**Section 310.140 Units of Exposure and Radiation Dose**

a) As used in 32 Ill. Adm. Code: Chapter II, Subchapters b and d, the unit of exposure is the coulomb per kilogram (C/kg) or roentgen (R). One roentgen (R) is equal to 2.58 x 10-4 C/kg.

b) As used in 32 Ill. Adm. Code: Chapter II, Subchapters b and d, the units of radiation dose are:

1) "Gray" (Gy) is the SI unit of absorbed dose. One Gy is equal to an absorbed dose of 1 joule per kilogram (J/kg). (1 Gy = 100 rad).

2) "Rad" is the special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs per gram or 0.01 joule per kilogram (J/kg). (1 rad = 0.01 Gy).

3) "Rem" is the special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem = 0.01 Sv).

4) "Sievert" (Sv) is the SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sievert is equal to the absorbed dose in gray multiplied by the quality factor (1 Sv = 100 rem).

c) As used in 32 Ill. Adm. Code: Chapter II, Subchapters b and d, the quality factors for converting absorbed dose to dose equivalent are as follows:

|  |  |  |
| --- | --- | --- |
| Type of Radiation | Quality Factor (Q) | Absorbed Dose Equal to a Unit Dose Equivalenta |
| X, gamma or beta radiation and high-speed electrons | 1 | 1 |
| Alpha particles, multiple-charged particles, fission fragments and heavy particles of unknown charge | 20 | 0.05 |
| Neutrons of unknown energy | 10 | 0.1 |
| High-energy protons | 10 | 0.1 |
| a Absorbed dose in gray equal to 1 Sv or the absorbed dose in rad equal to 1 rem. | | |

d) If it is more convenient to measure the neutron fluence rate than to determine the neutron dose equivalent rate in rem per hour or sievert per hour, as provided in subsection (c) of this Section, 0.01 Sv (1 rem) of neutron radiation of unknown energies may, for purposes of 32 Ill. Adm. Code: Chapter II, Subchapters b and d, be assumed to result from a total fluence of 25 million neutrons per square centimeter incident upon the body. If sufficient information exists to estimate the approximate energy distribution of the neutrons, the licensee may convert a measured tissue dose in gray (rad) to dose equivalent in sievert (rem) by using the fluence rate per unit dose equivalent or the appropriate Q value shown below.

|  |  |  |  |
| --- | --- | --- | --- |
| Neutron Energy (MeV) | Quality Factora (Q) | Fluence per Unit Dose Equivalentb (neutrons cm-2 Sv-1) | Fluence per Unit Dose Equivalentb (neutrons cm-2 rem-1) |
| 2.5 E-8 (thermal) | 2 | 980 E8 | 980 E6 |
| 1 E-7 | 2 | 980 E8 | 980 E6 |
| 1 E-6 | 2 | 810 E8 | 810 E6 |
| 1 E-5 | 2 | 810 E8 | 810 E6 |
| 1 E-4 | 2 | 840 E8 | 840 E6 |
| 1 E-3 | 2 | 980 E8 | 980 E6 |
| 1 E-2 | 2.5 | 1010 E8 | 1010 E6 |
| 1 E-1 | 7.5 | 170 E8 | 170 E6 |
| 5 E-1 | 11 | 39 E8 | 39 E6 |
| 1 | 11 | 27 E8 | 27 E6 |
| 2.5 | 9 | 29 E8 | 29 E6 |
| 5 | 8 | 23 E8 | 23 E6 |
| 7 | 7 | 24 E8 | 24 E6 |
| 10 | 6.5 | 24 E8 | 24 E6 |
| 14 | 7.5 | 17 E8 | 17 E6 |
| 20 | 8 | 16 E8 | 16 E6 |
| 40 | 7 | 14 E8 | 14 E6 |
| 60 | 5.5 | 16 E8 | 16 E6 |
| 1 E2 | 4 | 20 E8 | 20 E6 |
| 2 E2 | 3.5 | 19 E8 | 19 E6 |
| 3 E2 | 3.5 | 16 E8 | 16 E6 |
| 4 E2 | 3.5 | 14 E8 | 14 E6 |
| a Value of quality factor (Q) at the point where the dose equivalent is maximum in a 30-centimeter diameter cylinder tissue-equivalent phantom. | | | |
| b Monoenergetic neutrons incident normally on a 30-centimeter diameter cylinder tissue-equivalent phantom. | | | |

(Source: Amended at 23 Ill. Reg. 14454, effective January 1, 2000)