	0.00151	0.00159	0.00168	0.00239	0.00478	0.00887	0.0151	0.0248	0.0345	0.0406	0.0441	0.0454	0.00722
N-25	0.000710	0.000708	0.000848	0.000722	0.000923	0.00169	0.00318	0.00551	0.00875	0.0120	0.0141	0.0153	0.0157	0.00363
N-30	0.000304	0.000299	0.000327	0.000299	0.000321	0.000521	0.000921	0.00156	0.00245	0.00337	0.00401	0.00439	0.00453	0.00127
N-40	0.0000941	0.000105	0.0000941	0.000112	0.000112	0.000144	0.000199	0.000299	0.000444	0.000599	0.000715	0.000796	0.000822	0.000282
W-30	0.000734	0.000726	0.000842	0.000729	0.000858	0.00149	0.00274	0.00472	0.00742	0.0101	0.0119	0.0129	0.0133	0.00344
W-40	0.000394	0.000407	0.000401	0.000418	0.000428	0.000633	0.00101	0.00163	0.00248	0.00333	0.00392	0.00429	0.00441	0.00140
H-10	0.0333	0.0346	0.0400	0.0507	0.0736	0.101	0.135	0.196	0.354	—	—	—	—	0.0653
H-20	0.00996	0.00988	0.0105	0.0132	0.0204	0.038	0.0639	0.108	0.194	0.276	0.302	0.311	0.315	0.0357
H-30	0.00541	0.00545	0.00586	0.00617	0.00867	0.0166	0.0294	0.0481	0.0736	0.0931	0.102	0.106	0.107	0.0245
H-40	0.00206	0.00207	0.00227	0.00216	0.00263	0.00462	0.00819	0.0134	0.0202	0.0260	0.0295	0.0313	0.0319	0.00908
H-60	0.000414	0.000452	0.00044	0.000488	0.000518	0.000672	0.000982	0.00153	0.00223	0.00295	0.00345	0.00377	0.00388	0.00137

Table C6b. Parameter m_d for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96$ kg m^{-3} to $\rho = 1.32$ kg m^{-3} for $d_{\mathrm{local\ skin}\ K}(\mathrm{R};\alpha)_{\mathrm{rod}}$. The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for $m(1.0\ \mathrm{m})$ and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho)-1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %. The parameters are given for those radiation qualities only, for which the conversion coefficient itself is at least < 0.0005 Sv/Gy.

Radiation quality R	m_d for the quantity $d_{\mathrm{local\ skin}\ K}(\mathrm{R};\alpha)_{\mathrm{rod}}$ [m^2 kg^{-1}] for $\alpha =$												
	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	ROT
L-10	0.00119	0.00109	0.00130	0.00167	0.00275	0.00504	0.00775	0.0128	0.0280	0.0923	—	—	—	0.00331
L-20	0.00101	0.00102	0.00111	0.00115	0.00163	0.00314	0.00556	0.00903	0.0137	0.0179	0.0204	0.0218	0.0223	0.00470
L-30	0.0000941	0.0000943	0.0000902	0.0000953	0.0000934	0.000142	0.000231	0.000374	0.000582	0.000799	0.000956	0.00106	0.00109	0.000329
L-35	0.0000797	0.0000848	0.0000749	0.0000883	0.0000852	0.000117	0.00017	0.000261	0.000397	0.000542	0.000650	0.000723	0.000749	0.000244
N-10	−0.000350	−0.000631	−0.000637	−0.000765	−0.000475	0.00169	0.00399	0.00864	0.0250	0.126	—	—	—	0.00105
N-15	0.00157	0.00160	0.00150	0.00198	0.00302	0.00622	0.0111	0.0191	0.0346	0.0534	0.0640	0.0693	0.0721	0.00637
N-20	0.00105	0.00108	0.00117	0.00117	0.00164	0.00327	0.00617	0.0106	0.0175	0.0246	0.0294	0.0323	0.0333	0.00538
N-25	0.000531	0.000525	0.000647	0.000525	0.000652	0.00117	0.00225	0.00399	0.00647	0.00906	0.0109	0.0119	0.0123	0.00277
N-30	0.000304	0.000299	0.000326	0.000300	0.000322	0.000524	0.000923	0.00156	0.00244	0.00333	0.00395	0.00432	0.00445	0.00126
N-40	0.0000909	0.000102	0.0000912	0.000109	0.000109	0.000139	0.000191	0.000288	0.000427	0.000575	0.000687	0.000765	0.000791	0.000272
W-30	0.000651	0.000642	0.000743	0.000644	0.000748	0.00128	0.00236	0.00405	0.00637	0.00868	0.0102	0.0111	0.0114	0.00301
W-40	0.000332	0.000345	0.000332	0.000355	0.000357	0.000516	0.000808	0.00129	0.00198	0.00268	0.00319	0.00351	0.00362	0.00114
H-10	−0.00744	−0.00825	−0.00912	−0.0112	−0.0143	−0.0146	−0.0161	−0.0177	−0.0132	—	—	—	—	−0.0100
H-20	0.00451	0.00455	0.00446	0.00532	0.00803	0.0171	0.0312	0.0529	0.0867	0.116	0.131	0.138	0.140	0.0209
H-30	0.00234	0.00238	0.00265	0.00244	0.00315	0.00599	0.0113	0.0192	0.0299	0.0398	0.0458	0.0489	0.0499	0.0117
H-40	0.00128	0.00129	0.00143	0.00130	0.00147	0.00246	0.00447	0.00762	0.0119	0.0161	0.0188	0.0203	0.0208	0.00571
H-60	0.000377	0.000414	0.000401	0.000449	0.000475	0.000608	0.000876	0.00136	0.00199	0.00263	0.00309	0.00339	0.00348	0.00123

Table C7a. Parameter $m(1.0\ \mathrm{m})$ for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96$ kg m^{-3} to $\rho = 1.32$ kg m^{-3} for $d_{\mathrm{lens,sens}K}(\mathrm{R};\alpha)$. The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for $m(1.0\ \mathrm{m})$ and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho)-1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %. The parameters are given for those radiation qualities only, for which the conversion coefficient itself is at least < 0.0005 Sv/Gy.

Radiation quality R	$m(1.0\ \mathrm{m})$ for the quantity $d_{\mathrm{lens,sens}K}(\mathrm{R};\alpha)$ [m^3 kg^{-1}] for $\alpha =$							
	0°	15°	30°	45°	60°	75°	90°	ROT
L-10	0.0912	0.0913	0.0912	0.0917	0.0954	0.103	0.115	0.0937
L-20	0.00479	0.00485	0.00515	0.00553	0.00591	0.00681	0.00862	0.00622
L-30	0.000492	0.000483	0.000515	0.000566	0.000573	0.000624	0.000747	0.000739
L-35	0.000422	0.000410	0.000456	0.000467	0.000468	0.000513	0.000597	0.000618
N-10	0.243	0.242	0.241	0.241	0.248	0.263	0.286	0.246
N-15	0.0565	0.0570	0.0585	0.0608	0.0646	0.0714	0.082	0.0623
N-20	0.0176	0.0178	0.0185	0.0197	0.0210	0.0234	0.0282	0.0211
N-25	0.00535	0.00553	0.00575	0.00615	0.00672	0.00753	0.00915	0.00722
N-30	0.00161	0.00168	0.00170	0.00188	0.00204	0.00223	0.00269	0.00244
N-40	0.000492	0.000502	0.000537	0.000534	0.000565	0.000615	0.000689	0.000727
W-30	0.00461	0.00479	0.00493	0.00535	0.00584	0.00649	0.00786	0.00658
W-40	0.00205	0.00207	0.00218	0.00231	0.00243	0.00265	0.00309	0.00301
H-10	0.484	0.483	0.480	0.479	0.489	0.512	0.546	0.487
H-20	0.178	0.179	0.183	0.189	0.199	0.216	0.243	0.194
H-30	0.0577	0.0584	0.0600	0.0628	0.0663	0.0718	0.0813	0.0672
H-40	0.0144	0.0147	0.0152	0.0162	0.0173	0.0189	0.022	0.0189
H-60	0.00227	0.00228	0.0024	0.00250	0.00267	0.00283	0.00315	0.00331

Table C7b. Parameter m_d for the simple approximation of $m(d_{\mathrm{air}})$ given in equation (2) for air densities from $\rho = 0.96$ kg m^{-3} to $\rho = 1.32$ kg m^{-3} for $d_{\mathrm{lens,sens}K}(\mathrm{R};\alpha)$. The uncertainty of the linear approximations compared with the directly calculated values using equation (2) for $m(1.0\ \mathrm{m})$ and m_d is less or equal to 1 % in the regions mentioned below for the air density ρ. Inclusion of the uncertainties of the calculations themselves, leads to an overall uncertainty for the corrections, $|k(\rho)-1|$, of about 5 %, this in turn resulting in an overall uncertainty for the correction factors, $k(\rho)$, of about 2 %. The parameters are given for those radiation qualities only, for which the conversion coefficient itself is at least < 0.0005 Sv/Gy.

Radiation quality R	m_d for the quantity $d_{\mathrm{lens,sens}K}(\mathrm{R};\alpha)$ [m^2 kg^{-1}] for $\alpha =$							
	0°	15°	30°	45°	60°	75°	90°	ROT
L-10	0.0375	0.0377	0.0379	0.0385	0.0406	0.0447	0.0514	0.0392
L-20	0.0104	0.0105	0.0108	0.0113	0.0119	0.0130	0.0150	0.0121
L-30	0.000479	0.000470	0.000502	0.000551	0.000557	0.000606	0.000726	0.000718
L-35	0.000413	0.000401	0.000446	0.000457	0.000458	0.000502	0.000583	0.000604
N-10	0.0358	0.0361	0.0365	0.0372	0.0401	0.0458	0.0549	0.0383
N-15	0.0286	0.0290	0.0300	0.0315	0.0339	0.0379	0.0447	0.0326
N-20	0.0118	0.0119	0.0125	0.0133	0.0142	0.0160	0.0196	0.0145
N-25	0.00368	0.00384	0.00400	0.00431	0.00478	0.00540	0.00669	0.00524
N-30	0.00162	0.00168	0.00171	0.00189	0.00204	0.00223	0.00268	0.00243
N-40	0.000476	0.000486	0.000519	0.000516	0.000547	0.000596	0.000665	0.000704
W-30	0.00396	0.00412	0.00423	0.0046	0.00503	0.00558	0.00675	0.00571
W-40	0.00170	0.00172	0.00182	0.00191	0.00201	0.00219	0.00255	0.00254
H-10	−0.00937	−0.00891	−0.00818	−0.00732	−0.00403	0.00266	0.0134	−0.00606
H-20	0.0690	0.0696	0.0718	0.0753	0.0798	0.0875	0.101	0.0785
H-30	0.0196	0.0201	0.0209	0.0224	0.0242	0.0270	0.0324	0.0254
H-40	0.00785	0.00807	0.00843	0.00908	0.00981	0.0109	0.0131	0.0113
H-60	0.00208	0.00208	0.00219	0.00229	0.00244	0.00258	0.00287	0.00304

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