

3701:1-50-25 **Determination of A₁ and A₂ values for radionuclides.**

- (A) Values of A₁ and A₂ for individual radionuclides, which are the bases for many activity limits elsewhere in these rules are given in table 25-1 of appendix A to this rule. The curie (Ci) values specified are obtained by converting from the terabecquerel (TBq) value. The terabecquerel values are the regulatory standard. The curie values are for information only and are not intended to be the regulatory standard. Where values of A₁ or A₂ are unlimited, it is for radiation control purposes only. For nuclear criticality safety, some materials are subject to controls placed on fissile material.
- (B)
 - (1) For individual radionuclides whose identities are known, but which are not listed in table 25-1 of appendix A to this rule, the A₁ and A₂ values contained in table 25-3 of appendix C to this rule may be used. Otherwise, the licensee shall obtain prior department approval of the A₁ and A₂ values for radionuclides not listed in table 25-1 of appendix A to this rule, before shipping the material.
 - (2) For individual radionuclides whose identities are known, but which are not listed in table 25-2 of appendix B to this rule, the exempt material activity concentration and exempt consignment activity values contained in table 25-3 of appendix C to this rule may be used. Otherwise, the licensee shall obtain prior department approval of the exempt material activity concentration and exempt consignment activity values for radionuclides not listed in table 25-2 of appendix B to this rule, before shipping the material.
 - (3) The licensee shall submit requests for prior approval, described under paragraphs (B)(1) and (B)(2) of this rule, to the department, in accordance with rule 3701:1-50-03 of the Administrative Code.
- (C) In the calculations of A₁ and A₂ for a radionuclide not in table 25-1 of appendix A to this rule, a single radioactive decay chain, in which radionuclides are present in their naturally occurring proportions, and in which no daughter radionuclide has a half-life either longer than ten days, or longer than that of the parent radionuclide, shall be considered as a single radionuclide, and the activity to be taken into account, and the A₁ or A₂ value to be applied shall be those corresponding to the parent radionuclide of that chain. In the case of radioactive decay chains in which any daughter radionuclide has a half-life either longer than ten days, or greater than that of the parent radionuclide, the parent and those daughter radionuclides shall be considered as mixtures of different radionuclides.
- (D) For mixtures of radionuclides whose identities and respective activities are known, the following conditions apply:

- (1) For special form radioactive material, the maximum quantity transported in a type A package is as follows:

$$\sum_I \frac{B(i)}{A_1(i)} \leq 1$$

where B(i) is the activity of radionuclide I and A₁(i) is the A₁ value for radionuclide I.

- (2) For normal form radioactive material, the maximum quantity transported in a type A package is as follows:

$$\sum_I \frac{B(i)}{A_2(i)} \leq 1$$

where B(i) is the activity of radionuclide I and A₂(i) is the A₂ value for radionuclide I.

- (3) Alternatively, an A₁ value for mixtures of special form material may be determined as follows:

$$A_1 \text{ for mixture} = \frac{1}{\sum_I \frac{f(i)}{A_1(i)}}$$

where f(i) is the fraction of activity of radionuclide I in the mixture and A₁(i) is the appropriate A₁ value for radionuclide I.

- (4) Alternatively, an A₂ value for mixtures of normal form material may be determined as follows:

$$A_2 \text{ for mixture} = \frac{1}{\sum_I \frac{f(i)}{A_2(i)}}$$

where f(i) is the fraction of activity of radionuclide I in the mixture and A₂(i) is the appropriate A₂ value for radionuclide I.

- (5) The exempt activity concentration for mixtures of radionuclides may be determined as follows:

$$\text{Exempt activity concentration for mixture} = \frac{1}{\sum_I \frac{f(i)}{[A](i)}}$$

where f(i) is the fraction of activity concentration of radionuclide I in the mixture, and [A] is the activity concentration for exempt material containing radionuclide I.

- (6) The activity limit for an exempt consignment for mixtures of radionuclides may be determined as follows:

$$\text{Exempt consignment activity limit for mixture} = \frac{1}{\sum \frac{f(i)}{A(i)}}$$

where f(i) is the fraction of activity of radionuclide I in the mixture, and A is the activity limit for exempt consignments for radionuclide I.

- (E) When the identity of each radionuclide is known, but the individual activities of some of the radionuclides are not known, the radionuclides may be grouped, and the lowest A₁ or A₂ value, as appropriate, for the radionuclides in each group may be used in applying the formulas in paragraph (D) of this rule. Groups may be based on the total alpha activity and the total beta/gamma activity when these are known, using the lowest A₁ or A₂ values for the alpha emitters and beta/gamma emitters.

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Certification

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