

**4731.2750 ANNUAL LIMITS ON INTAKE AND DERIVED AIR CONCENTRATIONS.**

Subpart 1. **General explanation.** For each radionuclide, subpart 7, Table 1, indicates the chemical form that is to be used for selecting the appropriate annual limit on intake (ALI) or derived air concentration (DAC) value. The ALIs and DACs for inhalation are given for an aerosol with an activity median aerodynamic diameter (AMAD) of 1  $\mu\text{m}$  and for three classes (D,W,Y) of radioactive material, which refer to their retention (approximately days, weeks, or years) in the pulmonary region of the lung. This classification applies to a range of clearance half-times for D of less than ten days, for W from ten to 100 days, and for Y greater than 100 days. The class (D, W, or Y) given in the column headed "Atomic Number (AN), Radionuclide, and Class" applies only to the inhalation ALIs and DACs given in subpart 7, Table 1, columns 2 and 3. Subpart 7, Table 2, provides concentration limits for airborne and liquid effluents released to the general environment. Subpart 7, Table 3, provides concentration limits for discharges to sanitary sewer systems.

Subp. 2. **Notation.** The values in subpart 7, Tables 1, 2, and 3, are presented in the computer "E" notation. In this notation, a value of 6E-02 represents a value of  $6 \times 10^{-2}$  or 0.06, 6E+2 represents  $6 \times 10^2$  or 600, and 6E+0 represents  $6 \times 10^0$  or 6.

**Subp. 3. Table 1 explanation; occupational values.**

A. The columns in subpart 7, Table 1, are applicable to occupational exposure to radioactive material. Column 1 is the oral ingestion ALI, expressed in  $\mu\text{Ci}$ . Column 2 is the inhalation ALI, expressed in  $\mu\text{Ci}$ . Column 3 is the inhalation DAC, expressed in  $\mu\text{Ci}/\text{ml}$ .

B. The ALIs in this part are the annual intakes of a given radionuclide by reference man that would result in:

- (1) a committed effective dose equivalent of five rems (stochastic ALI); or
- (2) a committed dose equivalent of 50 rems to an organ or tissue (nonstochastic ALI).

C. The stochastic ALIs were derived to result in a risk, due to irradiation of organs and tissues, comparable to the risk associated with deep dose equivalent to the whole body of five rems.

D. The derivation includes multiplying the committed dose equivalent to an organ or tissue by a weighting factor,  $W_T$ . This weighting factor is the proportion of the risk of stochastic effects resulting from irradiation of the organ or tissue, T, to the total risk of stochastic effects when the whole body is irradiated uniformly. The values of  $W_T$  are listed under part 4731.0100, subpart 261. The nonstochastic ALIs were derived to avoid nonstochastic effects, such as prompt damage to tissue or reduction in organ function.

E. A value of  $W_T=0.06$  is applicable to each of the five organs or tissues in the "remainder" category receiving the highest dose equivalents and the dose equivalents of all other remaining tissues may be disregarded.

F. The following parts of the gastrointestinal tract are to be treated as four separate organs: stomach, small intestine, upper large intestine, and lower large intestine.

G. The dose equivalents for extremities (hands and forearms, feet and lower legs), skin, and lens of the eye are not considered in computing the committed effective dose equivalent, but are subject to limits that must be met separately.

H. When an ALI is defined by the stochastic dose limit, this value alone is given. When an ALI is determined by the nonstochastic dose limit to an organ, the organ or tissue to which the limit applies is shown, and the ALI for the stochastic limit is shown in parentheses. Abbreviated organ or tissue designations are used:

LLI = lower large intestine wall;

Stom = stomach wall;

Blad = bladder wall;

Bone = bone surface;

Kid = kidneys; and

Thyr = thyroid.

I. The use of the ALIs listed first, the more limiting of the stochastic and nonstochastic ALIs, will ensure that nonstochastic effects are avoided and that the risk of stochastic effects is limited to an acceptably low value. If, in a particular situation involving a radionuclide for which the nonstochastic ALI is limiting, use of that nonstochastic ALI is considered unduly conservative, a licensee may use the stochastic ALI to determine the committed effective dose equivalent. However, the licensee must also ensure that the 50-rem dose equivalent limit for any organ or tissue is not exceeded by the sum of the external deep dose equivalent plus the internal committed dose to that organ (not the effective dose). For the case where there is no external dose contribution, this would be demonstrated if the sum of the fractions of the nonstochastic ALIs ( $ALI_{ns}$ ) that contribute to the committed dose equivalent to the organ receiving the highest dose does not exceed unity:  $\sum \alpha \mu \times$  (intake(in  $\mu\text{Ci}$ ) of each radionuclide/ $ALI_{ns}$ )  $< 1.0$ . If there is an external deep dose equivalent contribution of  $H_d$ , then this sum must be less than  $1 - (H_d/50)$  instead of being less than 1.0.

J. The DAC values are derived limits intended to control chronic occupational exposures. The relationship between the DAC and the ALI is given by:

$$\text{DAC} = \text{ALI}(\text{in } \mu\text{Ci}) / (2000 \text{ hours per working year} \times 60 \text{ minutes/hour} \times 2 \times 10^4 \text{ ml per minute}) = [\text{ALI} / 2.4 \times 10^9] \mu\text{Ci/ml}$$

where  $2 \times 10^4$  ml is the volume of air breathed per minute at work by reference man under working conditions of light work.

K. The DAC values relate to one of two modes of exposure: either external submersion or the internal committed dose equivalents resulting from inhalation of radioactive materials. Derived air concentrations based upon submersion are for immersion in a semi-infinite cloud of uniform concentration and apply to each radionuclide separately.

L. The ALI and DAC values relate to exposure to the single radionuclide named, but also include contributions from the in-growth of any daughter radionuclide produced in the body by the decay of the parent. However, intakes that include both the parent and daughter radionuclides should be treated by the general method appropriate for mixtures.

M. The values of ALI and DAC do not apply directly when the individual both ingests and inhales a radionuclide, when the individual is exposed to a mixture of radionuclides by either inhalation or ingestion or both, or when the individual is exposed to both internal and external irradiation.

N. When an individual is exposed to radioactive materials that fall under several of the translocation classifications (Class D, W, or Y) of the same radionuclide, the exposure may be evaluated as if it were a mixture of different radionuclides.

O. The classification of a compound as Class D, W, or Y is based on the chemical form of the compound and does not take into account the radiological half-life of different radioisotopes. For this reason, values are given for Class D, W, and Y compounds, even for very short-lived radionuclides.

**Subp. 4. Table 2 explanation; effluent concentrations.**

A. The columns in subpart 7, Table 2, are applicable to the assessment and control of dose to the public, particularly in the implementation of part 4731.2095. Column 1 is the effluent concentration limit for air, expressed in  $\mu\text{Ci/ml}$ . Column 2 is the effluent concentration limit for water, expressed in  $\mu\text{Ci/ml}$ . The concentration values given in subpart 7, Table 2, columns 1 and 2, are equivalent to the radionuclide concentrations that, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent of 0.05 rem (50 mrem or 0.5 mSv).

B. Consideration of nonstochastic limits has not been included in deriving the air and water effluent concentration limits because nonstochastic effects are presumed not to occur at the dose levels established for individual members of the public. For radionuclides, where the nonstochastic limit was governing in deriving the occupational DAC, the stochastic ALI was used in deriving the corresponding airborne effluent limit in subpart 7, Table 2. For this reason, the DAC and airborne effluent limits are not always proportional as they were in previous Code of Federal Regulations, title 10, sections 20.1 to 20.602, Appendix B.

C. The air concentration values in subpart 7, Table 2, column 1, were derived by one of two methods. For those radionuclides for which the stochastic limit is governing, the occupational stochastic inhalation ALI was divided by  $2.4 \times 10^9$  (ml), relating the inhalation ALI to the DAC, and then divided by a factor of 300. The factor of 300 includes the following components: a factor of 50 to relate the five-rem annual occupational dose limit to the 0.1-rem limit for members of the public; a factor of three to adjust for the difference in exposure time and inhalation rate for a worker and for members of the public; and a factor of two to adjust the occupational values derived for adults so that they are applicable to other age groups.

D. For those radionuclides for which submersion (external dose) is limiting, the occupational DAC in subpart 7, Table 1, column 3, was divided by 219. The factor of 219 is composed of a factor of 50, according to item C, and a factor of 4.38 relating occupational exposure for 2,000 hours per year to full-time exposure (8,760 hours per year). An additional factor of two for age considerations is not warranted in the submersion case.

E. The water concentrations were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by  $7.3 \times 10^7$ . The factor of  $7.3 \times 10^7$ (ml) includes the following components: the factors of 50 and two, according to item C, and a factor of  $7.3 \times 10^5$ (ml), which is the annual water intake of reference man.

F. Subpart 8 provides groupings of radionuclides that are applicable to unknown mixtures of radionuclides. These groupings, including occupational inhalation ALIs and DACs, air and water effluent concentrations and sewerage, require demonstrating that the most limiting radionuclides in successive classes are absent. The limit for the unknown mixture is defined when the presence of one of the listed radionuclides cannot be definitely excluded, either from knowledge of the radionuclide composition of the source or from actual measurements.

Subp. 5. **Table 3 explanation; releases to sewers.** Subpart 7, Table 3, gives the monthly average concentrations for release to sanitary sewers, expressed in  $\mu\text{Ci/ml}$ . The monthly average concentrations for release to sanitary sewers are applicable to part 4731.2420. The concentration values were derived by taking the most restrictive occupational stochastic oral ingestion ALI and dividing by  $7.3 \times 10^6$ (ml). The factor of  $7.3 \times 10^6$ (ml) is composed of a factor of  $7.3 \times 10^5$ (ml), the annual water intake by reference man, and a factor of ten, such that the concentrations, if the sewage released by the licensee were the only source of water ingested by a reference man during a year, would result in a committed effective dose equivalent of 0.5 rem.

Subp. 6. **List of elements.**

Name	Symbol	Atomic Number (AN)
Actinium	Ac	89
Aluminum	Al	13
Americium	Am	95
Antimony	Sb	51
Argon	Ar	18
Arsenic	As	33
Astatine	At	85
Barium	Ba	56
Berkelium	Bk	97

Beryllium	Be	4
Bismuth	Bi	83
Bromine	Br	35
Cadmium	Cd	48
Calcium	Ca	20
Californium	Cf	98
Carbon	C	6
Cerium	Ce	58
Cesium	Cs	55
Chlorine	Cl	17
Chromium	Cr	24
Cobalt	Co	27
Copper	Cu	29
Curium	Cm	96
Dysprosium	Dy	66
Einsteinium	Es	99
Erbium	Er	68
Europium	Eu	63
Fermium	Fm	100
Fluorine	F	9
Francium	Fr	87
Gadolinium	Gd	64
Gallium	Ga	31
Germanium	Ge	32
Gold	Au	79

Hafnium	Hf	72
Holmium	Ho	67
Hydrogen	H	1
Indium	In	49
Iodine	I	53
Iridium	Ir	77
Iron	Fe	26
Krypton	Kr	36
Lanthanum	La	57
Lead	Pb	82
Lutetium	Lu	71
Magnesium	Mg	12
Manganese	Mn	25
Mendelevium	Md	101
Mercury	Hg	80
Molybdenum	Mo	42
Neodymium	Nd	60
Neptunium	Np	93
Nickel	Ni	28
Niobium	Nb	41
Nitrogen	N	7
Osmium	Os	76
Oxygen	O	8
Palladium	Pd	46
Phosphorus	P	15

Platinum	Pt	78
Plutonium	Pu	94
Polonium	Po	84
Potassium	K	19
Praseodymium	Pr	59
Promethium	Pm	61
Protactinium	Pa	91
Radium	Ra	88
Radon	Rn	86
Rhenium	Re	75
Rhodium	Rh	45
Rubidium	Rb	37
Ruthenium	Ru	44
Samarium	Sm	62
Scandium	Sc	21
Selenium	Se	34
Silicon	Si	14
Silver	Ag	47
Sodium	Na	11
Strontium	Sr	38
Sulfur	S	16
Tantalum	Ta	73
Technetium	Tc	43
Tellurium	Te	52
Terbium	Tb	65
Thallium	Tl	81

Thorium	Th	90
Thulium	Tm	69
Tin	Sn	50
Titanium	Ti	22
Tungsten	W	74
Uranium	U	92
Vanadium	V	23
Xenon	Xe	54
Ytterbium	Yb	70
Yttrium	Y	39
Zinc	Zn	30
Zirconium	Zr	40

Subp. 7. **Table of ALIs and DACs.**

Atomic Number (AN), Radionuclide, and Class	Table 1			Table 2		Table 3
	1	2	3	1	2	

**AN 1**

Hydrogen-3

Water, DAC includes skin  
absorption

8E+4	8E+4	2E-5	1E-7	1E-3	1E-2
------	------	------	------	------	------

Gas (HT or T<sub>2</sub>) submersion<sup>1</sup>: Use  
above values as HT and T<sub>2</sub>  
oxidize in air and in the body to  
HTO.



**AN 4**

## Beryllium-7

W, all compounds except those given for Y

4E+4      2E+4      9E-6      3E-8      6E-4      6E-3

Y, oxides, halides, and nitrates

---      2E+4      8E-6      3E-8      ---      ---

## Beryllium-10

W, see <sup>7</sup>Be

1E+3      2E+2      6E-8      2E-10      ---      ---

LLI(1E+3) ---      ---      2E-5      2E-4      ---

Y, see <sup>7</sup>Be

---      1E+1      6E-9      2E-11      ---      ---

**AN 6**Carbon-11<sup>2</sup>

Monoxide

---      1E+6      5E-4      2E-6      ---      ---

Dioxide

---      6E+5      3E-4      9E-7      ---      ---

Compounds

4E+5      4E+5      2E-4      6E-7      6E-3      6E-2

## Carbon-14

Monoxide

---      2E+6      7E-4      2E-6      ---      ---

Dioxide

---      2E+5      9E-5      3E-7      ---      ---

Compounds

2E+3      2E+3      1E-6      3E-9      3E-5      3E-4

**AN 7**Nitrogen-13<sup>2</sup>Submersion<sup>1</sup>

---      ---      4E-6      2E-8      ---      ---

**AN 8**Oxygen-15<sup>2</sup>Submersion<sup>1</sup>

---      ---      4E-6      2E-8      ---      ---

**AN 9**Fluorine-18<sup>2</sup>D, fluorides of H, Li, Na, K, Rb,  
Cs, and Fr

5E+4	7E+4	3E-5	1E-7	---	---
Stom (5E+4)	---	---	---	7E-4	7E-3

W, fluorides of Be, Mg, Ca, Sr,  
Ba, Ra, Al, Ga, In, Tl, As, Sb, Bi,  
Fe, Ru, Os, Co, Ni, Pd, Pt, Cu,  
Ag, Au, Zn, Cd, Hg, Sc, Y, Ti,  
Zr, V, Nb, Ta, Mn, Tc, and Re

---	9E+4	4E-5	1E-7	---	---
-----	------	------	------	-----	-----

Y, lanthanum fluoride

---	8E+4	3E-5	1E-7	---	---
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**AN 11**

## Sodium-22

D, all compounds

4E+2	6E+2	3E-7	9E-10	6E-6	6E-5
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## Sodium-24

D, all compounds

4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
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**AN 12**

## Magnesium-28

D, all compounds except those  
given for W

7E+2	2E+3	7E-7	2E-9	9E-6	9E-5
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W, oxides, hydroxides, carbides,  
halides, and nitrates

---	1E+3	5E-7	2E-9	---	---
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**AN 13**

## Aluminum-26

D, all compounds except those  
given for W

4E+2	6E+1	3E-8	9E-11	6E-6	6E-5
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W, oxides, hydroxides, carbides,  
halides, and nitrates

---	9E+1	4E-8	1E-10	---	---
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**AN 14**

## Silicon-31

D, all compounds except those  
given for W and Y

9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
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W, oxides, hydroxides, carbides,  
and nitrates

---	3E+4	1E-5	5E-8	---	---
-----	------	------	------	-----	-----

Y, aluminosilicate glass

---	3E+4	1E-5	4E-8	---	---
-----	------	------	------	-----	-----

## Silicon-32

D, see <sup>31</sup>Si

2E+3	2E+2	1E-7	3E-10	---	---
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LLI (3E+3)	---	---	---	4E-5	4E-4
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W, see <sup>31</sup>Si

---	1E+2	5E-8	2E-10	---	---
-----	------	------	-------	-----	-----

Y, see <sup>31</sup>Si

---	5E+0	2E-9	7E-12	---	---
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**AN 15**

## Phosphorus-32

D, all compounds except  
phosphates given for W

6E+2	9E+2	4E-7	1E-9	9E-6	9E-5
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W, phosphates of Zn<sup>2+</sup>, S<sup>3+</sup>,  
Mg<sup>2+</sup>, Fe<sup>3+</sup>, Bi<sup>3+</sup>, and lanthanides

---	4E+2	2E-7	5E-10	---	---
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## Phosphorus-33

D, see <sup>32</sup>P

6E+3	8E+3	4E-6	1E-8	8E-5	8E-4
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W, see <sup>32</sup>P

---	3E+3	1E-6	4E-9	---	---
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**AN 16**

## Sulfur-35

Vapor	1E+4	6E-6	2E-8	---	---	---
D, sulfides and sulfates except those given for W	1E+4	2E+4	7E-6	2E-8	---	---
	LLI (8E+3)	---	---	---	1E-4	1E-3
	6E+3	---	---	---	---	---
W, elemental sulfur, sulfides of Sr, Ba, Ge, Sn, Pb, As, Sb, Bi, Cu, Ag, Au, Zn, Cd, Hg, W, and Mo. Sulfates of Ca, Sr, Ba, Ra, As, Sb, and Bi	---	2E+3	9E-7	3E-9	---	---
<b>AN 17</b>						
Chlorine-36						
D, chlorides of H, Li, Na, K, Rb, Cs, and Fr	2E+3	2E+3	1E-6	3E-9	2E-5	2E-4
W, chlorides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Cr, Mo, W, Mn, Tc, and Re	---	2E+2	1E-7	3E-10	---	---
Chlorine-38 <sup>2</sup>						
D, see <sup>36</sup> Cl	2E+4	4E+4	2E-5	6E-8	---	---
	Stom (3E+4)	---	---	---	3E-4	3E-3
W, see <sup>36</sup> Cl	---	5E+4	2E-5	6E-8	---	---
Chlorine-39 <sup>2</sup>						
D, see <sup>36</sup> Cl	2E+4	5E+4	2E-5	7E-8	---	---
	Stom (4E+4)	---	---	---	5E-4	5E-3
W, see <sup>36</sup> Cl	---	6E+4	2E-5	8E-8	---	---

**AN 18**

Argon-37

Submersion <sup>1</sup>	---	---	1E+0	6E-3	---	---
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Argon-39

Submersion <sup>1</sup>	---	---	2E-4	8E-7	---	---
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Argon-41

Submersion <sup>1</sup>	---	---	3E-6	1E-8	---	---
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**AN 19**

Potassium-40

D, all compounds	3E+2	4E+2	2E-7	6E-10	4E-6	4E-5
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Potassium-42

D, all compounds	5E+3	5E+3	2E-6	7E-9	6E-5	6E-4
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Potassium-43

D, all compounds	6E+3	9E+3	4E-6	1E-8	9E-5	9E-4
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Potassium-44<sup>2</sup>

D, all compounds	2E+4	7E+4	3E-5	9E-8	---	---
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Stom (4E+4)	---	---	---	5E-4	5E-3	---
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Potassium-45<sup>2</sup>

D, all compounds	3E+4	1E+5	5E-5	2E-7	---	---
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Stom (5E+4)	---	---	---	---	7E-4	7E-3
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**AN 20**

## Calcium-41

W, all compounds	3E+3	4E+3	2E-6	---	---	---
	Bone (4E+3)	Bone (4E+3)	---	5E-9	6E-5	6E-4

## Calcium-45

W, all compounds	2E+3	8E+2	4E-7	1E-9	2E-5	2E-4
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## Calcium-47

W, all compounds	8E+2	9E+2	4E-7	1E-9	1E-5	1E-4
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**AN 21**

## Scandium-43

Y, all compounds	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
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## Scandium-44m

Y, all compounds	5E+2	7E+2	3E-7	1E-9	7E-6	7E-5
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## Scandium-44

Y, all compounds	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4
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## Scandium-46

Y, all compounds	9E+2	2E+2	1E-7	3E-10	1E-5	1E-4
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## Scandium-47

Y, all compounds	2E+3	3E+3	1E-6	4E-9	---	---
	LLI (3E+3)	---	---	---	4E-5	4E-4

## Scandium-48

Y, all compounds	8E+2	1E+3	6E-7	2E-9	1E-5	1E-4
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Scandium-49<sup>2</sup>

Y, all compounds	2E+4	5E+4	2E-5	8E-8	3E-4	3E-3
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**AN 22**

## Titanium-44

D, all compounds except those given for W and Y	3E+2	1E+1	5E-9	2E-11	4E-6	4E-5
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W, oxides, hydroxides, carbides, halides, and nitrates	---	3E+1	1E-8	4E-11	---	---
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Y, SrTiO <sub>3</sub>	---	6E+0	2E-9	8E-12	---	---
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## Titanium-45

D, see <sup>44</sup> Ti	9E+3	3E+4	1E-5	3E-8	1E-4	1E-3
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W, see <sup>44</sup> Ti	---	4E+4	1E-5	5E-8	---	---
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Y, see <sup>44</sup> Ti	---	3E+4	1E-5	4E-8	---	---
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**AN 23**Vanadium-47<sup>2</sup>

D, all compounds except those given for W	3E+4	8E+4	3E-5	1E-7	---	---
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Stom (3E+4)	---	---	---	4E-4	4E-3
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W, oxides hydroxides, carbides, and halides	---	1E+5	4E-5	1E-7	---	---
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## Vanadium-48

D, see <sup>47</sup> V	6E+2	1E+3	5E-7	2E-9	9E-6	9E-5
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W, see <sup>47</sup> V	---	6E+2	3E-7	9E-10	---	---
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## Vanadium-49

D, see <sup>47</sup> V	7E+4	3E+4	1E-5	---	---	---
		Bone				
	LLI (9E+4)	(3E+4)	---	5E-8	1E-3	1E-2
W, see <sup>47</sup> V	---	2E+4	8E-6	2E-8	---	---

## AN 24

## Chromium-48

D, all compounds except those given for W and Y	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
W, halides and nitrates	---	7E+3	3E-6	1E-8	---	---
Y, oxides hydroxides	---	7E+3	3E-6	1E-8	---	---

Chromium-49<sup>2</sup>

D, see <sup>48</sup> Cr	3E+4	8E+4	4E-5	1E-7	4E-4	4E-3
W, see <sup>48</sup> Cr	---	1E+5	4E-5	1E-7	---	---
Y, see <sup>48</sup> Cr	---	9E+4	4E-5	1E-7	---	---

## Chromium-51

D, see <sup>48</sup> Cr	4E+4	5E+4	2E-5	6E-8	5E-4	5E-3
W, see <sup>48</sup> Cr	---	2E+4	1E-5	3E-8	---	---
Y, see <sup>48</sup> Cr	---	2E+4	8E-6	3E-8	---	---

## AN 25

Manganese-51<sup>2</sup>

D, all compounds except those given for W	2E+4	5E+4	2E-5	7E-8	3E-4	3E-3
W, oxides, hydroxides halides, and nitrates	---	6E+4	3E-5	8E-8	---	---



Manganese-52m<sup>2</sup>

D, see <sup>51</sup> Mn	3E+4	9E+4	4E-5	1E-7	---	---
	Stom (4E+4)	---	---	---	5E-4	5E-3
W, see <sup>51</sup> Mn	---	1E+5	4E-5	1E-7	---	---

## Manganese-52

D, see <sup>51</sup> Mn	7E+2	1E+3	5E-7	2E-9	1E-5	1E-4
W, see <sup>51</sup> Mn	---	9E+2	4E-7	1E-9	---	---

## Manganese-53

D, see <sup>51</sup> Mn	5E+4	1E+4	5E-6	---	7E-4	7E-3
	---	Bone (2E+4)	---	3E-8	---	---
W, see <sup>51</sup> Mn	---	1E+4	5E-6	2E-8	---	---

## Manganese-54

D, see <sup>51</sup> Mn	2E+3	9E+2	4E-7	1E-9	3E-5	3E-4
W, see <sup>51</sup> Mn	---	8E+2	3E-7	1E-9	---	---

## Manganese-56

D, see <sup>51</sup> Mn	5E+3	2E+4	6E-6	2E-8	7E-5	7E-4
W, see <sup>51</sup> Mn	---	2E+4	9E-6	3E-8	---	---

**AN 26**

## Iron-52

D, all compounds except those given for W	9E+2	3E+3	1E-6	4E-9	1E-5	1E-4
W, oxides, hydroxides, and halides	---	2E+3	1E-6	3E-9	---	---

## Iron-55

D, see <sup>52</sup> Fe	9E+3	2E+3	8E-7	3E-9	1E-4	1E-3
W, see <sup>52</sup> Fe	---	4E+3	2E-6	6E-9	---	---

## Iron-59

D, see <sup>52</sup> Fe	8E+2	3E+2	1E-7	5E-10	1E-5	1E-4
W, see <sup>52</sup> Fe	---	5E+2	2E-7	7E-10	---	---

## Iron-60

D, see <sup>52</sup> Fe	3E+1	6E+0	3E-9	9E-12	4E-7	4E-6
W, see <sup>52</sup> Fe	---	2E+1	8E-9	3E-11	---	---

**AN 27**

## Cobalt-55

W, all compounds except those given for Y	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
Y, oxides, hydroxides, halides, and nitrates	---	3E+3	1E-6	4E-9	---	---

## Cobalt-56

W, see <sup>55</sup> Co	5E+2	3E+2	1E-7	4E-10	6E-6	6E-5
Y, see <sup>55</sup> Co	4E+2	2E+2	8E-8	3E-10	---	---

## Cobalt-57

W, see <sup>55</sup> Co	8E+3	3E+3	1E-6	4E-9	6E-5	6E-4
Y, see <sup>55</sup> Co	4E+3	7E+2	3E-7	9E-10	---	---

## Cobalt-58m

W, see <sup>55</sup> Co	6E+4	9E+4	4E-5	1E-7	8E-4	8E-3
Y, see <sup>55</sup> Co	---	6E+4	3E-5	9E-8	---	---

## Cobalt-58

W, see <sup>55</sup> Co	2E+3	1E+3	5E-7	2E-9	2E-5	2E-4
Y, see <sup>55</sup> Co	1E+3	7E+2	3E-7	1E-9	---	---

Cobalt-60m<sup>2</sup>

W, see <sup>55</sup> Co	1E+6	4E+6	2E-3	6E-6	---	---
Stom (1E+6)	---	---	---	---	2E-2	2E-1
Y, see <sup>55</sup> Co	---	3E+6	1E-3	4E-6	---	---

## Cobalt-60

W, see <sup>55</sup> Co	5E+2	2E+2	7E-8	2E-10	3E-6	3E-5
Y, see <sup>55</sup> Co	2E+2	3E+1	1E-8	5E-11	---	---

Cobalt-61<sup>2</sup>

W, see <sup>55</sup> Co	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
Y, see <sup>55</sup> Co	2E+4	6E+4	2E-5	8E-8	---	---

Cobalt-62m<sup>2</sup>

W, see <sup>55</sup> Co	4E+4	2E+5	7E-5	2E-7	---	---
Stom (5E+4)	---	---	---	---	7E-4	7E-3
Y, see <sup>55</sup> Co	---	2E+5	6E-5	2E-7	---	---

**AN 28**

## Nickel-56

D, all compounds except those given for W	1E+3	2E+3	8E-7	3E-9	2E-5	2E-4
W, oxides, hydroxides, and carbides	---	1E+3	5E-7	2E-9	---	---

Vapor	---	1E+3	5E-7	2E-9	---	---
Nickel-57						
D, see <sup>56</sup> Ni	2E+3	5E+3	2E-6	7E-9	2E-5	2E-4
W, see <sup>56</sup> Ni	---	3E+3	1E-6	4E-9	---	---
Vapor	---	6E+3	3E-6	9E-9	---	---
Nickel-59						
D, see <sup>56</sup> Ni	2E+4	4E+3	2E-6	5E-9	3E-4	3E-3
W, see <sup>56</sup> Ni	---	7E+3	3E-6	1E-8	---	---
Vapor	---	2E+3	8E-7	3E-9	---	---
Nickel-63						
D, see <sup>56</sup> Ni	9E+3	2E+3	7E-7	2E-9	1E-4	1E-3
W, see <sup>56</sup> Ni	---	3E+3	1E-6	4E-9	---	---
Vapor	---	8E+2	3E-7	1E-9	---	---
Nickel-65						
D, see <sup>56</sup> Ni	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
W, see <sup>56</sup> Ni	---	3E+4	1E-5	4E-8	---	---
Vapor	---	2E+4	7E-6	2E-8	---	---
Nickel-66						
D, see <sup>56</sup> Ni	4E+2	2E+3	7E-7	2E-9	---	---
	LLI (5E+2)	---	---	---	6E-6	6E-5
W, see <sup>56</sup> Ni	---	6E+2	3E-7	9E-10	---	---
Vapor	---	3E+3	1E-6	4E-9	---	---
<b>AN 29</b>						
Copper-60 <sup>2</sup>						

D, all compounds except those  
given for W and Y

3E+4	9E+4	4E-5	1E-7	---	---
Stom (3E+4)	---	---	---	4E-4	4E-3

W, sulfides, halides, and nitrates

---	1E+5	5E-5	2E-7	---	---
-----	------	------	------	-----	-----

Y, oxides and hydroxides

---	1E+5	4E-5	1E-7	---	---
-----	------	------	------	-----	-----

Copper-61

D, see <sup>60</sup>Cu

1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
------	------	------	------	------	------

W, see <sup>60</sup>Cu

---	4E+4	2E-5	6E-8	---	---
-----	------	------	------	-----	-----

Y, see <sup>60</sup>Cu

---	4E+4	1E-5	5E-8	---	---
-----	------	------	------	-----	-----

Copper-64

D, see <sup>60</sup>Cu

1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
------	------	------	------	------	------

W, see <sup>60</sup>Cu

---	2E+4	1E-5	3E-8	---	---
-----	------	------	------	-----	-----

Y, see <sup>60</sup>Cu

---	2E+4	9E-6	3E-8	---	---
-----	------	------	------	-----	-----

Copper-67

D, see <sup>60</sup>Cu

5E+3	8E+3	3E-6	1E-8	6E-5	6E-4
------	------	------	------	------	------

W, see <sup>60</sup>Cu

---	5E+3	2E-6	7E-9	---	---
-----	------	------	------	-----	-----

Y, see <sup>60</sup>Cu

---	5E+3	2E-6	6E-9	---	---
-----	------	------	------	-----	-----

**AN 30**

Zinc-62

Y, all compounds

1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
------	------	------	------	------	------

Zinc-63<sup>2</sup>

Y, all compounds

2E+4	7E+4	3E-5	9E-8	---	---
Stom (3E+4)	---	---	---	3E-4	3E-3

## Zinc-65

Y, all compounds	4E+2	3E+2	1E-7	4E-10	5E-6	5E-5
------------------	------	------	------	-------	------	------

## Zinc-69m

Y, all compounds	4E+3	7E+3	3E-6	1E-8	6E-5	6E-4
------------------	------	------	------	------	------	------

Zinc-69<sup>2</sup>

Y, all compounds	6E+4	1E+5	6E-5	2E-7	8E-4	8E-3
------------------	------	------	------	------	------	------

## Zinc-71m

Y, all compounds	6E+3	2E+4	7E-6	2E-8	8E-5	8E-4
------------------	------	------	------	------	------	------

## Zinc-72

Y, all compounds	1E+3	1E+3	5E-7	2E-9	1E-5	1E-4
------------------	------	------	------	------	------	------

**AN 31**Gallium-65<sup>2</sup>

D, all compounds except those  
given for W

5E+4	2E+5	7E-5	2E-7	---	---
Stom (6E+4)	---	---	---	9E-4	9E-3

W, oxides, hydroxides, carbides,  
halides, and nitrates

---	2E+5	8E-5	3E-7	---	---
-----	------	------	------	-----	-----

## Gallium-66

D, see <sup>65</sup> Ga	1E+3	4E+3	1E-6	5E-9	1E-5	1E-4
-------------------------	------	------	------	------	------	------

W, see <sup>65</sup> Ga	---	3E+3	1E-6	4E-9	---	---
-------------------------	-----	------	------	------	-----	-----

## Gallium-67

D, see <sup>65</sup> Ga	7E+3	1E+4	6E-6	2E-8	1E-4	1E-3
-------------------------	------	------	------	------	------	------

W, see <sup>65</sup> Ga	---	1E+4	4E-6	1E-8	---	---
Gallium-68 <sup>2</sup>						
D, see <sup>65</sup> Ga	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
W, see <sup>65</sup> Ga	---	5E+4	2E-5	7E-8	---	---
Gallium-70 <sup>2</sup>						
D, see <sup>65</sup> Ga	5E+4	2E+5	7E-5	2E-7	---	---
	Stom (7E+4)	---	---	---	1E-3	1E-2
W, see <sup>65</sup> Ga	---	2E+5	8E-5	3E-7	---	---
Gallium-72						
D, see <sup>65</sup> Ga	1E+3	4E+3	1E-6	5E-9	2E-5	2E-4
W, see <sup>65</sup> Ga	---	3E+3	1E-6	4E-9	---	---
Gallium-73						
D, see <sup>65</sup> Ga	5E+3	2E+4	6E-6	2E-8	7E-5	7E-4
W, see <sup>65</sup> Ga	---	2E+4	6E-6	2E-8	---	---
<b>AN 32</b>						
Germanium-66						
D, all compounds except those given for W	2E+4	3E+4	1E-5	4E-8	3E-4	3E-3
W, oxides, sulfides, and halides	---	2E+4	8E-6	3E-8	---	---
Germanium-67 <sup>2</sup>						
D, see <sup>66</sup> Ge	3E+4	9E+4	4E-5	1E-7	---	---
	Stom (4E+4)	---	---	6E-4	6E-3	---

W, see <sup>66</sup> Ge	---	1E+5	4E-5	1E-7	---	---
Germanium-68						
D, see <sup>66</sup> Ge	5E+3	4E+3	2E-6	5E-9	6E-5	6E-4
W, see <sup>66</sup> Ge	---	1E+2	4E-8	1E-10	---	---
Germanium-69						
D, see <sup>66</sup> Ge	1E+4	2E+4	6E-6	2E-8	2E-4	2E-3
W, see <sup>66</sup> Ge	---	8E+3	3E-6	1E-8	---	---
Germanium-71						
D, see <sup>66</sup> Ge	5E+5	4E+5	2E-4	6E-7	7E-3	7E-2
W, see <sup>66</sup> Ge	---	4E+4	2E-5	6E-8	---	---
Germanium-75 <sup>2</sup>						
D, see <sup>66</sup> Ge	4E+4	8E+4	3E-5	1E-7	---	---
	Stom (7E+4)	---	---	---	9E-4	9E-3
W, see <sup>66</sup> Ge	---	8E+4	4E-5	1E-7	---	---
Germanium-77						
D, see <sup>66</sup> Ge	9E+3	1E+4	4E-6	1E-8	1E-4	1E-3
W, see <sup>66</sup> Ge	---	6E+3	2E-6	8E-9	---	---
Germanium-78 <sup>2</sup>						
D, see <sup>66</sup> Ge	2E+4	2E+4	9E-6	3E-8	---	---
	Stom (2E+4)	---	---	---	3E-4	3E-3
W, see <sup>66</sup> Ge	---	2E+4	9E-6	3E-8	---	---



**AN 33**Arsenic-69<sup>2</sup>

W, all compounds	3E+4	1E+5	5E-5	2E-7	---	---
	Stom (4E+4)	---	---	---	6E-4	6E-3

Arsenic-70<sup>2</sup>

W, all compounds	1E+4	5E+4	2E-5	7E-8	2E-4	2E-3
------------------	------	------	------	------	------	------

## Arsenic-71

W, all compounds	4E+3	5E+3	2E-6	6E-9	5E-5	5E-4
------------------	------	------	------	------	------	------

## Arsenic-72

W, all compounds	9E+2	1E+3	6E-7	2E-9	1E-5	1E-4
------------------	------	------	------	------	------	------

## Arsenic-73

W, all compounds	8E+3	2E+3	7E-7	2E-9	1E-4	1E-3
------------------	------	------	------	------	------	------

## Arsenic-74

W, all compounds	1E+3	8E+2	3E-7	1E-9	2E-5	2E-4
------------------	------	------	------	------	------	------

## Arsenic-76

W, all compounds	1E+3	1E+3	6E-7	2E-9	1E-5	1E-4
------------------	------	------	------	------	------	------

## Arsenic-77

W, all compounds	4E+3	5E+3	2E-6	7E-9	---	---
	LLI (5E+3)	---	---	---	6E-5	6E-4

Arsenic-78<sup>2</sup>

W, all compounds	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3
------------------	------	------	------	------	------	------

**AN 34**Selenium-70<sup>2</sup>D, all compounds except those  
given for W

2E+4      4E+4      2E-5      5E-8      1E-4      1E-3

W, oxides, hydroxides, carbides,  
and elemental Se

1E+4      4E+4      2E-5      6E-8      ---      ---

Selenium-73m<sup>2</sup>D, see <sup>70</sup>Se

6E+4      2E+5      6E-5      2E-7      4E-4      4E-3

W, see <sup>70</sup>Se

3E+4      1E+5      6E-5      2E-7      ---      ---

## Selenium-73

D, see <sup>70</sup>Se

3E+3      1E+4      5E-6      2E-8      4E-5      4E-4

W, see <sup>70</sup>Se

---      2E+4      7E-6      2E-8      ---      ---

## Selenium-75

D, see <sup>70</sup>Se

5E+2      7E+2      3E-7      1E-9      7E-6      7E-5

W, see <sup>70</sup>Se

---      6E+2      3E-7      8E-10      ---      ---

## Selenium-79

D, see <sup>70</sup>Se

6E+2      8E+2      3E-7      1E-9      8E-6      8E-5

W, see <sup>70</sup>Se

---      6E+2      2E-7      8E-10      ---      ---

Selenium-81m<sup>2</sup>D, see <sup>70</sup>Se

4E+4      7E+4      3E-5      9E-8      3E-4      3E-3

W, see <sup>70</sup>Se

2E+4      7E+4      3E-5      1E-7      ---      ---

Selenium-81<sup>2</sup>D, see <sup>70</sup>Se

6E+4      2E+5      9E-5      3E-7      ---      ---

	Stom (8E+4)	---	---	---	1E-3	1E-2
W, see <sup>70</sup> Se	---	2E+5	1E-4	3E-7	---	---
Selenium-83 <sup>2</sup>						
D, see <sup>70</sup> Se	4E+4	1E+5	5E-5	2E-7	4E-4	4E-3
W, see <sup>70</sup> Se	3E+4	1E+5	5E-5	2E-7	---	---
<b>AN 35</b>						
Bromine-74m <sup>2</sup>						
D, bromides of H, Li, Na, K, Rb, Cs, and Fr	1E+4	4E+4	2E-5	5E-8	---	---
	Stom (2E+4)	---	---	---	3E-4	3E-3
W, bromides of lanthanides, Be, Mg, Ca, Sr, Ba, Ra, Al, Ga, In, Tl, Ge, Sn, Pb, As, Sb, Bi, Fe, Ru, Os, Co, Rh, Ir, Ni, Pd, Pt, Cu, Ag, Au, Zn, Cd, Hg, Sc, Y, Ti, Zr, Hf, V, Nb, Ta, Mn, Tc, and Re	---	4E+4	2E-5	6E-8	---	---
Bromine-74 <sup>2</sup>						
D, see <sup>74m</sup> Br	2E+4	7E+4	3E-5	1E-7	---	---
	Stom (4E+4)	---	---	---	5E-4	5E-3
W, see <sup>74m</sup> Br	---	8E+4	4E-5	1E-7	---	---
Bromine-75 <sup>2</sup>						
D, see <sup>74m</sup> Br	3E+4	5E+4	2E-5	7E-8	---	---
	Stom (4E+4)	---	---	---	5E-4	5E-3
W, see <sup>74m</sup> Br	---	5E+4	2E-5	7E-8	---	---

## Bromine-76

D, see <sup>74m</sup> Br	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
--------------------------	------	------	------	------	------	------

W, see <sup>74m</sup> Br	---	4E+3	2E-6	6E-9	---	---
--------------------------	-----	------	------	------	-----	-----

## Bromine-77

D, see <sup>74m</sup> Br	2E+4	2E+4	1E-5	3E-8	2E-4	2E-3
--------------------------	------	------	------	------	------	------

W, see <sup>74m</sup> Br	---	2E+4	8E-6	3E-8	---	---
--------------------------	-----	------	------	------	-----	-----

## Bromine-80m

D, see <sup>74m</sup> Br	2E+4	2E+4	7E-6	2E-8	3E-4	3E-3
--------------------------	------	------	------	------	------	------

W, see <sup>74m</sup> Br	---	1E+4	6E-6	2E-8	---	---
--------------------------	-----	------	------	------	-----	-----

Bromine-80<sup>2</sup>

D, see <sup>74m</sup> Br	5E+4	2E+5	8E-5	3E-7	---	---
--------------------------	------	------	------	------	-----	-----

	Stom (9E+4)	---	---	---	1E-3	1E-2
--	----------------	-----	-----	-----	------	------

W, see <sup>74m</sup> Br	---	2E+5	9E-5	3E-7	---	---
--------------------------	-----	------	------	------	-----	-----

## Bromine-82

D, see <sup>74m</sup> Br	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
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W, see <sup>74m</sup> Br	---	4E+3	2E-6	5E-9	---	---
--------------------------	-----	------	------	------	-----	-----

## Bromine-83

D, see <sup>74m</sup> Br	5E+4	6E+4	3E-5	9E-8	---	---
--------------------------	------	------	------	------	-----	-----

	Stom (7E+4)	---	---	---	9E-4	9E-3
--	----------------	-----	-----	-----	------	------

W, see <sup>74m</sup> Br	---	6E+4	3E-5	9E-8	---	---
--------------------------	-----	------	------	------	-----	-----

Bromine-84<sup>2</sup>

D, see <sup>74m</sup> Br	2E+4	6E+4	2E-5	8E-8	---	---
--------------------------	------	------	------	------	-----	-----

	Stom (3E+4)	---	---	---	4E-4	4E-3
W, see <sup>74m</sup> Br	---	6E+4	3E-5	9E-8	---	---
<b>AN 36</b>						
Krypton-74 <sup>2</sup>						
Submersion <sup>1</sup>	---	---	3E-6	1E-8	---	---
Krypton-76						
Submersion <sup>1</sup>	---	---	9E-6	4E-8	---	---
Krypton-77 <sup>2</sup>						
Submersion <sup>1</sup>	---	---	4E-6	2E-8	---	---
Krypton-79						
Submersion <sup>1</sup>	---	---	2E-5	7E-8	---	---
Krypton-81						
Submersion <sup>1</sup>	---	---	7E-4	3E-6	---	---
Krypton-83m <sup>2</sup>						
Submersion <sup>1</sup>	---	---	1E-2	5E-5	---	---
Krypton-85m						
Submersion <sup>1</sup>	---	---	2E-5	1E-7	---	---
Krypton-85						
Submersion <sup>1</sup>	---	---	1E-4	7E-7	---	---
Krypton-87 <sup>2</sup>						

Submersion <sup>1</sup>	---	---	5E-6	2E-8	---	---
Krypton-88						
Submersion <sup>1</sup>	---	---	2E-6	9E-9	---	---
<b>AN 37</b>						
Rubidium-79 <sup>2</sup>						
D, all compounds	4E+4	1E+5	5E-5	2E-7	---	---
	Stom (6E+4)	---	---	---	8E-4	8E-3
Rubidium-81m <sup>2</sup>						
D, all compounds	2E+5	3E+5	1E-4	5E-7	---	---
	Stom (3E+5)	---	---	---	4E-3	4E-2
Rubidium-81						
D, all compounds	4E+4	5E+4	2E-5	7E-8	5E-4	5E-3
Rubidium-82m						
D, all compounds	1E+4	2E+4	7E-6	2E-8	2E-4	2E-3
Rubidium-83						
D, all compounds	6E+2	1E+3	4E-7	1E-9	9E-6	9E-5
Rubidium-84						
D, all compounds	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
Rubidium-86						
D, all compounds	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5

## Rubidium-87

D, all compounds	1E+3	2E+3	6E-7	2E-9	1E-5	1E-4
------------------	------	------	------	------	------	------

Rubidium-88<sup>2</sup>

D, all compounds	2E+4	6E+4	3E-5	9E-8	---	---
Stom (3E+4)	---	---	---	---	4E-4	4E-3

Rubidium-89<sup>2</sup>

D, all compounds	4E+4	1E+5	6E-5	2E-7	---	---
Stom (6E+4)	---	---	---	---	9E-4	9E-3

**AN 38**Strontium-80<sup>2</sup>

D, all soluble compounds except SrTiO <sub>3</sub>	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
---	------	------	------	------	------	------

Y, all insoluble compounds and SrTiO <sub>3</sub>	---	1E+4	5E-6	2E-8	---	---
--	-----	------	------	------	-----	-----

Strontium-81<sup>2</sup>

D, see <sup>80</sup> Sr	3E+4	8E+4	3E-5	1E-7	3E-4	3E-3
-------------------------	------	------	------	------	------	------

Y, see <sup>80</sup> Sr	2E+4	8E+4	3E-5	1E-7	---	---
-------------------------	------	------	------	------	-----	-----

## Strontium-82

D, see <sup>80</sup> Sr	3E+2	4E+2	2E-7	6E-10	---	---
LLI (2E+2)	---	---	---	---	3E-6	3E-5

Y, see <sup>80</sup> Sr	2E+2	9E+1	4E-8	1E-10	---	---
-------------------------	------	------	------	-------	-----	-----

## Strontium-83

D, see $^{80}\text{Sr}$	3E+3	7E+3	3E-6	1E-8	3E-5	3E-4
Y, see $^{80}\text{Sr}$	2E+3	4E+3	1E-6	5E-9	---	---
Strontium-85m <sup>2</sup>						
D, see $^{80}\text{Sr}$	2E+5	6E+5	3E-4	9E-7	3E-3	3E-2
Y, see $^{80}\text{Sr}$	---	8E+5	4E-4	1E-6	---	---
Strontium-85						
D, see $^{80}\text{Sr}$	3E+3	3E+3	1E-6	4E-9	4E-5	4E-4
Y, see $^{80}\text{Sr}$	---	2E+3	6E-7	2E-9	---	---
Strontium-87m						
D, see $^{80}\text{Sr}$	5E+4	1E+5	5E-5	2E-7	6E-4	6E-3
Y, see $^{80}\text{Sr}$	4E+4	2E+5	6E-5	2E-7	---	---
Strontium-89						
D, see $^{80}\text{Sr}$	6E+2	8E+2	4E-7	1E-9	---	---
	LLI (6E+2)	---	---	---	8E-6	8E-5
Y, see $^{80}\text{Sr}$	5E+2	1E+2	6E-8	2E-10	---	---
Strontium-90						
D, see $^{80}\text{Sr}$	3E+1	2E+1	8E-9	---	---	---
	Bone (4E+1)	Bone (2E+1)	---	3E-11	5E-7	5E-6
Y, see $^{80}\text{Sr}$	---	4E+0	2E-9	6E-12	---	---
Strontium-91						
D, see $^{80}\text{Sr}$	2E+3	6E+3	2E-6	8E-9	2E-5	2E-4
Y, see $^{80}\text{Sr}$	---	4E+3	1E-6	5E-9	---	---



## Strontium-92

D, see $^{80}\text{Sr}$	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
Y, see $^{80}\text{Sr}$	---	7E+3	3E-6	9E-9	---	---

**AN 39**Yttrium-86m<sup>2</sup>

W, all compounds except those given for Y	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
Y, oxides and hydroxides	---	5E+4	2E-5	8E-8	---	---

## Yttrium-86

W, see $^{86m}\text{Y}$	1E+3	3E+3	1E-6	5E-9	2E-5	2E-4
Y, see $^{86m}\text{Y}$	---	3E+3	1E-6	5E-9	---	---

## Yttrium-87

W, see $^{86m}\text{Y}$	2E+3	3E+3	1E-6	5E-9	3E-5	3E-4
Y, see $^{86m}\text{Y}$	---	3E+3	1E-6	5E-9	---	---

## Yttrium-88

W, see $^{86m}\text{Y}$	1E+3	3E+2	1E-7	3E-10	1E-5	1E-4
Y, see $^{86m}\text{Y}$	---	2E+2	1E-7	3E-10	---	---

## Yttrium-90m

W, see $^{86m}\text{Y}$	8E+3	1E+4	5E-6	2E-8	1E-4	1E-3
Y, see $^{86m}\text{Y}$	---	1E+4	5E-6	2E-8	---	---

## Yttrium-90

W, see $^{86m}\text{Y}$	4E+2	7E+2	3E-7	9E-10	---	---
	LLI (5E+2)	---	---	---	7E-6	7E-5

Y, see <sup>86m</sup> Y	---	6E+2	3E-7	9E-10	---	---
Yttrium-91m <sup>2</sup>						
W, see <sup>86m</sup> Y	1E+5	2E+5	1E-4	3E-7	2E-3	2E-2
Y, see <sup>86m</sup> Y	---	2E+5	7E-5	2E-7	---	---
Yttrium-91						
W, see <sup>86m</sup> Y	5E+2	2E+2	7E-8	2E-10	---	---
	LLI (6E+2)	---	---	---	8E-6	8E-5
Y, see <sup>86m</sup> Y	---	1E+2	5E-8	2E-10	---	---
Yttrium-92						
W, see <sup>86m</sup> Y	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
Y, see <sup>86m</sup> Y	---	8E+3	3E-6	1E-8	---	---
Yttrium-93						
W, see <sup>86m</sup> Y	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
Y, see <sup>86m</sup> Y	---	2E+3	1E-6	3E-9	---	---
Yttrium-94 <sup>2</sup>						
W, see <sup>86m</sup> Y	2E+4	8E+4	3E-5	1E-7	---	---
	Stom (3E+4)	---	---	---	4E-4	4E-3
Y, see <sup>86m</sup> Y	---	8E+4	3E-5	1E-7	---	---
Yttrium-95 <sup>2</sup>						
W, see <sup>86m</sup> Y	4E+4	2E+5	6E-5	2E-7	---	---
	Stom (5E+4)	---	---	---	7E-4	7E-3
Y, see <sup>86m</sup> Y	---	1E+5	6E-5	2E-7	---	---

**AN 40**

## Zirconium-86

D, all compounds except those  
given for W and Y

1E+3      4E+3      2E-6      6E-9      2E-5      2E-4

W, oxides, hydroxides, halides,  
and nitrates

---      3E+3      1E-6      4E-9      ---      ---

Y, carbide

---      2E+3      1E-6      3E-9      ---      ---

## Zirconium-88

D, see <sup>86</sup>Zr

4E+3      2E+2      9E-8      3E-10      5E-5      5E-4

W, see <sup>86</sup>Zr

---      5E+2      2E-7      7E-10      ---      ---

Y, see <sup>86</sup>Zr

---      3E+2      1E-7      4E-10      ---      ---

## Zirconium-89

D, see <sup>86</sup>Zr

2E+3      4E+3      1E-6      5E-9      2E-5      2E-4

W, see <sup>86</sup>Zr

---      2E+3      1E-6      3E-9      ---      ---

Y, see <sup>86</sup>Zr

---      2E+3      1E-6      3E-9      ---      ---

## Zirconium-93

D, see <sup>86</sup>Zr

1E+3      6E+0      3E-9      ---      ---      ---

Bone      Bone  
(3E+3)      (2E+1)      ---      2E-11      4E-5      4E-4W, see <sup>86</sup>Zr

---      2E+1      1E-8      ---      ---      ---

---      Bone  
(6E+1)      ---      9E-11      ---      ---Y, see <sup>86</sup>Zr

---      6E+1      2E-8      ---      ---      ---

---      Bone  
(7E+1)      ---      9E-11      ---      ---

## Zirconium-95

D, see $^{86}\text{Zr}$	1E+3	1E+2	5E-8	---	2E-5	2E-4
		Bone (3E+2)	---	4E-10	---	---
W, see $^{86}\text{Zr}$	---	4E+2	2E-7	5E-10	---	---
Y, see $^{86}\text{Zr}$	---	3E+2	1E-7	4E-10	---	---
Zirconium-97						
D, see $^{86}\text{Zr}$	6E+2	2E+3	8E-7	3E-9	9E-6	9E-5
W, see $^{86}\text{Zr}$	---	1E+3	6E-7	2E-9	---	---
Y, see $^{86}\text{Zr}$	---	1E+3	5E-7	2E-9	---	---
<b>AN 41</b>						
Niobium-88 <sup>2</sup>						
W, all compounds except those given for Y	5E+4	2E+5	9E-5	3E-7	---	---
	Stom (7E+4)	---	---	---	1E-3	1E-2
Y, oxides and hydroxides	---	2E+5	9E-5	3E-7	---	---
Niobium-89 <sup>2</sup> (66 min)						
W, see $^{88}\text{Nb}$	1E+4	4E+4	2E-5	6E-8	1E-4	1E-3
Y, see $^{88}\text{Nb}$	---	4E+4	2E-5	5E-8	---	---
Niobium-89 (122 min)						
W, see $^{88}\text{Nb}$	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
Y, see $^{88}\text{Nb}$	---	2E+4	6E-6	2E-8	---	---
Niobium-90						
W, see $^{88}\text{Nb}$	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
Y, see $^{88}\text{Nb}$	---	2E+3	1E-6	3E-9	---	---

## Niobium-93m

W, see $^{88}\text{Nb}$	9E+3	2E+3	8E-7	3E-9	---	---
	LLI (1E+4)	---	---	---	2E-4	2E-3
Y, see $^{88}\text{Nb}$	---	2E+2	7E-8	2E-10	---	---

## Niobium-94

W, see $^{88}\text{Nb}$	9E+2	2E+2	8E-8	3E-10	1E-5	1E-4
Y, see $^{88}\text{Nb}$	---	2E+1	6E-9	2E-11	---	---

## Niobium-95m

W, see $^{88}\text{Nb}$	2E+3	3E+3	1E-6	4E-9	---	---
	LLI (2E+3)	---	---	---	3E-5	3E-4
Y, see $^{88}\text{Nb}$	---	2E+3	9E-7	3E-9	---	---

## Niobium-95

W, see $^{88}\text{Nb}$	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
Y, see $^{88}\text{Nb}$	---	1E+3	5E-7	2E-9	---	---

## Niobium-96

W, see $^{88}\text{Nb}$	1E+3	3E+3	1E-6	4E-9	2E-5	2E-4
Y, see $^{88}\text{Nb}$	---	2E+3	1E-6	3E-9	---	---

Niobium-97<sup>2</sup>

W, see $^{88}\text{Nb}$	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
Y, see $^{88}\text{Nb}$	---	7E+4	3E-5	1E-7	---	---

Niobium-98<sup>2</sup>

W, see $^{88}\text{Nb}$	1E+4	5E+4	2E-5	8E-8	2E-4	2E-3
Y, see $^{88}\text{Nb}$	---	5E+4	2E-5	7E-8	---	---

**AN 42**

## Molybdenum-90

D, all compounds except those given for Y	4E+3	7E+3	3E-6	1E-8	3E-5	3E-4
Y, oxides, hydroxides, and MoS <sub>2</sub>	2E+3	5E+3	2E-6	6E-9	---	---

## Molybdenum-93m

D, see <sup>90</sup> Mo	9E+3	2E+4	7E-6	2E-8	6E-5	6E-4
Y, see <sup>90</sup> Mo	4E+3	1E+4	6E-6	2E-8	---	---

## Molybdenum-93

D, see <sup>90</sup> Mo	4E+3	5E+3	2E-6	8E-9	5E-5	5E-4
Y, see <sup>90</sup> Mo	2E+4	2E+2	8E-8	2E-10	---	---

## Molybdenum-99

D, see <sup>90</sup> Mo	2E+3	3E+3	1E-6	4E-9	---	---
	LLI (1E+3)	---	---	---	2E-5	2E-4
Y, see <sup>90</sup> Mo	1E+3	1E+3	6E-7	2E-9	---	---

Molybdenum-101<sup>2</sup>

D, see <sup>90</sup> Mo	4E+4	1E+5	6E-5	2E-7	---	---
	Stom (5E+4)	---	---	---	7E-4	7E-3
Y, see <sup>90</sup> Mo	---	1E+5	6E-5	2E-7	---	---

**AN 43**Technetium-93m<sup>2</sup>

D, all compounds except those given for W	7E+4	2E+5	6E-5	2E-7	1E-3	1E-2
---	------	------	------	------	------	------

W, oxides, hydroxides, halides,  
and nitrates

--- 3E+5 1E-4 4E-7 --- ---

Technetium-93

D, see <sup>93m</sup>Tc 3E+4 7E+4 3E-5 1E-7 4E-4 4E-3

W, see <sup>93m</sup>Tc --- 1E+5 4E-5 1E-7 --- ---

Technetium-94m<sup>2</sup>

D, see <sup>93m</sup>Tc 2E+4 4E+4 2E-5 6E-8 3E-4 3E-3

W, see <sup>93m</sup>Tc --- 6E+4 2E-5 8E-8 --- ---

Technetium-94

D, see <sup>93m</sup>Tc 9E+3 2E+4 8E-6 3E-8 1E-4 1E-3

W, see <sup>93m</sup>Tc --- 2E+4 1E-5 3E-8 --- ---

Technetium-95m

D, see <sup>93m</sup>Tc 4E+3 5E+3 2E-6 8E-9 5E-5 5E-4

W, see <sup>93m</sup>Tc --- 2E+3 8E-7 3E-9 --- ---

Technetium-95

D, see <sup>93m</sup>Tc 1E+4 2E+4 9E-6 3E-8 1E-4 1E-3

W, see <sup>93m</sup>Tc --- 2E+4 8E-6 3E-8 --- ---

Technetium-96m<sup>2</sup>

D, see <sup>93m</sup>Tc 2E+5 3E+5 1E-4 4E-7 2E-3 2E-2

W, see <sup>93m</sup>Tc --- 2E+5 1E-4 3E-7 --- ---

Technetium-96

D, see <sup>93m</sup>Tc 2E+3 3E+3 1E-6 5E-9 3E-5 3E-4

W, see <sup>93m</sup>Tc --- 2E+3 9E-7 3E-9 --- ---

## Technetium-97m

D, see $^{93m}\text{Tc}$	5E+3	7E+3	3E-6	---	6E-5	6E-4
		Stom (7E+3)	---	1E-8	---	---
W, see $^{93m}\text{Tc}$	---	1E+3	5E-7	2E-9	---	---

## Technetium-97

D, see $^{93m}\text{Tc}$	4E+4	5E+4	2E-5	7E-8	5E-4	5E-3
W, see $^{93m}\text{Tc}$	---	6E+3	2E-6	8E-9	---	---

## Technetium-98

D, see $^{93m}\text{Tc}$	1E+3	2E+3	7E-7	2E-9	1E-5	1E-4
W, see $^{93m}\text{Tc}$	---	3E+2	1E-7	4E-10	---	---

## Technetium-99m

D, see $^{93m}\text{Tc}$	8E+4	2E+5	6E-5	2E-7	1E-3	1E-2
W, see $^{93m}\text{Tc}$	---	2E+5	1E-4	3E-7	---	---

## Technetium-99

D, see $^{93m}\text{Tc}$	4E+3	5E+3	2E-6	---	6E-5	6E-4
		Stom (6E+3)	---	8E-9	---	---
W, see $^{93m}\text{Tc}$	---	7E+2	3E-7	9E-10	---	---

Technetium-101<sup>2</sup>

D, see $^{93m}\text{Tc}$	9E+4	3E+5	1E-4	5E-7	---	---
		Stom (1E+5)	---	---	2E-3	2E-2
W, see $^{93m}\text{Tc}$	---	4E+5	2E-4	5E-7	---	---



Technetium-104<sup>2</sup>

D, see <sup>93m</sup> Tc	2E+4	7E+4	3E-5	1E-7	---	---
	Stom (3E+4)	---	---	---	4E-4	4E-3
W, see <sup>93m</sup> Tc	---	9E+4	4E-5	1E-7	---	---

## AN 44

Ruthenium-94<sup>2</sup>

D, all compounds except those given for W and Y	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
W, halides	---	6E+4	3E-5	9E-8	---	---
Y, oxides and hydroxides	---	6E+4	2E-5	8E-8	---	---

## Ruthenium-97

D, see <sup>94</sup> Ru	8E+3	2E+4	8E-6	3E-8	1E-4	1E-3
W, see <sup>94</sup> Ru	---	1E+4	5E-6	2E-8	---	---
Y, see <sup>94</sup> Ru	---	1E+4	5E-6	2E-8	---	---

## Ruthenium-103

D, see <sup>94</sup> Ru	2E+3	2E+3	7E-7	2E-9	3E-5	3E-4
W, see <sup>94</sup> Ru	---	1E+3	4E-7	1E-9	---	---
Y, see <sup>94</sup> Ru	---	6E+2	3E-7	9E-10	---	---

## Ruthenium-105

D, see <sup>94</sup> Ru	5E+3	1E+4	6E-6	2E-8	7E-5	7E-4
W, see <sup>94</sup> Ru	---	1E+4	6E-6	2E-8	---	---
Y, see <sup>94</sup> Ru	---	1E+4	5E-6	2E-8	---	---

## Ruthenium-106

D, see <sup>94</sup> Ru	2E+2	9E+1	4E-8	1E-10	---	---
	LLI(2E+2)	---	---	---	3E-6	3E-5
W, see <sup>94</sup> Ru	---	5E+1	2E-8	8E-11	---	---
Y, see <sup>94</sup> Ru	---	1E+1	5E-9	2E-11	---	---

**AN 45**

## Rhodium-99m

D, all compounds except those given for W and Y	2E+4	6E+4	2E-5	8E-8	2E-4	2E-3
W, halides	---	8E+4	3E-5	1E-7	---	---
Y, oxides and hydroxides	---	7E+4	3E-5	9E-8	---	---

## Rhodium-99

D, see <sup>99m</sup> Rh	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
W, see <sup>99m</sup> Rh	---	2E+3	9E-7	3E-9	---	---
Y, see <sup>99m</sup> Rh	---	2E+3	8E-7	3E-9	---	---

## Rhodium-100

D, see <sup>99m</sup> Rh	2E+3	5E+3	2E-6	7E-9	2E-5	2E-4
W, see <sup>99m</sup> Rh	---	4E+3	2E-6	6E-9	---	---
Y, see <sup>99m</sup> Rh	---	4E+3	2E-6	5E-9	---	---

## Rhodium-101m

D, see <sup>99m</sup> Rh	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
W, see <sup>99m</sup> Rh	---	8E+3	4E-6	1E-8	---	---
Y, see <sup>99m</sup> Rh	---	8E+3	3E-6	1E-8	---	---

## Rhodium-101

D, see <sup>99m</sup> Rh	2E+3	5E+2	2E-7	7E-10	3E-5	3E-4
--------------------------	------	------	------	-------	------	------

W, see <sup>99m</sup> Rh	---	8E+2	3E-7	1E-9	---	---
Y, see <sup>99m</sup> Rh	---	2E+2	6E-8	2E-10	---	---
Rhodium-102m						
D, see <sup>99m</sup> Rh	1E+3	5E+2	2E-7	7E-10	---	---
	LLI (1E+3)	---	---	---	2E-5	2E-4
W, see <sup>99m</sup> Rh	---	4E+2	2E-7	5E-10	---	---
Y, see <sup>99m</sup> Rh	---	1E+2	5E-8	2E-10	---	---
Rhodium-102						
D, see <sup>99m</sup> Rh	6E+2	9E+1	4E-8	1E-10	8E-6	8E-5
W, see <sup>99m</sup> Rh	---	2E+2	7E-8	2E-10	---	---
Y, see <sup>99m</sup> Rh	---	6E+1	2E-8	8E-11	---	---
Rhodium-103m <sup>2</sup>						
D, see <sup>99m</sup> Rh	4E+5	1E+6	5E-4	2E-6	6E-3	6E-2
W, see <sup>99m</sup> Rh	---	1E+6	5E-4	2E-6	---	---
Y, see <sup>99m</sup> Rh	---	1E+6	5E-4	2E-6	---	---
Rhodium-105						
D, see <sup>99m</sup> Rh	4E+3	1E+4	5E-6	2E-8	---	---
	LLI (4E+3)	---	---	---	5E-5	5E-4
W, see <sup>99m</sup> Rh	---	6E+3	3E-6	9E-9	---	---
Y, see <sup>99m</sup> Rh	---	6E+3	2E-6	8E-9	---	---
Rhodium-106m						
D, see <sup>99m</sup> Rh	8E+3	3E+4	1E-5	4E-8	1E-4	1E-3
W, see <sup>99m</sup> Rh	---	4E+4	2E-5	5E-8	---	---
Y, see <sup>99m</sup> Rh	---	4E+4	1E-5	5E-8	---	---

Rhodium-107<sup>2</sup>

D, see <sup>99m</sup> Rh	7E+4	2E+5	1E-4	3E-7	---	---
	Stom (9E+4)	---	---	---	1E-3	1E-2
W, see <sup>99m</sup> Rh	---	3E+5	1E-4	4E-7	---	---
Y, see <sup>99m</sup> Rh	---	3E+5	1E-4	3E-7	---	---

**AN 46**

## Palladium-100

D, all compounds except those given for W and Y	1E+3	1E+3	6E-7	2E-9	2E-5	2E-4
W, nitrates	---	1E+3	5E-7	2E-9	---	---
Y, oxides and hydroxides	---	1E+3	6E-7	2E-9	---	---

## Palladium-101

D, see <sup>100</sup> Pd	1E+4	3E+4	1E-5	5E-8	2E-4	2E-3
W, see <sup>100</sup> Pd	---	3E+4	1E-5	5E-8	---	---
Y, see <sup>100</sup> Pd	---	3E+4	1E-5	4E-8	---	---

## Palladium-103

D, see <sup>100</sup> Pd	6E+3	6E+3	3E-6	9E-9	---	---
	LLI (7E+3)	---	---	---	1E-4	1E-3
W, see <sup>100</sup> Pd	---	4E+3	2E-6	6E-9	---	---
Y, see <sup>100</sup> Pd	---	4E+3	1E-6	5E-9	---	---

## Palladium-107

D, see <sup>100</sup> Pd	3E+4	2E+4	9E-6	---	---	---
	LLI (4E+4)	Kid (2E+4)	---	3E-8	5E-4	5E-3
W, see <sup>100</sup> Pd	---	7E+3	3E-6	1E-8	---	---

Y, see <sup>100</sup> Pd	---	4E+2	2E-7	6E-10	---	---
Palladium-109						
D, see <sup>100</sup> Pd	2E+3	6E+3	3E-6	9E-9	3E-5	3E-4
W, see <sup>100</sup> Pd	---	5E+3	2E-6	8E-9	---	---
Y, see <sup>100</sup> Pd	---	5E+3	2E-6	6E-9	---	---
AN 47						
Silver-102 <sup>2</sup>						
D, all compounds except those given for W and Y	5E+4	2E+5	8E-5	2E-7	---	---
	Stom (6E+4)	---	---	---	9E-4	9E-3
W, nitrates and sulfides	---	2E+5	9E-5	3E-7	---	---
Y, oxides and hydroxides	---	2E+5	8E-5	3E-7	---	---
Silver-103 <sup>2</sup>						
D, see <sup>102</sup> Ag	4E+4	1E+5	4E-5	1E-7	5E-4	5E-3
W, see <sup>102</sup> Ag	---	1E+5	5E-5	2E-7	---	---
Y, see <sup>102</sup> Ag	---	1E+5	5E-5	2E-7	---	---
Silver-104m <sup>2</sup>						
D, see <sup>102</sup> Ag	3E+4	9E+4	4E-5	1E-7	4E-4	4E-3
W, see <sup>102</sup> Ag	---	1E+5	5E-5	2E-7	---	---
Y, see <sup>102</sup> Ag	---	1E+5	5E-5	2E-7	---	---
Silver-104 <sup>2</sup>						
D, see <sup>102</sup> Ag	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
W, see <sup>102</sup> Ag	---	1E+5	6E-5	2E-7	---	---
Y, see <sup>102</sup> Ag	---	1E+5	6E-5	2E-7	---	---

## Silver-105

D, see $^{102}\text{Ag}$	3E+3	1E+3	4E-7	1E-9	4E-5	4E-4
W, see $^{102}\text{Ag}$	---	2E+3	7E-7	2E-9	---	---
Y, see $^{102}\text{Ag}$	---	2E+3	7E-7	2E-9	---	---

## Silver-106m

D, see $^{102}\text{Ag}$	8E+2	7E+2	3E-7	1E-9	1E-5	1E-4
W, see $^{102}\text{Ag}$	---	9E+2	4E-7	1E-9	---	---
Y, see $^{102}\text{Ag}$	---	9E+2	4E-7	1E-9	---	---

Silver-106<sup>2</sup>

D, see $^{102}\text{Ag}$	6E+4	2E+5	8E-5	3E-7	---	---
	Stom (6E+4)	---	---	---	9E-4	9E-3
W, see $^{102}\text{Ag}$	---	2E+5	9E-5	3E-7	---	---
Y, see $^{102}\text{Ag}$	---	2E+5	8E-5	3E-7	---	---

## Silver-108m

D, see $^{102}\text{Ag}$	6E+2	2E+2	8E-8	3E-10	9E-6	9E-5
W, see $^{102}\text{Ag}$	---	3E+2	1E-7	4E-10	---	---
Y, see $^{102}\text{Ag}$	---	2E+1	1E-8	3E-11	---	---

## Silver-110m

D, see $^{102}\text{Ag}$	5E+2	1E+2	5E-8	2E-10	6E-6	6E-5
W, see $^{102}\text{Ag}$	---	2E+2	8E-8	3E-10	---	---
Y, see $^{102}\text{Ag}$	---	9E+1	4E-8	1E-10	---	---

## Silver-111

D, see $^{102}\text{Ag}$	9E+2	2E+3	6E-7	---	---	---
--------------------------	------	------	------	-----	-----	-----

		Liver				
	LLI (1E+3)	(2E+3)	---	2E-9	2E-5	2E-4
W, see <sup>102</sup> Ag	---	9E+2	4E-7	1E-9	---	---
Y, see <sup>102</sup> Ag	---	9E+2	4E-7	1E-9	---	---
Silver-112						
D, see <sup>102</sup> Ag	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
W, see <sup>102</sup> Ag	---	1E+4	4E-6	1E-8	---	---
Y, see <sup>102</sup> Ag	---	9E+3	4E-6	1E-8	---	---
Silver-115 <sup>2</sup>						
D, see <sup>102</sup> Ag	3E+4	9E+4	4E-5	1E-7	---	---
	Stom					
	(3E+4)	---	---	---	4E-4	4E-3
W, see <sup>102</sup> Ag	---	9E+4	4E-5	1E-7	---	---
Y, see <sup>102</sup> Ag	---	8E+4	3E-5	1E-7	---	---
<b>AN 48</b>						
Cadmium-104 <sup>2</sup>						
D, all compounds except those given for W and Y	2E+4	7E+4	3E-5	9E-8	3E-4	3E-3
W, sulfides, halides, and nitrates	---	1E+5	5E-5	2E-7	---	---
Y, oxides and hydroxides	---	1E+5	5E-5	2E-7	---	---
Cadmium-107						
D, see <sup>104</sup> Cd	2E+4	5E+4	2E-5	8E-8	3E-4	3E-3
W, see <sup>104</sup> Cd	---	6E+4	2E-5	8E-8	---	---
Y, see <sup>104</sup> Cd	---	5E+4	2E-5	7E-8	---	---
Cadmium-109						

D, see $^{104}\text{Cd}$	3E+2	4E+1	1E-8	---	---	---
	Kid (4E+2)	Kid (5E+1)	---	7E-11	6E-6	6E-5
W, see $^{104}\text{Cd}$	---	1E+2	5E-8	---	---	---
	---	Kid (1E+2)	---	2E-10	---	---
Y, see $^{104}\text{Cd}$	---	1E+2	5E-8	2E-10	---	---
Cadmium-113m						
D, see $^{104}\text{Cd}$	2E+1	2E+0	1E-9	---	---	---
	Kid (4E+1)	Kid (4E+0)	---	5E-12	5E-7	5E-6
W, see $^{104}\text{Cd}$	---	8E+0	4E-9	---	---	---
	---	Kid (1E+1)	---	2E-11	---	---
Y, see $^{104}\text{Cd}$	---	1E+1	5E-9	2E-11	---	---
Cadmium-113						
D, see $^{104}\text{Cd}$	2E+1	2E+0	9E-10	---	---	---
	Kid (3E+1)	Kid (3E+0)	---	5E-12	4E-7	4E-6
W, see $^{104}\text{Cd}$	---	8E+0	3E-9	---	---	---
	---	Kid (1E+1)	---	2E-11	---	---
Y, see $^{104}\text{Cd}$	---	1E+1	6E-9	2E-11	---	---
Cadmium-115m						
D, see $^{104}\text{Cd}$	3E+2	5E+1	2E-8	---	4E-6	4E-5
	---	Kid (8E+1)	---	1E-10	---	---
W, see $^{104}\text{Cd}$	---	1E+2	5E-8	2E-10	---	---
Y, see $^{104}\text{Cd}$	---	1E+2	6E-8	2E-10	---	---
Cadmium-115						
D, see $^{104}\text{Cd}$	9E+2	1E+3	6E-7	2E-9	---	---
	LLI (1E+3)	---	---	---	1E-5	1E-4



W, see $^{104}\text{Cd}$	---	1E+3	5E-7	2E-9	---	---
Y, see $^{104}\text{Cd}$	---	1E+3	6E-7	2E-9	---	---
Cadmium-117m						
D, see $^{104}\text{Cd}$	5E+3	1E+4	5E-6	2E-8	6E-5	6E-4
W, see $^{104}\text{Cd}$	---	2E+4	7E-6	2E-8	---	---
Y, see $^{104}\text{Cd}$	---	1E+4	6E-6	2E-8	---	---
Cadmium-117						
D, see $^{104}\text{Cd}$	5E+3	1E+4	5E-6	2E-8	6E-5	6E-4
W, see $^{104}\text{Cd}$	---	2E+4	7E-6	2E-8	---	---
Y, see $^{104}\text{Cd}$	---	1E+4	6E-6	2E-8	---	---
<b>AN 49</b>						
Indium-109						
D, all compounds except those given for W	2E+4	4E+4	2E-5	6E-8	3E-4	3E-3
W, oxides, hydroxides, halides, and nitrates	---	6E+4	3E-5	9E-8	---	---
Indium-110 <sup>2</sup> (69.1 min)						
D, see $^{109}\text{In}$	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
W, see $^{109}\text{In}$	---	6E+4	2E-5	8E-8	---	---
Indium-110 (4.9 h)						
D, see $^{109}\text{In}$	5E+3	2E+4	7E-6	2E-8	7E-5	7E-4
W, see $^{109}\text{In}$	---	2E+4	8E-6	3E-8	---	---
Indium-111						
D, see $^{109}\text{In}$	4E+3	6E+3	3E-6	9E-9	6E-5	6E-4

W, see $^{109}\text{In}$	---	6E+3	3E-6	9E-9	---	---
Indium-112 <sup>2</sup>						
D, see $^{109}\text{In}$	2E+5	6E+5	3E-4	9E-7	2E-3	2E-2
W, see $^{109}\text{In}$	---	7E+5	3E-4	1E-6	---	---
Indium-113m <sup>2</sup>						
D, see $^{109}\text{In}$	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
W, see $^{109}\text{In}$	---	2E+5	8E-5	3E-7	---	---
Indium-114m						
D, see $^{109}\text{In}$	3E+2	6E+1	3E-8	9E-11	---	---
	LLI (4E+2)	---	---	---	5E-6	5E-5
W, see $^{109}\text{In}$	---	1E+2	4E-8	1E-10	---	---
Indium-115m						
D, see $^{109}\text{In}$	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
W, see $^{109}\text{In}$	---	5E+4	2E-5	7E-8	---	---
Indium-115						
D, see $^{109}\text{In}$	4E+1	1E+0	6E-10	2E-12	5E-7	5E-6
W, see $^{109}\text{In}$	---	5E+0	2E-9	8E-12	---	---
Indium-116m <sup>2</sup>						
D, see $^{109}\text{In}$	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
W, see $^{109}\text{In}$	---	1E+5	5E-5	2E-7	---	---
Indium-117m <sup>2</sup>						
D, see $^{109}\text{In}$	1E+4	3E+4	1E-5	5E-8	2E-4	2E-3

W, see $^{109}\text{In}$	---	4E+4	2E-5	6E-8	---	---
Indium-117 <sup>2</sup>						
D, see $^{109}\text{In}$	6E+4	2E+5	7E-5	2E-7	8E-4	8E-3
W, see $^{109}\text{In}$	---	2E+5	9E-5	3E-7	---	---
Indium-119m <sup>2</sup>						
D, see $^{109}\text{In}$	4E+4	1E+5	5E-5	2E-7	---	---
	Stom (5E+4)	---	---	---	7E-4	7E-3
W, see $^{109}\text{In}$	---	1E+5	6E-5	2E-7	---	---
<b>AN 50</b>						
Tin-110						
D, all compounds except those given for W	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4
W, sulfides, oxides, hydroxides, halides, nitrates, and stannic phosphate	---	1E+4	5E-6	2E-8	---	---
Tin-111 <sup>2</sup>						
D, see $^{110}\text{Sn}$	7E+4	2E+5	9E-5	3E-7	1E-3	1E-2
W, see $^{110}\text{Sn}$	---	3E+5	1E-4	4E-7	---	---
Tin-113						
D, see $^{110}\text{Sn}$	2E+3	1E+3	5E-7	2E-9	---	---
	LLI (2E+3)	---	---	---	3E-5	3E-4
W, see $^{110}\text{Sn}$	---	5E+2	2E-7	8E-10	---	---
Tin-117m						
D, see $^{110}\text{Sn}$	2E+3	1E+3	5E-7	---	---	---

		Bone				
	LLI(2E+3)	(2E+3)	---	3E-9	3E-5	3E-4
W, see <sup>110</sup> Sn	---	1E+3	6E-7	2E-9	---	---
Tin-119m						
D, see <sup>110</sup> Sn	3E+3	2E+3	1E-6	3E-9	---	---
	LLI(4E+3)	---	---	---	6E-5	6E-4
W, see <sup>110</sup> Sn	---	1E+3	4E-7	1E-9	---	---
Tin-121m						
D, see <sup>110</sup> Sn	3E+3	9E+2	4E-7	1E-9	---	---
	LLI(4E+3)	---	---	---	5E-5	5E-4
W, see <sup>110</sup> Sn	---	5E+2	2E-7	8E-10	---	---
Tin-121						
D, see <sup>110</sup> Sn	6E+3	2E+4	6E-6	2E-8	---	---
	LLI(6E+3)	---	---	---	8E-5	8E-4
W, see <sup>110</sup> Sn	---	1E+4	5E-6	2E-8	---	---
Tin-123m <sup>2</sup>						
D, see <sup>110</sup> Sn	5E+4	1E+5	5E-5	2E-7	7E-4	7E-3
W, see <sup>110</sup> Sn	---	1E+5	6E-5	2E-7	---	---
Tin-123						
D, see <sup>110</sup> Sn	5E+2	6E+2	3E-7	9E-10	---	----
	LLI(6E+2)	---	---	---	9E-6	9E-5
W, see <sup>110</sup> Sn	---	2E+2	7E-8	2E-10	---	---
Tin-125						
D, see <sup>110</sup> Sn	4E+2	9E+2	4E-7	1E-9	---	---

	LLI (5E+2)	---	---	---	6E-6	6E-5
W, see <sup>110</sup> Sn	---	4E+2	1E-7	5E-10	---	---
Tin-126						
D, see <sup>110</sup> Sn	3E+2	6E+1	2E-8	8E-11	4E-6	4E-5
W, see <sup>110</sup> Sn	---	7E+1	3E-8	9E-11	---	---
Tin-127						
D, see <sup>110</sup> Sn	7E+3	2E+4	8E-6	3E-8	9E-5	9E-4
W, see <sup>110</sup> Sn	---	2E+4	8E-6	3E-8	---	---
Tin-128 <sup>2</sup>						
D, see <sup>110</sup> Sn	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
W, see <sup>110</sup> Sn	---	4E+4	1E-5	5E-8	---	---
<b>AN 51</b>						
Antimony-115 <sup>2</sup>						
D, all compounds except those given for W	8E+4	2E+5	1E-4	3E-7	1E-3	1E-2
W, oxides, hydroxides, halides, sulfides, sulfates, and nitrates	---	3E+5	1E-4	4E-7	---	---
Antimony-116m <sup>2</sup>						
D, see <sup>115</sup> Sb	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
W, see <sup>115</sup> Sb	---	1E+5	6E-5	2E-7	---	---
Antimony-116 <sup>2</sup>						
D, see <sup>115</sup> Sb	7E+4	3E+5	1E-4	4E-7	---	---
	Stom (9E+4)	---	---	---	1E-3	1E-2

W, see <sup>115</sup> Sb	---	3E+5	1E-4	5E-7	---	---
Antimony-117						
D, see <sup>115</sup> Sb	7E+4	2E+5	9E-5	3E-7	9E-4	9E-3
W, see <sup>115</sup> Sb	---	3E+5	1E-4	4E-7	---	---
Antimony-118m						
D, see <sup>115</sup> Sb	6E+3	2E+4	8E-6	3E-8	7E-5	7E-4
W, see <sup>115</sup> Sb	5E+3	2E+4	9E-6	3E-8	---	---
Antimony-119						
D, see <sup>115</sup> Sb	2E+4	5E+4	2E-5	6E-8	2E-4	2E-3
W, see <sup>115</sup> Sb	2E+4	3E+4	1E-5	4E-8	---	---
Antimony-120 <sup>2</sup> (16 min)						
D, see <sup>115</sup> Sb	1E+5	4E+5	2E-4	6E-7	---	---
	Stom (2E+5)	---	---	---	2E-3	2E-2
W, see <sup>115</sup> Sb	---	5E+5	2E-4	7E-7	---	---
Antimony-120 (5.76 d)						
D, see <sup>115</sup> Sb	1E+3	2E+3	9E-7	3E-9	1E-5	1E-4
W, see <sup>115</sup> Sb	9E+2	1E+3	5E-7	2E-9	---	---
Antimony-122						
D, see <sup>115</sup> Sb	8E+2	2E+3	1E-6	3E-9	---	---
	LLI (8E+2)	---	---	---	1E-5	1E-4
W, see <sup>115</sup> Sb	7E+2	1E+3	4E-7	2E-9	---	---
Antimony-124m <sup>2</sup>						

D, see <sup>115</sup> Sb	3E+5	8E+5	4E-4	1E-6	3E-3	3E-2
W, see <sup>115</sup> Sb	2E+5	6E+5	2E-4	8E-7	---	---
Antimony-124						
D, see <sup>115</sup> Sb	6E+2	9E+2	4E-7	1E-9	7E-6	7E-5
W, see <sup>115</sup> Sb	5E+2	2E+2	1E-7	3E-10	---	---
Antimony-125						
D, see <sup>115</sup> Sb	2E+3	2E+3	1E-6	3E-9	3E-5	3E-4
W, see <sup>115</sup> Sb	---	5E+2	2E-7	7E-10	---	---
Antimony-126m <sup>2</sup>						
D, see <sup>115</sup> Sb	5E+4	2E+5	8E-5	3E-7	---	---
	Stom (7E+4)	---	---	---	9E-4	9E-3
W, see <sup>115</sup> Sb	---	2E+5	8E-5	3E-7	---	---
Antimony-126						
D, see <sup>115</sup> Sb	6E+2	1E+3	5E-7	2E-9	7E-6	7E-5
W, see <sup>115</sup> Sb	5E+2	5E+2	2E-7	7E-10	---	---
Antimony-127						
D, see <sup>115</sup> Sb	8E+2	2E+3	9E-7	3E-9	---	---
	LLI (8E+2)	---	---	---	1E-5	1E-4
W, see <sup>115</sup> Sb	7E+2	9E+2	4E-7	1E-9	---	---
Antimony-128 <sup>2</sup> (10.4 min)						
D, see <sup>115</sup> Sb	8E+4	4E+5	2E-4	5E-7	---	---
	Stom (1E+5)	---	---	---	1E-3	1E-2

W, see <sup>115</sup> Sb	---	4E+5	2E-4	6E-7	---	---
Antimony-128 (9.01 h)						
D, see <sup>115</sup> Sb	1E+3	4E+3	2E-6	6E-9	2E-5	2E-4
W, see <sup>115</sup> Sb	---	3E+3	1E-6	5E-9	---	---
Antimony-129						
D, see <sup>115</sup> Sb	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
W, see <sup>115</sup> Sb	---	9E+3	4E-6	1E-8	---	---
Antimony-130 <sup>2</sup>						
D, see <sup>115</sup> Sb	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
W, see <sup>115</sup> Sb	---	8E+4	3E-5	1E-7	---	---
Antimony-131 <sup>2</sup>						
D, see <sup>115</sup> Sb	1E+4	2E+4	1E-5	---	---	---
	Thyr (2E+4)	Thyr (4E+4)	---	6E-8	2E-4	2E-3
W, see <sup>115</sup> Sb	---	2E+4	1E-5	---	---	---
	---	Thyr (4E+4)	---	6E-8	---	---
<b>AN 52</b>						
Tellurium-116						
D, all compounds except those given for W	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3
W, oxides, hydroxides, and nitrates	---	3E+4	1E-5	4E-8	---	---
Tellurium-121m						
D, see <sup>116</sup> Te	5E+2	2E+2	8E-8	---	---	---



	Bone (7E+2)	Bone (4E+2)	---	5E-10	1E-5	1E-4
W, see <sup>116</sup> Te	---	4E+2	2E-7	6E-10	---	---
Tellurium-121						
D, see <sup>116</sup> Te	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
W, see <sup>116</sup> Te	---	3E+3	1E-6	4E-9	---	---
Tellurium-123m						
D, see <sup>116</sup> Te	6E+2	2E+2	9E-8	---	---	---
	Bone (1E+3)	Bone (5E+2)	---	8E-10	1E-5	1E-4
W, see <sup>116</sup> Te	---	5E+2	2E-7	8E-10	---	---
Tellurium-123						
D, see <sup>116</sup> Te	5E+2	2E+2	8E-8	---	---	---
	Bone (1E+3)	Bone (5E+2)	---	7E-10	2E-5	2E-4
W, see <sup>116</sup> Te	---	4E+2	2E-7	---	---	---
	---	Bone (1E+3)	---	2E-9	---	---
Tellurium-125m						
D, see <sup>116</sup> Te	1E+3	4E+2	2E-7	---	---	---
	Bone (1E+3)	Bone (1E+3)	---	1E-9	2E-5	2E-4
W, see <sup>116</sup> Te	---	7E+2	3E-7	1E-9	---	---
Tellurium-127m						
D, see <sup>116</sup> Te	6E+2	3E+2	1E-7	---	9E-6	9E-5

		Bone				
	---	(4E+2)	---	6E-10	---	---
W, see <sup>116</sup> Te	---	3E+2	1E-7	4E-10	---	---
Tellurium-127						
D, see <sup>116</sup> Te	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
W, see <sup>116</sup> Te	---	2E+4	7E-6	2E-8	---	---
Tellurium-129m						
D, see <sup>116</sup> Te	5E+2	6E+2	3E-7	9E-10	7E-6	7E-5
W, see <sup>116</sup> Te	---	2E+2	1E-7	3E-10	---	---
Tellurium-129 <sup>2</sup>						
D, see <sup>116</sup> Te	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
W, see <sup>116</sup> Te	---	7E+4	3E-5	1E-7	---	---
Tellurium-131m						
D, see <sup>116</sup> Te	3E+2	4E+2	2E-7	---	---	---
	Thyr	Thyr				
	(6E+2)	(1E+3)	---	2E-9	8E-6	8E-5
W, see <sup>116</sup> Te	---	4E+2	2E-7	---	---	---
		Thyr				
	---	(9E+2)	---	1E-9	---	---
Tellurium-131 <sup>2</sup>						
D, see <sup>116</sup> Te	3E+3	5E+3	2E-6	---	---	---
	Thyr	Thyr				
	(6E+3)	(1E+4)	---	2E-8	8E-5	8E-4
W, see <sup>116</sup> Te	---	5E+3	2E-6	---	---	---
		Thyr				
	---	(1E+4)	---	2E-8	---	---

## Tellurium-132

D, see $^{116}\text{Te}$	2E+2	2E+2	9E-8	---	---	---
	Thyr (7E+2)	Thyr (8E+2)	---	1E-9	9E-6	9E-5
W, see $^{116}\text{Te}$	---	2E+2	9E-8	---	---	---
	---	Thyr (6E+2)	---	9E-10	---	---

Tellurium-133m<sup>2</sup>

D, see $^{116}\text{Te}$	3E+3	5E+3	2E-6	---	---	---
	Thyr (6E+3)	Thyr (1E+4)	---	2E-8	9E-5	9E-4
W, see $^{116}\text{Te}$	---	5E+3	2E-6	---	---	---
	---	Thyr (1E+4)	---	2E-8	---	---

Tellurium-133<sup>2</sup>

D, see $^{116}\text{Te}$	1E+4	2E+4	9E-6	---	---	---
	Thyr (3E+4)	Thyr (6E+4)	---	8E-8	4E-4	4E-3
W, see $^{116}\text{Te}$	---	2E+4	9E-6	---	---	---
	---	Thyr (6E+4)	---	8E-8	---	---

Tellurium-134<sup>2</sup>

D, see $^{116}\text{Te}$	2E+4	2E+4	1E-5	---	---	---
	Thyr (2E+4)	Thyr (5E+4)	---	7E-8	3E-4	3E-3
W, see $^{116}\text{Te}$	---	2E+4	1E-5	---	---	---
	---	Thyr (5E+4)	---	7E-8	---	---

**AN 53**Iodine-120m<sup>2</sup>

D, all compounds	1E+4	2E+4	9E-6	3E-8	---	---
	Thyr (1E+4)	---	---	---	2E-4	2E-3

Iodine-120<sup>2</sup>

D, all compounds	4E+3	9E+3	4E-6	---	---	---
	Thyr (8E+3)	Thyr (1E+4)	---	2E-8	1E-4	1E-3

## Iodine-121

D, all compounds	1E+4	2E+4	8E-6	---	---	---
	Thyr (3E+4)	Thyr (5E+4)	---	7E-8	4E-4	4E-3

## Iodine-123

D, all compounds	3E+3	6E+3	3E-6	---	---	---
	Thyr (1E+4)	Thyr (2E+4)	---	2E-8	1E-4	1E-3

## Iodine-124

D, all compounds	5E+1	8E+1	3E-8	---	---	---
	Thyr (2E+2)	Thyr (3E+2)	---	4E-10	2E-6	2E-5

## Iodine-125

D, all compounds	4E+1	6E+1	3E-8	---	---	---
	Thyr (1E+2)	Thyr (2E+2)	---	3E-10	2E-6	2E-5

## Iodine-126

D, all compounds	2E+1	4E+1	1E-8	---	---	---
	Thyr (7E+1)	Thyr (1E+2)	---	2E-10	1E-6	1E-5

Iodine-128<sup>2</sup>

D, all compounds	4E+4	1E+5	5E-5	2E-7	---	---
	Stom (6E+4)	---	---	---	8E-4	8E-3

## Iodine-129

D, all compounds	5E+0	9E+0	4E-9	---	---	---
	Thyr (2E+1)	Thyr (3E+1)	---	4E-11	2E-7	2E-6

## Iodine-130

D, all compounds	4E+2	7E+2	3E-7	---	---	---
	Thyr (1E+3)	Thyr (2E+3)	---	3E-9	2E-5	2E-4

## Iodine-131

D, all compounds	3E+1	5E+1	2E-8	---	---	---
	Thyr (9E+1)	Thyr (2E+2)	---	2E-10	1E-6	1E-5

Iodine-132m<sup>2</sup>

D, all compounds	4E+3	8E+3	4E-6	---	---	---
	Thyr (1E+4)	Thyr (2E+4)	---	3E-8	1E-4	1E-3

## Iodine-132

D, all compounds	4E+3	8E+3	3E-6	---	---	---
	Thyr (9E+3)	Thyr (1E+4)	---	2E-8	1E-4	1E-3
Iodine-133						
D, all compounds	1E+2	3E+2	1E-7	---	---	---
	Thyr (5E+2)	Thyr (9E+2)	---	1E-9	7E-6	7E-5
Iodine-134 <sup>2</sup>						
D, all compounds	2E+4	5E+4	2E-5	6E-8	---	---
	Thyr (3E+4)	---	---	---	4E-4	4E-3
Iodine-135						
D, all compounds	8E+2	2E+3	7E-7	---	---	---
	Thyr (3E+3)	Thyr (4E+3)	---	6E-9	3E-5	3E-4
<b>AN 54</b>						
Xenon-120 <sup>2</sup>						
Submersion <sup>1</sup>	---	---	1E-5	4E-8	---	---
Xenon-121 <sup>2</sup>						
Submersion <sup>1</sup>	---	---	2E-6	1E-8	---	---
Xenon-122						
Submersion <sup>1</sup>	---	---	7E-5	3E-7	---	---
Xenon-123						
Submersion <sup>1</sup>	---	---	6E-6	3E-8	---	---

Xenon-125

Submersion <sup>1</sup>	---	---	2E-5	7E-8	---	---
-------------------------	-----	-----	------	------	-----	-----

Xenon-127

Submersion <sup>1</sup>	---	---	1E-5	6E-8	---	---
-------------------------	-----	-----	------	------	-----	-----

Xenon-129m

Submersion <sup>1</sup>	---	---	2E-4	9E-7	---	---
-------------------------	-----	-----	------	------	-----	-----

Xenon-131m

Submersion <sup>1</sup>	---	---	4E-4	2E-6	---	---
-------------------------	-----	-----	------	------	-----	-----

Xenon-133m

Submersion <sup>1</sup>	---	---	1E-4	6E-7	---	---
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Xenon-133

Submersion <sup>1</sup>	---	---	1E-4	5E-7	---	---
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Xenon-135m<sup>2</sup>

Submersion <sup>1</sup>	---	---	9E-6	4E-8	---	---
-------------------------	-----	-----	------	------	-----	-----

Xenon-135

Submersion <sup>1</sup>	---	---	1E-5	7E-8	---	---
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Xenon-138<sup>2</sup>

Submersion <sup>1</sup>	---	---	4E-6	2E-8	---	---
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**AN 55**Cesium-125<sup>2</sup>

D, all compounds	5E+4	1E+5	6E-5	2E-7	---	---
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	Stom (9E+4)	---	---	---	1E-3	1E-2
Cesium-127						
D, all compounds	6E+4	9E+4	4E-5	1E-7	9E-4	9E-3
Cesium-129						
D, all compounds	2E+4	3E+4	1E-5	5E-8	3E-4	3E-3
Cesium-130 <sup>2</sup>						
D, all compounds	6E+4	2E+5	8E-5	3E-7	---	---
	Stom (1E+5)	---	---	---	1E-3	1E-2
Cesium-131						
D, all compounds	2E+4	3E+4	1E-5	4E-8	3E-4	3E-3
Cesium-132						
D, all compounds	3E+3	4E+3	2E-6	6E-9	4E-5	4E-4
Cesium-134m						
D, all compounds	1E+5	1E+5	6E-5	2E-7	---	---
	Stom (1E+5)	---	---	---	2E-3	2E-2
Cesium-134						
D, all compounds	7E+1	1E+2	4E-8	2E-10	9E-7	9E-6
Cesium-135m <sup>2</sup>						
D, all compounds	1E+5	2E+5	8E-5	3E-7	1E-3	1E-2



## Cesium-135

D, all compounds	7E+2	1E+3	5E-7	2E-9	1E-5	1E-4
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## Cesium-136

D, all compounds	4E+2	7E+2	3E-7	9E-10	6E-6	6E-5
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## Cesium-137

D, all compounds	1E+2	2E+2	6E-8	2E-10	1E-6	1E-5
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Cesium-138<sup>2</sup>

D, all compounds	2E+4	6E+4	2E-5	8E-8	---	---
Stom (3E+4)	---	---	---	---	4E-4	4E-3

**AN 56**Barium-126<sup>2</sup>

D, all compounds	6E+3	2E+4	6E-6	2E-8	8E-5	8E-4
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## Barium-128

D, all compounds	5E+2	2E+3	7E-7	2E-9	7E-6	7E-5
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Barium-131m<sup>2</sup>

D, all compounds	4E+5	1E+6	6E-4	2E-6	---	---
Stom (5E+5)	---	---	---	---	7E-3	7E-2

## Barium-131

D, all compounds	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
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## Barium-133m

D, all compounds	2E+3	9E+3	4E-6	1E-8	---	---
	LLI (3E+3)	---	---	---	4E-5	4E-4

## Barium-133

D, all compounds	2E+3	7E+2	3E-7	9E-10	2E-5	2E-4
------------------	------	------	------	-------	------	------

## Barium-135m

D, all compounds	3E+3	1E+4	5E-6	2E-8	4E-5	4E-4
------------------	------	------	------	------	------	------

Barium-139<sup>2</sup>

D, all compounds	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
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## Barium-140

D, all compounds	5E+2	1E+3	6E-7	2E-9	---	---
	LLI (6E+2)	---	---	---	8E-6	8E-5

Barium-141<sup>2</sup>

D, all compounds	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
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Barium-142<sup>2</sup>

D, all compounds	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
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**AN 57**Lanthanum-131<sup>2</sup>

D, all compounds except those given for W	5E+4	1E+5	5E-5	2E-7	6E-4	6E-3
W, oxides and hydroxides	---	2E+5	7E-5	2E-7	---	---

## Lanthanum-132

D, see <sup>131</sup> La	3E+3	1E+4	4E-6	1E-8	4E-5	4E-4
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W, see <sup>131</sup> La	---	1E+4	5E-6	2E-8	---	---
Lanthanum-135						
D, see <sup>131</sup> La	4E+4	1E+5	4E-5	1E-7	5E-4	5E-3
W, see <sup>131</sup> La	---	9E+4	4E-5	1E-7	---	---
Lanthanum-137						
D, see <sup>131</sup> La	1E+4	6E+1	3E-8	---	2E-4	2E-3
		Liver (7E+1)	---	1E-10	---	---
W, see <sup>131</sup> La	---	3E+2	1E-7	---	---	---
		Liver (3E+2)	---	4E-10	---	---
Lanthanum-138						
D, see <sup>131</sup> La	9E+2	4E+0	1E-9	5E-12	1E-5	1E-4
W, see <sup>131</sup> La	---	1E+1	6E-9	2E-11	---	---
Lanthanum-140						
D, see <sup>131</sup> La	6E+2	1E+3	6E-7	2E-9	9E-6	9E-5
W, see <sup>131</sup> La	---	1E+3	5E-7	2E-9	---	---
Lanthanum-141						
D, see <sup>131</sup> La	4E+3	9E+3	4E-6	1E-8	5E-5	5E-4
W, see <sup>131</sup> La	---	1E+4	5E-6	2E-8	---	---
Lanthanum-142 <sup>2</sup>						
D, see <sup>131</sup> La	8E+3	2E+4	9E-6	3E-8	1E-4	1E-3
W, see <sup>131</sup> La	---	3E+4	1E-5	5E-8	---	---
Lanthanum-143 <sup>2</sup>						

D, see <sup>131</sup> La	4E+4	1E+5	4E-5	1E-7	---	---
	Stom (4E+4)	---	---	---	5E-4	5E-3
W, see <sup>131</sup> La	---	9E+4	4E-5	1E-7	---	---
<b>AN 58</b>						
Cerium-134						
W, all compounds except those given for Y	5E+2	7E+2	3E-7	1E-9	---	---
	LLI (6E+2)	---	---	---	8E-6	8E-5
Y, oxides, hydroxides, and fluorides	---	7E+2	3E-7	9E-10	---	---
Cerium-135						
W, see <sup>134</sup> Ce	2E+3	4E+3	2E-6	5E-9	2E-5	2E-4
Y, see <sup>134</sup> Ce	---	4E+3	1E-6	5E-9	---	---
Cerium-137m						
W, see <sup>134</sup> Ce	2E+3	4E+3	2E-6	6E-9	---	---
	LLI (2E+3)	---	---	---	3E-5	3E-4
Y, see <sup>134</sup> Ce	---	4E+3	2E-6	5E-9	---	---
Cerium-137						
W, see <sup>134</sup> Ce	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
Y, see <sup>134</sup> Ce	---	1E+5	5E-5	2E-7	---	---
Cerium-139						
W, see <sup>134</sup> Ce	5E+3	8E+2	3E-7	1E-9	7E-5	7E-4
Y, see <sup>134</sup> Ce	---	7E+2	3E-7	9E-10	---	---
Cerium-141						

W, see $^{134}\text{Ce}$	2E+3	7E+2	3E-7	1E-9	---	---
	LLI(2E+3)	---	---	---	3E-5	3E-4
Y, see $^{134}\text{Ce}$	---	6E+2	2E-7	8E-10	---	---
Cerium-143						
W, see $^{134}\text{Ce}$	1E+3	2E+3	8E-7	3E-9	---	---
	LLI(1E+3)	---	---	---	2E-5	2E-4
Y, see $^{134}\text{Ce}$	---	2E+3	7E-7	2E-9	---	---
Cerium-144						
W, see $^{134}\text{Ce}$	2E+2	3E+1	1E-8	4E-11	---	---
	LLI(3E+2)	---	---	---	3E-6	3E-5
Y, see $^{134}\text{Ce}$	---	1E+1	6E-9	2E-11	---	---
<b>AN 59</b>						
Praseodymium-136 <sup>2</sup>						
W, all compounds except those given for Y	5E+4	2E+5	1E-4	3E-7	---	---
	Stom (7E+4)	---	---	---	1E-3	1E-2
Y, oxides, hydroxides, carbides, and fluorides	---	2E+5	9E-5	3E-7	---	---
Praseodymium-137 <sup>2</sup>						
W, see $^{136}\text{Pr}$	4E+4	2E+5	6E-5	2E-7	5E-4	5E-3
Y, see $^{136}\text{Pr}$	---	1E+5	6E-5	2E-7	---	---
Praseodymium-138m						
W, see $^{136}\text{Pr}$	1E+4	5E+4	2E-5	8E-8	1E-4	1E-3
Y, see $^{136}\text{Pr}$	---	4E+4	2E-5	6E-8	---	---

## Praseodymium-139

W, see <sup>136</sup> Pr	4E+4	1E+5	5E-5	2E-7	6E-4	6E-3
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Y, see <sup>136</sup> Pr	---	1E+5	5E-5	2E-7	---	---
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Praseodymium-142m<sup>2</sup>

W, see <sup>136</sup> Pr	8E+4	2E+5	7E-5	2E-7	1E-3	1E-2
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Y, see <sup>136</sup> Pr	---	1E+5	6E-5	2E-7	---	---
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## Praseodymium-142

W, see <sup>136</sup> Pr	1E+3	2E+3	9E-7	3E-9	1E-5	1E-4
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Y, see <sup>136</sup> Pr	---	2E+3	8E-7	3E-9	---	---
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## Praseodymium-143

W, see <sup>136</sup> Pr	9E+2	8E+2	3E-7	1E-9	---	---
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LLI (1E+3)	---	---	---	---	2E-5	2E-4
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Y, see <sup>136</sup> Pr	---	7E+2	3E-7	9E-10	---	---
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Praseodymium-144<sup>2</sup>

W, see <sup>136</sup> Pr	3E+4	1E+5	5E-5	2E-7	---	---
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Stom (4E+4)	---	---	---	---	6E-4	6E-3
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Y, see <sup>136</sup> Pr	---	1E+5	5E-5	2E-7	---	---
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## Praseodymium-145

W, see <sup>136</sup> Pr	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
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Y, see <sup>136</sup> Pr	---	8E+3	3E-6	1E-8	---	---
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Praseodymium-147<sup>2</sup>

W, see <sup>136</sup> Pr	5E+4	2E+5	8E-5	3E-7	---	---
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	Stom (8E+4)	---	---	---	1E-3	1E-2
Y, see <sup>136</sup> Pr	---	2E+5	8E-5	3E-7	---	---

**AN 60**Neodymium-136<sup>2</sup>

W, all compounds except those given for Y	1E+4	6E+4	2E-5	8E-8	2E-4	2E-3
---	------	------	------	------	------	------

Y, oxides, hydroxides, carbides, and fluorides	---	5E+4	2E-5	8E-8	---	---
--	-----	------	------	------	-----	-----

## Neodymium-138

W, see <sup>136</sup> Nd	2E+3	6E+3	3E-6	9E-9	3E-5	3E-4
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Y, see <sup>136</sup> Nd	---	5E+3	2E-6	7E-9	---	---
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## Neodymium-139m

W, see <sup>136</sup> Nd	5E+3	2E+4	7E-6	2E-8	7E-5	7E-4
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Y, see <sup>136</sup> Nd	---	1E+4	6E-6	2E-8	---	---
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Neodymium-139<sup>2</sup>

W, see <sup>136</sup> Nd	9E+4	3E+5	1E-4	5E-7	1E-3	1E-2
--------------------------	------	------	------	------	------	------

Y, see <sup>136</sup> Nd	---	3E+5	1E-4	4E-7	---	---
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## Neodymium-141

W, see <sup>136</sup> Nd	2E+5	7E+5	3E-4	1E-6	2E-3	2E-2
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Y, see <sup>136</sup> Nd	---	6E+5	3E-4	9E-7	---	---
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## Neodymium-147

W, see <sup>136</sup> Nd	1E+3	9E+2	4E-7	1E-9	---	---
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LLI (1E+3)	---	---	---	---	2E-5	2E-4
------------	-----	-----	-----	-----	------	------

Y, see <sup>136</sup> Nd	---	8E+2	4E-7	1E-9	---	---
Neodymium-149 <sup>2</sup>						
W, see <sup>136</sup> Nd	1E+4	3E+4	1E-5	4E-8	1E-4	1E-3
Y, see <sup>136</sup> Nd	---	2E+4	1E-5	3E-8	---	---
Neodymium-151 <sup>2</sup>						
W, see <sup>136</sup> Nd	7E+4	2E+5	8E-5	3E-7	9E-4	9E-3
Y, see <sup>136</sup> Nd	---	2E+5	8E-5	3E-7	---	---
<b>AN 61</b>						
Promethium-141 <sup>2</sup>						
W, all compounds except those given for Y	5E+4	2E+5	8E-5	3E-7	---	---
	Stom (6E+4)	---	---	---	8E-4	8E-3
Y, oxides, hydroxides, carbides, and fluorides	---	2E+5	7E-5	2E-7	---	---
Promethium-143						
W, see <sup>141</sup> Pm	5E+3	6E+2	2E-7	8E-10	7E-5	7E-4
Y, see <sup>141</sup> Pm	---	7E+2	3E-7	1E-9	---	---
Promethium-144						
W, see <sup>141</sup> Pm	1E+3	1E+2	5E-8	2E-10	5E-5	2E-4
Y, see <sup>141</sup> Pm	---	1E+2	5E-8	2E-10	---	---
Promethium-145						
W, see <sup>141</sup> Pm	1E+4	2E+2	7E-8	---	1E-4	1E-3
	---	Bone (2E+2)	---	3E-10	---	---



Y, see $^{141}\text{Pm}$	---	2E+2	8E-8	3E-10	---	---
Promethium-146						
W, see $^{141}\text{Pm}$	2E+3	5E+1	2E-8	7E-11	2E-5	2E-4
Y, see $^{141}\text{Pm}$	---	4E+1	2E-8	6E-11	---	---
Promethium-147						
W, see $^{141}\text{Pm}$	4E+3	1E+2	5E-8	---	---	---
		Bone				
	LLI (5E+3)	(2E+2)	---	3E-10	7E-5	7E-4
Y, see $^{141}\text{Pm}$	---	1E+2	6E-8	2E-10	---	---
Promethium-148m						
W, see $^{141}\text{Pm}$	7E+2	3E+2	1E-7	4E-10	1E-5	1E-4
Y, see $^{141}\text{Pm}$	---	3E+2	1E-7	5E-10	---	---
Promethium-148						
W, see $^{141}\text{Pm}$	4E+2	5E+2	2E-7	8E-10	---	---
	LLI (5E+2)	---	---	---	7E-6	7E-5
Y, see $^{141}\text{Pm}$	---	5E+2	2E-7	7E-10	---	---
Promethium-149						
W, see $^{141}\text{Pm}$	1E+3	2E+3	8E-7	3E-9	---	---
	LLI (1E+3)	---	---	---	2E-5	2E-4
Y, see $^{141}\text{Pm}$	---	2E+3	8E-7	2E-9	---	---
Promethium-150						
W, see $^{141}\text{Pm}$	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
Y, see $^{141}\text{Pm}$	---	2E+4	7E-6	2E-8	---	---

## Promethium-151

W, see <sup>141</sup> Pm	2E+3	4E+3	1E-6	5E-9	2E-5	2E-4
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Y, see <sup>141</sup> Pm	---	3E+3	1E-6	4E-9	---	---
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**AN 62**Samarium-141m<sup>2</sup>

W, all compounds	3E+4	1E+5	4E-5	1E-7	4E-4	4E-3
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Samarium-141<sup>2</sup>

W, all compounds	5E+4	2E+5	8E-5	2E-7	---	---
------------------	------	------	------	------	-----	-----

Stom (6E+4)	---	---	---	8E-4	8E-3
----------------	-----	-----	-----	------	------

Samarium-142<sup>2</sup>

W, all compounds	8E+3	3E+4	1E-5	4E-8	1E-4	1E-3
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## Samarium-145

W, all compounds	6E+3	5E+2	2E-7	7E-10	8E-5	8E-4
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## Samarium-146

W, all compounds	1E+1	4E-2	1E-11	---	---	---
------------------	------	------	-------	-----	-----	-----

Bone (3E+1)	Bone (6E-2)	---	9E-14	3E-7	3E-6
----------------	----------------	-----	-------	------	------

## Samarium-147

W, all compounds	2E+1	4E-2	2E-11	---	---	---
------------------	------	------	-------	-----	-----	-----

Bone (3E+1)	Bone (7E-2)	---	1E-13	4E-7	4E-6
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## Samarium-151

W, all compounds	1E+4	1E+2	4E-8	---	---	---
------------------	------	------	------	-----	-----	-----

		Bone					
	LLI (1E+4)	(2E+2)	---	2E-10	2E-4	2E-3	
Samarium-153							
W, all compounds	2E+3	3E+3	1E-6	4E-9	---	---	
	LLI (2E+3)	---	---	---	3E-5	3E-4	
Samarium-155 <sup>2</sup>							
W, all compounds	6E+4	2E+5	9E-5	3E-7	---	---	
	Stom						
	(8E+4)	---	---	---	1E-3	1E-2	
Samarium-156							
W, all compounds	5E+3	9E+3	4E-6	1E-8	7E-5	7E-4	
<b>AN 63</b>							
Europium-145							
W, all compounds	2E+3	2E+3	8E-7	3E-9	2E-5	2E-4	
Europium-146							
W, all compounds	1E+3	1E+3	5E-7	2E-9	1E-5	1E-4	
Europium-147							
W, all compounds	3E+3	2E+3	7E-7	2E-9	4E-5	4E-4	
Europium-148							
W, all compounds	1E+3	4E+2	1E-7	5E-10	1E-5	1E-4	
Europium-149							
W, all compounds	1E+4	3E+3	1E-6	4E-9	2E-4	2E-3	

## Europium-150 (12.62 h)

W, all compounds	3E+3	8E+3	4E-6	1E-8	4E-5	4E-4
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## Europium-150 (34.2 y)

W, all compounds	8E+2	2E+1	8E-9	3E-11	1E-5	1E-4
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## Europium-152m

W, all compounds	3E+3	6E+3	3E-6	9E-9	4E-5	4E-4
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## Europium-152

W, all compounds	8E+2	2E+1	1E-8	3E-11	1E-5	1E-4
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## Europium-154

W, all compounds	5E+2	2E+1	8E-9	3E-11	7E-6	7E-5
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## Europium-155

W, all compounds	4E+3	9E+1	4E-8	---	5E-5	5E-4
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---	Bone (1E+2)	---	2E-10	---	---
-----	----------------	-----	-------	-----	-----

## Europium-156

W, all compounds	6E+2	5E+2	2E-7	6E-10	8E-6	8E-5
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## Europium-157

W, all compounds	2E+3	5E+3	2E-6	7E-9	3E-5	3E-4
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Europium-158<sup>2</sup>

W, all compounds	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
------------------	------	------	------	------	------	------

**AN 64****Gadolinium-145<sup>2</sup>**D, all compounds except those  
given for W

5E+4	2E+5	6E-5	2E-7	---	---
Stom (5E+4)	---	---	---	6E-4	6E-3

W, oxides, hydroxides, and  
fluorides

---	2E+5	7E-5	2E-7	---	---
-----	------	------	------	-----	-----

**Gadolinium-146**D, see <sup>145</sup>Gd

1E+3	1E+2	5E-8	2E-10	2E-5	2E-4
------	------	------	-------	------	------

W, see <sup>145</sup>Gd

---	3E+2	1E-7	4E-10	---	---
-----	------	------	-------	-----	-----

**Gadolinium-147**D, see <sup>145</sup>Gd

2E+3	4E+3	2E-6	6E-9	3E-5	3E-4
------	------	------	------	------	------

W, see <sup>145</sup>Gd

---	4E+3	1E-6	5E-9	---	---
-----	------	------	------	-----	-----

**Gadolinium-148**D, see <sup>145</sup>Gd

1E+1	8E-3	3E-12	---	---	---
Bone (2E+1)	Bone (2E-2)	---	2E-14	3E-7	3E-6

W, see <sup>145</sup>Gd

---	3E-2	1E-11	---	---	---
---	Bone (6E-2)	---	8E-14	---	---

**Gadolinium-149**D, see <sup>145</sup>Gd

3E+3	2E+3	9E-7	3E-9	4E-5	4E-4
------	------	------	------	------	------

W, see <sup>145</sup>Gd

---	2E+3	1E-6	3E-9	---	---
-----	------	------	------	-----	-----

**Gadolinium-151**

D, see <sup>145</sup> Gd	6E+3	4E+2	2E-7	---	9E-5	9E-4
		Bone (6E+2)	---	9E-10	---	---
W, see <sup>145</sup> Gd	---	1E+3	5E-7	2E-9	---	---
Gadolinium-152						
D, see <sup>145</sup> Gd	2E+1	1E-2	4E-12	---	---	---
	Bone (3E+1)	Bone (2E-2)	---	3E-14	4E-7	4E-6
W, see <sup>145</sup> Gd	---	4E-2	2E-11	---	---	---
	---	Bone (8E-2)	---	1E-13	---	---
Gadolinium-153						
D, see <sup>145</sup> Gd	5E+3	1E+2	6E-8	---	6E-5	6E-4
	---	Bone (2E+2)	---	3E-10	---	---
W, see <sup>145</sup> Gd	---	6E+2	2E-7	8E-10	---	---
Gadolinium-159						
D, see <sup>145</sup> Gd	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
W, see <sup>145</sup> Gd	---	6E+3	2E-6	8E-9	---	---
<b>AN 65</b>						
Terbium-147 <sup>2</sup>						
W, all compounds	9E+3	3E+4	1E-5	5E-8	1E-4	1E-3
Terbium-149						
W, all compounds	5E+3	7E+2	3E-7	1E-9	7E-5	7E-4
Terbium-150						

W, all compounds	5E+3	2E+4	9E-6	3E-8	7E-5	7E-4
Terbium-151						
W, all compounds	4E+3	9E+3	4E-6	1E-8	5E-5	5E-4
Terbium-153						
W, all compounds	5E+3	7E+3	3E-6	1E-8	7E-5	7E-4
Terbium-154						
W, all compounds	2E+3	4E+3	2E-6	6E-9	2E-5	2E-4
Terbium-155						
W, all compounds	6E+3	8E+3	3E-6	1E-8	8E-5	8E-4
Terbium-156m (5.0 h)						
W, all compounds	2E+4	3E+4	1E-5	4E-8	2E-4	2E-3
Terbium-156m (24.4 h)						
W, all compounds	7E+3	8E+3	3E-6	1E-8	1E-4	1E-3
Terbium-156						
W, all compounds	1E+3	1E+3	6E-7	2E-9	1E-5	1E-4
Terbium-157						
W, all compounds	5E+4	3E+2	1E-7	---	---	---
		Bone				
	LLI (5E+4)	(6E+2)	---	8E-10	7E-4	7E-3
Terbium-158						
W, all compounds	1E+3	2E+1	8E-9	3E-11	2E-5	2E-4

## Terbium-160

W, all compounds	8E+2	2E+2	9E-8	3E-10	1E-5	1E-4
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## Terbium-161

W, all compounds	2E+3	2E+3	7E-7	2E-9	---	---
	LLI (2E+3)	---	---	---	3E-5	3E-4

**AN 66**

## Dysprosium-155

W, all compounds	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
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## Dysprosium-157

W, all compounds	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
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## Dysprosium-159

W, all compounds	1E+4	2E+3	1E-6	3E-9	2E-4	2E-3
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## Dysprosium-165

W, all compounds	1E+4	5E+4	2E-5	6E-8	2E-4	2E-3
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## Dysprosium-166

W, all compounds	6E+2	7E+2	3E-7	1E-9	---	---
	LLI (8E+2)	---	---	---	1E-5	1E-4

**AN 67**Holmium-155<sup>2</sup>

W, all compounds	4E+4	2E+5	6E-5	2E-7	6E-4	6E-3
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Holmium-157<sup>2</sup>



W, all compounds	3E+5	1E+6	6E-4	2E-6	4E-3	4E-2
Holmium-159 <sup>2</sup>						
W, all compounds	2E+5	1E+6	4E-4	1E-6	3E-3	3E-2
Holmium-161						
W, all compounds	1E+5	4E+5	2E-4	6E-7	1E-3	1E-2
Holmium-162m <sup>2</sup>						
W, all compounds	5E+4	3E+5	1E-4	4E-7	7E-4	7E-3
Holmium-162 <sup>2</sup>						
W, all compounds	5E+5	2E+6	1E-3	3E-6	---	---
	Stom (8E+5)	---	---	---	1E-2	1E-1
Holmium-164m <sup>2</sup>						
W, all compounds	1E+5	3E+5	1E-4	4E-7	1E-3	1E-2
Holmium-164 <sup>2</sup>						
W, all compounds	2E+5	6E+5	3E-4	9E-7	---	---
	Stom (2E+5)	---	---	---	3E-3	3E-2
Holmium-166m						
W, all compounds	6E+2	7E+0	3E-9	9E-12	9E-6	9E-5
Holmium-166						
W, all compounds	9E+2	2E+3	7E-7	2E-9	---	---
	LLI (9E+2)	---	---	---	1E-5	1E-4

## Holmium-167

W, all compounds	2E+4	6E+4	2E-5	8E-8	2E-4	2E-3
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**AN 68**

## Erbium-161

W, all compounds	2E+4	6E+4	3E-5	9E-8	2E-4	2E-3
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## Erbium-165

W, all compounds	6E+4	2E+5	8E-5	3E-7	9E-4	9E-3
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## Erbium-169

W, all compounds	3E+3	3E+3	1E-6	4E-9	---	---
	LLI(4E+3)	---	---	---	5E-5	5E-4

## Erbium-171

W, all compounds	4E+3	1E+4	4E-6	1E-8	5E-5	5E-4
------------------	------	------	------	------	------	------

## Erbium-172

W, all compounds	1E+3	1E+3	6E-7	2E-9	---	---
	LLI (E+3)	---	---	---	2E-5	2E-4

**AN 69**Thulium-162<sup>2</sup>

W, all compounds	7E+4	3E+5	1E-4	4E-7	---	---
	Stom (7E+4)	---	---	---	1E-3	1E-2

## Thulium-166

W, all compounds	4E+3	1E+4	6E-6	2E-8	6E-5	6E-4
------------------	------	------	------	------	------	------

## Thulium-167

W, all compounds	2E+3	2E+3	8E-7	3E-9	---	---
	LLI (2E+3)	---	---	---	3E-5	3E-4

## Thulium-170

W, all compounds	8E+2	2E+2	9E-8	3E-10	---	---
	LLI (1E+3)	---	---	---	1E-5	1E-4

## Thulium-171

W, all compounds	1E+4	3E+2	1E-7	---	---	---
		Bone				
	LLI (1E+4)	(6E+2)	---	8E-10	2E-4	2E-3

## Thulium-172

W, all compounds	7E+2	1E+3	5E-7	2E-9	---	---
	LLI (8E+2)	---	---	---	1E-5	1E-4

## Thulium-173

W, all compounds	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
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Thulium-175<sup>2</sup>

W, all compounds	7E+4	3E+5	1E-4	4E-7	---	---
	Stom					
	(9E+4)	---	---	---	1E-3	1E-2

## AN 70

Ytterbium-162<sup>2</sup>

W, all compounds except those given for Y	7E+4	3E+5	1E-4	4E-7	1E-3	1E-2
Y, oxides, hydroxides, and fluorides	---	3E+5	1E-4	4E-7	---	---

## Ytterbium-166

W, see <sup>162</sup> Yb	1E+3	2E+3	8E-7	3E-9	2E-5	2E-4
Y, see <sup>162</sup> Yb	---	2E+3	8E-7	3E-9	---	---

Ytterbium-167<sup>2</sup>

W, see <sup>162</sup> Yb	3E+5	8E+5	3E-4	1E-6	4E-3	4E-2
Y, see <sup>162</sup> Yb	---	7E+5	3E-4	1E-6	---	---

## Ytterbium-169

W, see <sup>162</sup> Yb	2E+3	8E+2	4E-7	1E-9	2E-5	2E-4
Y, see <sup>162</sup> Yb	---	7E+2	3E-7	1E-9	---	---

## Ytterbium-175

W, see <sup>162</sup> Yb	3E+3	4E+3	1E-6	5E-9	---	---
	LLI(3E+3)	---	---	---	4E-5	4E-4
Y, see <sup>162</sup> Yb	---	3E+3	1E-6	5E-9	---	---

Ytterbium-177<sup>2</sup>

W, see <sup>162</sup> Yb	2E+4	5E+4	2E-5	7E-8	2E-4	2E-3
Y, see <sup>162</sup> Yb	---	5E+4	2E-5	6E-8	---	---

Ytterbium-178<sup>2</sup>

W, see <sup>162</sup> Yb	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
Y, see <sup>162</sup> Yb	---	4E+4	2E-5	5E-8	---	---

**AN 71**

## Lutetium-169

W, all compounds except those given for Y	3E+3	4E+3	2E-6	6E-9	3E-5	3E-4
--	------	------	------	------	------	------

Y, oxides, hydroxides, and  
fluorides

--- 4E+3 2E-6 6E-9 --- ---

Lutetium-170

W, see <sup>169</sup>Lu 1E+3 2E+3 9E-7 3E-9 2E-5 2E-4

Y, see <sup>169</sup>Lu --- 2E+3 8E-7 3E-9 --- ---

Lutetium-171

W, see <sup>169</sup>Lu 2E+3 2E+3 8E-7 3E-9 3E-5 3E-4

Y, see <sup>169</sup>Lu --- 2E+3 8E-7 3E-9 --- ---

Lutetium-172

W, see <sup>169</sup>Lu 1E+3 1E+3 5E-7 2E-9 1E-5 1E-4

Y, see <sup>169</sup>Lu --- 1E+3 5E-7 2E-9 --- ---

Lutetium-173

W, see <sup>169</sup>Lu 5E+3 3E+2 1E-7 --- 7E-5 7E-4

--- Bone  
(5E+2) --- 6E-10 --- ---

Y, see <sup>169</sup>Lu --- 3E+2 1E-7 4E-10 --- ---

Lutetium-174m

W, see <sup>169</sup>Lu 2E+3 2E+2 1E-7 --- --- ---

--- Bone  
LLI(3E+3) (3E+3) --- 5E-10 4E-5 4E-4

Y, see <sup>169</sup>Lu --- 2E+2 9E-8 3E-10 --- ---

Lutetium-174

W, see <sup>169</sup>Lu 5E+3 1E+2 5E-8 --- 7E-5 7E-4

--- Bone  
(2E+2) --- 3E-10 --- ---

Y, see <sup>176</sup> Lu	---	2E+2	6E-8	2E-10	---	---
Lutetium-176m						
W, see <sup>169</sup> Lu	8E+3	3E+4	1E-5	3E-8	1E-4	1E-3
Y, see <sup>169</sup> Lu	---	2E+4	9E-6	3E-8	---	---
Lutetium-176						
W, see <sup>169</sup> Lu	7E+2	5E+0	2E-9	---	1E-5	1E-4
		Bone (1E+1)	---	2E-11	---	---
Y, see <sup>169</sup> Lu	---	8E+0	3E-9	1E-11	---	---
Lutetium-177m						
W, see <sup>169</sup> Lu	7E+2	1E+2	5E-8	---	1E-5	1E-4
		Bone (1E+2)	---	2E-10	---	---
Y, see <sup>169</sup> Lu	---	8E+1	3E-8	1E-10	---	---
Lutetium-177						
W, see <sup>169</sup> Lu	2E+3	2E+3	9E-7	3E-9	---	---
	LLI (3E+3)	---	---	---	4E-5	4E-4
Y, see <sup>169</sup> Lu	---	2E+3	9E-7	3E-9	---	---
Lutetium-178m <sup>2</sup>						
W, see <sup>169</sup> Lu	5E+4	2E+5	8E-5	3E-7	---	---
	Stom (6E+4)	---	---	---	8E-4	8E-3
Y, see <sup>169</sup> Lu	---	2E+5	7E-5	2E-7	---	---
Lutetium-178 <sup>2</sup>						

W, see <sup>169</sup> Lu	4E+4	1E+5	5E-5	2E-7	---	---
	Stom (4E+4)	---	---	---	6E-4	6E-3
Y, see <sup>169</sup> Lu	---	1E+5	5E-5	2E-7	---	---
Lutetium-179						
W, see <sup>169</sup> Lu	6E+3	2E+4	8E-6	3E-8	9E-5	9E-4
Y, see <sup>169</sup> Lu	---	2E+4	6E-6	3E-8	---	---
<b>AN 72</b>						
Hafnium-170						
D, all compounds except those given for W	3E+3	6E+3	2E-6	8E-9	4E-5	4E-4
W, oxides, hydroxides, carbides, and nitrates	---	5E+3	2E-6	6E-9	---	---
Hafnium-172						
D, see <sup>170</sup> Hf	1E+3	9E+0	4E-9	---	2E-5	2E-4
	---	Bone (2E+1)	---	3E-11	---	---
W, see <sup>170</sup> Hf	---	4E+1	2E-8	---	---	---
	---	Bone (6E+1)	---	8E-11	---	---
Hafnium-173						
D, see <sup>170</sup> Hf	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
W, see <sup>170</sup> Hf	---	1E+4	5E-6	2E-8	---	---
Hafnium-175						
D, see <sup>170</sup> Hf	3E+3	9E+2	4E-7	---	4E-5	4E-4

		Bone (1E+3)	---	1E-9	---	---
W, see <sup>170</sup> Hf	---	1E+3	5E-7	2E-9	---	---
Hafnium-177m <sup>2</sup>						
D, see <sup>170</sup> Hf	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
W, see <sup>170</sup> Hf	---	9E+4	4E-5	1E-7	---	---
Hafnium-178m						
D, see <sup>170</sup> Hf	3E+2	1E+0	5E-10	---	3E-6	3E-5
		Bone (2E+0)	---	3E-12	---	---
W, see <sup>170</sup> Hf	---	5E+0	2E-9	---	---	---
		Bone (9E+0)	---	1E-11	---	---
Hafnium-179m						
D, see <sup>170</sup> Hf	1E+3	3E+2	1E-7	---	1E-5	1E-4
		Bone (6E+2)	---	8E-10	---	---
W, see <sup>170</sup> Hf	---	6E+2	3E-7	8E-10	---	---
Hafnium-180m						
D, see <sup>170</sup> Hf	7E+3	2E+4	9E-6	3E-8	1E-4	1E-3
W, see <sup>170</sup> Hf	---	3E+4	1E-5	4E-8	---	---
Hafnium-181						
D, see <sup>170</sup> Hf	1E+3	2E+2	7E-8	---	2E-5	2E-4
		Bone (4E+2)	---	6E-10	---	---
W, see <sup>170</sup> Hf	---	4E+2	2E-7	6E-10	---	---



Hafnium-182m<sup>2</sup>

D, see <sup>170</sup> Hf	4E+4	9E+4	4E-5	1E-7	5E-4	5E-3
W, see <sup>170</sup> Hf	---	1E+5	6E-5	2E-7	---	---

## Hafnium-182

D, see <sup>170</sup> Hf	2E+2	8E-1	3E-10	---	---	---
	<b>Bone</b> (4E+2)	<b>Bone</b> (2E+0)	---	2E-12	5E-6	5E-5
W, see <sup>170</sup> Hf	---	3E+0	1E-9	---	---	---
	---	<b>Bone</b> (7E+0)	---	1E-11	---	---

Hafnium-183<sup>2</sup>

D, see <sup>170</sup> Hf	2E+4	5E+4	2E-5	6E-8	3E-4	3E-3
W, see <sup>170</sup> Hf	---	6E+4	2E-5	8E-8	---	---

## Hafnium-184

D, see <sup>170</sup> Hf	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
W, see <sup>170</sup> Hf	---	6E+3	3E-6	9E-9	---	---

**AN 73**Tantalum-172<sup>2</sup>

W, all compounds except those given for Y	4E+4	1E+5	5E-5	2E-7	5E-4	5E-3
Y, elemental Ta, oxides, hydroxides, halides, carbides, nitrates, and nitrides	---	1E+5	4E-5	1E-7	---	---

## Tantalum-173

W, see <sup>172</sup> Ta	7E+3	2E+4	8E-6	3E-8	9E-5	9E-4
--------------------------	------	------	------	------	------	------

Y, see <sup>172</sup> Ta	---	2E+4	7E-6	2E-8	---	---
Tantalum-174 <sup>2</sup>						
W, see <sup>172</sup> Ta	3E+4	1E+5	4E-5	1E-7	4E-4	4E-3
Y, see <sup>172</sup> Ta	---	9E+4	4E-5	1E-7	---	---
Tantalum-175						
W, see <sup>172</sup> Ta	6E+3	2E+4	7E-6	2E-8	8E-5	8E-4
Y, see <sup>172</sup> Ta	---	1E+4	6E-6	2E-8	---	---
Tantalum-176						
W, see <sup>172</sup> Ta	4E+3	1E+4	5E-6	2E-8	5E-5	5E-4
Y, see <sup>172</sup> Ta	---	1E+4	5E-6	2E-8	---	---
Tantalum-177						
W, see <sup>172</sup> Ta	1E+4	2E+4	8E-6	3E-8	2E-4	2E-3
Y, see <sup>172</sup> Ta	---	2E+4	7E-6	2E-8	---	---
Tantalum-178						
W, see <sup>172</sup> Ta	2E+4	9E+4	4E-5	1E-7	2E-4	2E-3
Y, see <sup>172</sup> Ta	---	7E+4	3E-5	1E-7	---	---
Tantalum-179						
W, see <sup>172</sup> Ta	2E+4	5E+3	2E-6	8E-9	3E-4	3E-3
Y, see <sup>172</sup> Ta	---	9E+2	4E-7	1E-9	---	---
Tantalum-180m						
W, see <sup>172</sup> Ta	2E+4	7E+4	3E-5	9E-8	3E-4	3E-3
Y, see <sup>172</sup> Ta	---	6E+4	2E-5	8E-8	---	---

## Tantalum-180

W, see $^{172}\text{Ta}$	1E+3	4E+2	2E-7	6E-10	2E-5	2E-4
--------------------------	------	------	------	-------	------	------

Y, see $^{172}\text{Ta}$	---	2E+1	1E-8	3E-11	---	---
--------------------------	-----	------	------	-------	-----	-----

Tantalum-182m<sup>2</sup>

W, see $^{172}\text{Ta}$	2E+5	5E+5	2E-4	8E-7	---	---
--------------------------	------	------	------	------	-----	-----

Stom (2E+5)	---	---	---	---	3E-3	3E-2
----------------	-----	-----	-----	-----	------	------

Y, see $^{172}\text{Ta}$	---	4E+5	2E-4	6E-7	---	---
--------------------------	-----	------	------	------	-----	-----

## Tantalum-182

W, see $^{172}\text{Ta}$	8E+2	3E+2	1E-7	5E-10	1E-5	1E-4
--------------------------	------	------	------	-------	------	------

Y, see $^{172}\text{Ta}$	---	1E+2	6E-8	2E-10	---	---
--------------------------	-----	------	------	-------	-----	-----

## Tantalum-183

W, see $^{172}\text{Ta}$	9E+2	1E+3	5E-7	2E-9	---	---
--------------------------	------	------	------	------	-----	-----

LLI (1E+3)	---	---	---	---	2E-5	2E-4
------------	-----	-----	-----	-----	------	------

Y, see $^{172}\text{Ta}$	---	1E+3	4E-7	1E-9	---	---
--------------------------	-----	------	------	------	-----	-----

## Tantalum-184

W, see $^{172}\text{Ta}$	2E+3	5E+3	2E-6	8E-9	3E-5	3E-4
--------------------------	------	------	------	------	------	------

Y, see $^{172}\text{Ta}$	---	5E+3	2E-6	7E-9	---	---
--------------------------	-----	------	------	------	-----	-----

Tantalum-185<sup>2</sup>

W, see $^{172}\text{Ta}$	3E+4	7E+4	3E-5	1E-7	4E-4	4E-3
--------------------------	------	------	------	------	------	------

Y, see $^{172}\text{Ta}$	---	6E+4	3E-5	9E-8	---	---
--------------------------	-----	------	------	------	-----	-----

Tantalum-186<sup>2</sup>

W, see $^{172}\text{Ta}$	5E+4	2E+5	1E-4	3E-7	---	---
--------------------------	------	------	------	------	-----	-----

	Stom (7E+4)	---	---	---	1E-3	1E-2
Y, see <sup>172</sup> Ta	---	2E+5	9E-5	3E-7	---	---

**AN 74**

## Tungsten-176

D, all compounds	1E+4	5E+4	2E-5	7E-8	1E-4	1E-3
------------------	------	------	------	------	------	------

## Tungsten-177

D, all compounds	2E+4	9E+4	4E-5	1E-7	3E-4	3E-3
------------------	------	------	------	------	------	------

## Tungsten-178

D, all compounds	5E+3	2E+4	8E-6	3E-8	7E-5	7E-4
------------------	------	------	------	------	------	------

Tungsten-179<sup>2</sup>

D, all compounds	5E+5	2E+6	7E-4	2E-6	7E-3	7E-2
------------------	------	------	------	------	------	------

## Tungsten-181

D, all compounds	2E+4	3E+4	1E-5	5E-8	2E-4	2E-3
------------------	------	------	------	------	------	------

## Tungsten-185

D, all compounds	2E+3	7E+3	3E-6	9E-9	---	---
	LLI (3E+3)	---	---	---	4E-5	4E-4

## Tungsten-187

D, all compounds	2E+3	9E+3	4E-6	1E-8	3E-5	3E-4
------------------	------	------	------	------	------	------

## Tungsten-188

D, all compounds	4E+2	1E+3	5E-7	2E-9	---	---
	LLI (5E+2)	---	---	---	7E-6	7E-5

**AN 75**Rhenium-177<sup>2</sup>D, all compounds except those  
given for W

9E+4	3E+5	1E-4	4E-7	---	---
Stom (1E+5)	---	---	---	2E-3	2E-2

W, oxides, hydroxides, and  
nitrates

---	4E+5	1E-4	5E-7	---	---
-----	------	------	------	-----	-----

Rhenium-178<sup>2</sup>D, see <sup>177</sup>Re

7E+4	3E+5	1E-4	4E-7	---	---
Stom (1E+5)	---	---	---	1E-3	1E-2

W, see <sup>177</sup>Re

---	3E+5	1E-4	4E-7	---	---
-----	------	------	------	-----	-----

## Rhenium-181

D, see <sup>177</sup>Re

5E+3	9E+3	4E-6	1E-8	7E-5	7E-4
------	------	------	------	------	------

W, see <sup>177</sup>Re

---	9E+3	4E-6	1E-8	---	---
-----	------	------	------	-----	-----

## Rhenium-182 (12.7 h)

D, see <sup>177</sup>Re

7E+3	1E+4	5E-6	2E-8	9E-5	9E-4
------	------	------	------	------	------

W, see <sup>177</sup>Re

---	2E+4	6E-6	2E-8	---	---
-----	------	------	------	-----	-----

## Rhenium-182 (64.0 h)

D, see <sup>177</sup>Re

1E+3	2E+3	1E-6	3E-9	2E-5	2E-4
------	------	------	------	------	------

W, see <sup>177</sup>Re

---	2E+3	9E-7	3E-9	---	---
-----	------	------	------	-----	-----

## Rhenium-184m

D, see <sup>177</sup>Re

2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
------	------	------	------	------	------

W, see <sup>177</sup>Re

---	4E+2	2E-7	6E-10	---	---
-----	------	------	-------	-----	-----

## Rhenium-184

D, see <sup>177</sup> Re	2E+3	4E+3	1E-6	5E-9	3E-5	3E-4
--------------------------	------	------	------	------	------	------

W, see <sup>177</sup> Re	---	1E+3	6E-7	2E-9	---	---
--------------------------	-----	------	------	------	-----	-----

## Rhenium-186m

D, see <sup>177</sup> Re	1E+3	2E+3	7E-7	---	---	---
--------------------------	------	------	------	-----	-----	-----

	Stom (2E+3)	Stom (2E+3)	---	3E-9	2E-5	2E-4
--	----------------	----------------	-----	------	------	------

W, see <sup>177</sup> Re	---	2E+2	6E-8	2E-10	---	---
--------------------------	-----	------	------	-------	-----	-----

## Rhenium-186

D, see <sup>177</sup> Re	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
--------------------------	------	------	------	------	------	------

W, see <sup>177</sup> Re	---	2E+3	7E-7	2E-9	---	---
--------------------------	-----	------	------	------	-----	-----

## Rhenium-187

D, see <sup>177</sup> Re	6E+5	8E+5	4E-4	---	8E-3	8E-2
--------------------------	------	------	------	-----	------	------

	---	Stom (9E+5)	---	1E-6	---	---
--	-----	----------------	-----	------	-----	-----

W, see <sup>177</sup> Re	---	1E+5	4E-5	1E-7	---	---
--------------------------	-----	------	------	------	-----	-----

Rhenium-188m<sup>2</sup>

D, see <sup>177</sup> Re	8E+4	1E+5	6E-5	2E-7	1E-3	1E-2
--------------------------	------	------	------	------	------	------

W, see <sup>177</sup> Re	---	1E+5	6E-5	2E-7	---	---
--------------------------	-----	------	------	------	-----	-----

## Rhenium-188

D, see <sup>177</sup> Re	2E+3	3E+3	1E-6	4E-9	2E-5	2E-4
--------------------------	------	------	------	------	------	------

W, see <sup>177</sup> Re	---	3E+3	1E-6	4E-9	---	---
--------------------------	-----	------	------	------	-----	-----

## Rhenium-189

D, see <sup>177</sup> Re	3E+3	5E+3	2E-6	7E-9	4E-5	4E-4
W, see <sup>177</sup> Re	---	4E+3	2E-6	6E-9	---	---

**AN 76**Osmium-180<sup>2</sup>

D, all compounds except those given for W and Y	1E+5	4E+5	2E-4	5E-7	1E-3	1E-2
W, halides and nitrates	---	5E+5	2E-4	7E-7	---	---
Y, oxides and hydroxides	---	5E+5	2E-4	6E-7	---	---

Osmium-181<sup>2</sup>

D, see <sup>180</sup> Os	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
W, see <sup>180</sup> Os	---	5E+4	2E-5	6E-8	---	---
Y, see <sup>180</sup> Os	---	4E+4	2E-5	6E-8	---	---

## Osmium-182

D, see <sup>180</sup> Os	2E+3	6E+3	2E-6	8E-9	3E-5	3E-4
W, see <sup>180</sup> Os	---	4E+3	2E-6	6E-9	---	---
Y, see <sup>180</sup> Os	---	4E+3	2E-6	6E-9	---	---

## Osmium-185

D, see <sup>180</sup> Os	2E+3	5E+2	2E-7	7E-10	3E-5	3E-4
W, see <sup>180</sup> Os	---	8E+2	3E-7	1E-9	---	---
Y, see <sup>180</sup> Os	---	8E+2	3E-7	1E-9	---	---

## Osmium-189m

D, see <sup>180</sup> Os	8E+4	2E+5	1E-4	3E-7	1E-3	1E-2
W, see <sup>180</sup> Os	---	2E+5	9E-5	3E-7	---	---
Y, see <sup>180</sup> Os	---	2E+5	7E-5	2E-7	---	---

## Osmium-191m

D, see $^{180}\text{Os}$	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
W, see $^{180}\text{Os}$	---	2E+4	8E-6	3E-8	---	---
Y, see $^{180}\text{Os}$	---	2E+4	7E-6	2E-8	---	---

## Osmium-191

D, see $^{180}\text{Os}$	2E+3	2E+3	9E-7	3E-9	---	---
	LLI (3E+3)	---	---	---	3E-5	3E-4
W, see $^{180}\text{Os}$	---	2E+3	7E-7	2E-9	---	---
Y, see $^{180}\text{Os}$	---	1E+3	6E-7	2E-9	---	---

## Osmium-193

D, see $^{180}\text{Os}$	2E+3	5E+3	2E-6	6E-9	---	---
	LLI (2E+3)	---	---	---	2E-5	2E-4
W, see $^{180}\text{Os}$	---	3E+3	1E-6	4E-9	---	---
Y, see $^{180}\text{Os}$	---	3E+3	1E-6	4E-9	---	---

## Osmium-194

D, see $^{180}\text{Os}$	4E+2	4E+1	2E-8	6E-11	---	---
	LLI (6E+2)	---	---	---	8E-6	8E-5
W, see $^{180}\text{Os}$	---	6E+1	2E-8	8E-11	---	---
Y, see $^{180}\text{Os}$	---	8E+0	3E-9	1E-11	---	---

## AN 77

Iridium-182<sup>2</sup>

D, all compounds except those given for W and Y	4E+4	1E+5	6E-5	2E-7	---	---
	Stom (4E+4)	---	---	---	6E-4	6E-3



W, halides, nitrates, and metallic  
iridium

--- 2E+5 6E-5 2E-7 --- ---

Y, oxides and hydroxides

--- 1E+5 5E-5 2E-7 --- ---

Iridium-184

D, see <sup>182</sup>Ir

8E+3 2E+4 1E-5 3E-8 1E-4 1E-3

W, see <sup>182</sup>Ir

--- 3E+4 1E-5 5E-8 --- ---

Y, see <sup>182</sup>Ir

--- 3E+4 1E-5 4E-8 --- ---

Iridium-185

D, see <sup>182</sup>Ir

5E+3 1E+4 5E-6 2E-8 7E-5 7E-4

W, see <sup>182</sup>Ir

--- 1E+4 5E-6 2E-8 --- ---

Y, see <sup>182</sup>Ir

--- 1E+4 4E-6 1E-8 --- ---

Iridium-186

D, see <sup>182</sup>Ir

2E+3 8E+3 3E-6 1E-8 3E-5 3E-4

W, see <sup>182</sup>Ir

--- 6E+3 3E-6 9E-9 --- ---

Y, see <sup>182</sup>Ir

--- 6E+3 2E-6 8E-9 --- ---

Iridium-187

D, see <sup>182</sup>Ir

1E+4 3E+4 1E-5 5E-8 1E-4 1E-3

W, see <sup>182</sup>Ir

--- 3E+4 1E-5 4E-8 --- ---

Y, see <sup>182</sup>Ir

--- 3E+4 1E-5 4E-8 --- ---

Iridium-188

D, see <sup>182</sup>Ir

2E+3 5E+3 2E-6 6E-9 3E-5 3E-4

W, see <sup>182</sup>Ir

--- 4E+3 1E-6 5E-9 --- ---

Y, see <sup>182</sup>Ir

--- 3E+3 1E-6 5E-9 --- ---

Iridium-189

D, see $^{182}\text{Ir}$	5E+3	5E+3	2E-6	7E-9	---	---
	LLI(5E+3)	---	---	---	7E-5	7E-4
W, see $^{182}\text{Ir}$	---	4E+3	2E-6	5E-9	---	---
Y, see $^{182}\text{Ir}$	---	4E+3	1E-6	5E-9	---	---
Iridium-190m <sup>2</sup>						
D, see $^{182}\text{Ir}$	2E+5	2E+5	8E-5	3E-7	2E-3	2E-2
W, see $^{182}\text{Ir}$	---	2E+5	9E-5	3E-7	---	---
Y, see $^{182}\text{Ir}$	---	2E+5	8E-5	3E-7	---	---
Iridium-190						
D, see $^{182}\text{Ir}$	1E+3	9E+2	4E-7	1E-9	1E-5	1E-4
W, see $^{182}\text{Ir}$	---	1E+3	4E-7	1E-9	---	---
Y, see $^{182}\text{Ir}$	---	9E+2	4E-7	1E-9	---	---
Iridium-192m						
D, see $^{182}\text{Ir}$	3E+3	9E+1	4E-8	1E-10	4E-5	4E-4
W, see $^{182}\text{Ir}$	---	2E+2	9E-8	3E-10	---	---
Y, see $^{182}\text{Ir}$	---	2E+1	6E-9	2E-11	---	---
Iridium-192						
D, see $^{182}\text{Ir}$	9E+2	3E+2	1E-7	4E-10	1E-5	1E-4
W, see $^{182}\text{Ir}$	---	4E+2	2E-7	6E-10	---	---
Y, see $^{182}\text{Ir}$	---	2E+2	9E-8	3E-10	---	---
Iridium-194m						
D, see $^{182}\text{Ir}$	6E+2	9E+1	4E-8	1E-10	9E-6	9E-5
W, see $^{182}\text{Ir}$	---	2E+2	7E-8	2E-10	---	---
Y, see $^{182}\text{Ir}$	---	1E+2	4E-8	1E-10	---	---

## Iridium-194

D, see <sup>182</sup> Ir	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
W, see <sup>182</sup> Ir	---	2E+3	9E-7	3E-9	---	---
Y, see <sup>182</sup> Ir	---	2E+3	8E-7	3E-9	---	---

## Iridium-195m

D, see <sup>182</sup> Ir	8E+3	2E+4	1E-5	3E-8	1E-4	1E-3
W, see <sup>182</sup> Ir	---	3E+4	1E-5	4E-8	---	---
Y, see <sup>182</sup> Ir	---	2E+4	9E-6	3E-8	---	---

## Iridium-195

D, see <sup>182</sup> Ir	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
W, see <sup>182</sup> Ir	---	5E+4	2E-5	7E-8	---	---
Y, see <sup>182</sup> Ir	---	4E+4	2E-5	6E-8	---	---

**AN 78**

## Platinum-186

D, all compounds	1E+4	4E+4	2E-5	5E-8	2E-4	2E-3
------------------	------	------	------	------	------	------

## Platinum-188

D, all compounds	2E+3	2E+3	7E-7	2E-9	2E-5	2E-4
------------------	------	------	------	------	------	------

## Platinum-189

D, all compounds	1E+4	3E+4	1E-5	4E-8	1E-4	1E-3
------------------	------	------	------	------	------	------

## Platinum-191

D, all compounds	4E+3	8E+3	4E-6	1E-8	5E-5	5E-4
------------------	------	------	------	------	------	------

## Platinum-193m

D, all compounds	3E+3	6E+3	3E-6	8E-9	---	---
	LLI (3E+4)	---	---	---	4E-5	4E-4
Platinum-193						
D, all compounds	4E+4	2E+4	1E-5	3E-8	---	---
	LLI (5E+4)	---	---	---	6E-4	6E-3
Platinum-195m						
D, all compounds	2E+3	4E+3	2E-6	6E-9	---	---
	LLI (2E+3)	---	---	---	3E-5	3E-4
Platinum-197m <sup>2</sup>						
D, all compounds	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
Platinum-197						
D, all compounds	3E+3	1E+4	4E-6	1E-8	4E-5	4E-4
Platinum-199 <sup>2</sup>						
D, all compounds	5E+4	1E+5	6E-5	2E-7	7E-4	7E-3
Platinum-200						
D, all compounds	1E+3	3E+3	1E-6	5E-9	2E-5	2E-4

**AN 79**

## Gold-193

D, all compounds except those given for W and Y	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
W, halides and nitrates	---	2E+4	9E-6	3E-8	---	---
Y, oxides and hydroxides	---	2E+4	8E-6	3E-8	---	---

## Gold-194

D, see $^{193}\text{Au}$	3E+3	8E+3	3E-6	1E-8	4E-5	4E-4
W, see $^{193}\text{Au}$	---	5E+3	2E-6	8E-9	---	---
Y, see $^{193}\text{Au}$	---	5E+3	2E-6	7E-9	---	---

## Gold-195

D, see $^{193}\text{Au}$	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4
W, see $^{193}\text{Au}$	---	1E+3	6E-7	2E-9	---	---
Y, see $^{193}\text{Au}$	---	4E+2	2E-7	6E-10	---	---

## Gold-198m

D, see $^{193}\text{Au}$	1E+3	3E+3	1E-6	4E-9	1E-5	1E-4
W, see $^{193}\text{Au}$	---	1E+3	5E-7	2E-9	---	---
Y, see $^{193}\text{Au}$	---	1E+3	5E-7	2E-9	---	---

## Gold-198

D, see $^{193}\text{Au}$	1E+3	4E+3	2E-6	5E-9	2E-5	2E-4
W, see $^{193}\text{Au}$	---	2E+3	8E-7	3E-9	---	---
Y, see $^{193}\text{Au}$	---	2E+3	7E-7	2E-9	---	---

## Gold-199

D, see $^{193}\text{Au}$	3E+3	9E+3	4E-6	1E-8	---	---
	LLI(3E+3)	---	---	---	4E-5	4E-4
W, see $^{193}\text{Au}$	---	4E+3	2E-6	6E-9	---	---
Y, see $^{193}\text{Au}$	---	4E+3	2E-6	5E-9	---	---

## Gold-200m

D, see $^{193}\text{Au}$	1E+3	4E+3	1E-6	5E-9	2E-5	2E-4
W, see $^{193}\text{Au}$	---	3E+3	1E-6	4E-9	---	---

Y, see <sup>193</sup> Au	---	2E+4	1E-6	3E-9	---	---
Gold-200 <sup>2</sup>						
D, see <sup>193</sup> Au	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
W, see <sup>193</sup> Au	---	8E+4	3E-5	1E-7	---	---
Y, see <sup>193</sup> Au	---	7E+4	3E-5	1E-7	---	---
Gold-201 <sup>2</sup>						
D, see <sup>193</sup> Au	7E+4	2E+5	9E-5	3E-7	---	---
	Stom (9E+4)	---	---	---	1E-3	1E-2
W, see <sup>193</sup> Au	---	2E+5	1E-4	3E-7	---	---
Y, see <sup>193</sup> Au	---	2E+5	9E-5	3E-7	---	---
<b>AN 80</b>						
Mercury-193m						
Vapor	---	8E+3	4E-6	1E-8	---	---
Organic D	4E+3	1E+4	5E-6	2E-8	6E-5	6E-4
D, sulfates	3E+3	9E+3	4E-6	1E-8	4E-5	4E-4
W, oxides, hydroxides, halides, nitrates, and sulfides	---	8E+3	3E-6	1E-8	---	---
Mercury-193						
Vapor	---	3E+4	1E-5	4E-8	---	---
Organic D	2E+4	6E+4	3E-5	9E-8	3E-4	3E-3
D, see <sup>193m</sup> Hg	2E+4	4E+4	2E-5	6E-8	2E-4	2E-3
W, see <sup>193m</sup> Hg	---	4E+4	2E-5	6E-8	---	---
Mercury-194						
Vapor	---	3E+1	1E-8	4E-11	---	---

Organic D	2E+1	3E+1	1E-8	4E-11	2E-7	2E-6
D, see <sup>193m</sup> Hg	8E+2	4E+1	2E-8	6E-11	1E-5	1E-4
W, see <sup>193m</sup> Hg	---	1E+2	5E-8	2E-10	---	---
Mercury-195m						
Vapor	---	4E+3	2E-6	6E-9	---	---
Organic D	3E+3	6E+3	3E-6	8E-9	4E-5	4E-4
D, see <sup>193m</sup> Hg	2E+3	5E+3	2E-6	7E-9	3E-5	3E-4
W, see <sup>193m</sup> Hg	---	4E+3	2E-6	5E-9	---	---
Mercury-195						
Vapor	---	3E+4	1E-5	4E-8	---	---
Organic D	2E+4	5E+4	2E-5	6E-8	2E-4	2E-3
D, see <sup>193m</sup> Hg	1E+4	4E+4	1E-5	5E-8	2E-4	2E-3
W, see <sup>193m</sup> Hg	---	3E+4	1E-5	5E-8	---	---
Mercury-197m						
Vapor	---	5E+3	2E-6	7E-9	---	---
Organic D	4E+3	9E+3	4E-6	1E-8	5E-5	5E-4
D, see <sup>193m</sup> Hg	3E+3	7E+3	3E-6	1E-8	4E-5	4E-4
W, see <sup>193m</sup> Hg	---	5E+3	2E-6	7E-9	---	---
Mercury-197						
Vapor	---	8E+3	4E-6	1E-8	---	---
Organic D	7E+3	1E+4	6E-6	2E-8	9E-5	9E-4
D, see <sup>193m</sup> Hg	6E+3	1E+4	5E-6	2E-8	8E-5	8E-4
W, see <sup>193m</sup> Hg	---	9E+3	4E-6	1E-8	---	---
Mercury-199m <sup>2</sup>						

Vapor	---	8E+4	3E-5	1E-7	---	---
Organic D	6E+4	2E+5	7E-5	2E-7	---	---
	Stom (1E+5)	---	---	---	1E-3	1E-2
D, see <sup>193m</sup> Hg	6E+4	1E+5	6E-5	2E-7	8E-4	8E-3
W, see <sup>193m</sup> Hg	---	2E+5	7E-5	2E-7	---	---
Mercury-203						
Vapor	---	8E+2	4E-7	1E-9	---	---
Organic D	5E+2	8E+2	3E-7	1E-9	7E-6	7E-5
D, see <sup>193m</sup> Hg	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
W, see <sup>193m</sup> Hg	---	1E+3	5E-7	2E-9	---	---
<b>AN 81</b>						
Thallium-194m <sup>2</sup>						
D, all compounds	5E+4	2E+5	6E-5	2E-7	---	---
	Stom (7E+4)	---	---	---	1E-3	1E-2
Thallium-194 <sup>2</sup>						
D, all compounds	3E+5	6E+5	2E-4	8E-7	---	---
	Stom (3E+5)	---	---	---	4E-3	4E-2
Thallium-195 <sup>2</sup>						
D, all compounds	6E+4	1E+5	5E-5	2E-7	9E-4	9E-3
Thallium-197						
D, all compounds	7E+4	1E+5	5E-5	2E-7	1E-3	1E-2
Thallium-198m <sup>2</sup>						



D, all compounds	3E+4	5E+4	2E-5	8E-8	4E-4	4E-3
Thallium-198						
D, all compounds	2E+4	3E+4	1E-5	5E-8	3E-4	3E-3
Thallium-199						
D, all compounds	6E+4	8E+4	4E-5	1E-7	9E-4	9E-3
Thallium-200						
D, all compounds	8E+3	1E+4	5E-6	2E-8	1E-4	1E-3
Thallium-201						
D, all compounds	2E+4	2E+4	9E-6	3E-8	2E-4	2E-3
Thallium-202						
D, all compounds	4E+3	5E+3	2E-6	7E-9	5E-5	5E-4
Thallium-204						
D, all compounds	2E+3	2E+3	9E-7	3E-9	2E-5	2E-4
<b>AN 82</b>						
Lead-195m <sup>2</sup>						
D, all compounds	6E+4	2E+5	8E-5	3E-7	8E-4	8E-3
Lead-198						
D, all compounds	3E+4	6E+4	3E-5	9E-8	4E-4	4E-3
Lead-199 <sup>2</sup>						
D, all compounds	2E+4	7E+4	3E-5	1E-7	3E-4	3E-3
Lead-200						

D, all compounds	3E+3	6E+3	3E-6	9E-9	4E-5	4E-4
Lead-201						
D, all compounds	7E+3	2E+4	8E-6	3E-8	1E-4	1E-3
Lead-202m						
D, all compounds	9E+3	3E+4	1E-5	4E-8	1E-4	1E-3
Lead-202						
D, all compounds	1E+2	5E+1	2E-8	7E-11	2E-6	2E-5
Lead-203						
D, all compounds	5E+3	9E+3	4E-6	1E-8	7E-5	7E-4
Lead-205						
D, all compounds	4E+3	1E+3	6E-7	2E-9	5E-5	5E-4
Lead-209						
D, all compounds	2E+4	6E+4	2E-5	8E-8	3E-4	3E-3
Lead-210						
D, all compounds	6E-1	2E-1	1E-10	---	---	---
	Bone (1E+0)	Bone (4E-1)	---	6E-13	1E-8	1E-7
Lead-211 <sup>2</sup>						
D, all compounds	1E+4	6E+2	3E-7	9E-10	2E-4	2E-3
Lead-212						
D, all compounds	8E+1	3E+1	1E-8	5E-11	---	---

	Bone (1E+2)	---	---	---	2E-6	2E-5
Lead-214 <sup>2</sup>						
D, all compounds	9E+3	8E+2	3E-7	1E-9	1E-4	1E-3
<b>AN 83</b>						
Bismuth-200 <sup>2</sup>						
D, nitrates	3E+4	8E+4	4E-5	1E-7	4E-4	4E-3
W, all other compounds	---	1E+5	4E-5	1E-7	---	---
Bismuth-201 <sup>2</sup>						
D, see <sup>200</sup> Bi	1E+4	3E+4	1E-5	4E-8	2E-4	2E-3
W, see <sup>200</sup> Bi	---	4E+4	2E-5	5E-8	---	---
Bismuth-202 <sup>2</sup>						
D, see <sup>200</sup> Bi	1E+4	4E+4	2E-5	6E-8	2E-4	2E-3
W, see <sup>200</sup> Bi	---	8E+4	3E-5	1E-7	---	---
Bismuth-203						
D, see <sup>200</sup> Bi	2E+3	7E+3	3E-6	9E-9	3E-5	3E-4
W, see <sup>200</sup> Bi	---	6E+3	3E-6	9E-9	---	---
Bismuth-205						
D, see <sup>200</sup> Bi	1E+3	3E+3	1E-6	3E-9	2E-5	2E-4
W, see <sup>200</sup> Bi	---	1E+3	5E-7	2E-9	---	---
Bismuth-206						
D, see <sup>200</sup> Bi	6E+2	1E+3	6E-7	2E-9	9E-6	9E-5
W, see <sup>200</sup> Bi	---	9E+2	4E-7	1E-9	---	---

## Bismuth-207

D, see <sup>200</sup> Bi	1E+3	2E+3	7E-7	2E-9	1E-5	1E-4
W, see <sup>200</sup> Bi	---	4E+2	1E-7	5E-10	---	---

## Bismuth-210m

D, see <sup>200</sup> Bi	4E+1	5E+0	2E-9	---	---	---
	Kid (6E+1)	Kid (6E+0)	---	9E-12	8E-7	8E-6
W, see <sup>200</sup> Bi	---	7E-1	3E-10	9E-13	---	---

## Bismuth-210

D, see <sup>200</sup> Bi	8E+2	2E+2	1E-7	---	1E-5	1E-4
	---	Kid (4E+2)	---	5E-10	---	---
W, see <sup>200</sup> Bi	---	3E+1	1E-8	4E-11	---	---

Bismuth-212<sup>2</sup>

D, see <sup>200</sup> Bi	5E+3	2E+2	1E-7	3E-10	7E-5	7E-4
W, see <sup>200</sup> Bi	---	3E+2	1E-7	4E-10	---	---

Bismuth-213<sup>2</sup>

D, see <sup>200</sup> Bi	7E+3	3E+2	1E-7	4E-10	1E-4	1E-3
W, see <sup>200</sup> Bi	---	4E+2	1E-7	5E-10	---	---

Bismuth-214<sup>2</sup>

D, see <sup>200</sup> Bi	2E+4	8E+2	3E-7	1E-9	---	---
	Stom (2E+4)	---	---	---	3E-4	3E-3
W, see <sup>200</sup> Bi	---	9E-2	4E-7	1E-9	---	---

## AN 84

Polonium-203<sup>2</sup>

D, all compounds except those given for W	3E+4	6E+4	3E-5	9E-8	3E-4	3E-3
W, oxides, hydroxides, and nitrates	---	9E+4	4E-5	1E-7	---	---
Polonium-205 <sup>2</sup>						
D, see <sup>203</sup> Po	2E+4	4E+4	2E-5	5E-8	3E-4	3E-3
W, see <sup>203</sup> Po	---	7E+4	3E-5	1E-7	---	---
Polonium-207						
D, see <sup>203</sup> Po	8E+3	3E+4	1E-5	3E-8	1E-4	1E-3
W, see <sup>203</sup> Po	---	3E+4	1E-5	4E-8	---	---
Polonium-210						
D, see <sup>203</sup> Po	3E+0	6E-1	3E-10	9E-13	4E-8	4E-7
W, see <sup>203</sup> Po	---	6E-1	3E-10	9E-13	---	---
<b>AN 85</b>						
Astatine-207 <sup>2</sup>						
D, halides	6E+3	3E+3	1E-6	4E-9	8E-5	8E-4
W	---	2E+3	9E-7	3E-9	---	---
Astatine-211						
D, halides	1E+2	8E+1	3E-8	1E-10	2E-6	2E-5
W	---	5E+1	2E-8	8E-11	---	---
<b>AN 86</b>						
Radon-220						
With daughters removed	---	2E+4	7E-6	2E-8	---	---

With daughters present	---	2E+1 (or 12 working level months)	9E-9 (or 1.0 working level)	3E-11	---	---
Radon-222						
With daughters removed	---	1E+4	4E-6	1E-8	---	---
With daughters present	---	1E+2 (or 4 working level months)	3E-8 (or 0.33 working level)	1E-10	---	---
<b>AN 87</b>						
Francium-222 <sup>2</sup>						
D, all compounds	2E+3	5E+2	2E-7	6E-10	3E-5	3E-4
Francium-223 <sup>2</sup>						
D, all compounds	6E+2	8E+2	3E-7	1E-9	8E-6	8E-5
<b>AN 88</b>						
Radium-223						
W, all compounds	5E+0	7E-1	3E-10	9E-13	---	---
	Bone (9E+0)	---	---	---	1E-7	1E-6
Radium-224						
W, all compounds	8E+0	2E+0	7E-10	2E-12	---	---
	Bone (2E+1)	---	---	---	2E-7	2E-6
Radium-225						
W, all compounds	8E+0	7E-1	3E-10	9E-13	---	---

	Bone (2E+1)	---	---	---	2E-7	2E-6	
Radium-226							
W, all compounds	2E+0	6E-1	3E-10	9E-13	---	---	
	Bone (5E+0)	---	---	---	6E-8	6E-7	
Radium-227 <sup>2</sup>							
W, all compounds	2E+4	1E+4	6E-6	---	---	---	
	Bone (2E+4)	Bone (2E+4)	---	3E-8	3E-4	3E-3	
Radium-228							
W, all compounds	2E+0	1E+0	5E-10	2E-12	---	---	
	Bone (4E+0)	---	---	---	6E-8	6E-7	
<b>AN 89</b>							
Actinium-224							
D, all compounds except those given for W and Y	2E+3	3E+1	1E-8	---	---	---	
		Bone LLI (2E+3)	(4E+1)	---	5E-11	3E-5	3E-4
W, halides and nitrates	---	5E+1	2E-8	7E-11	---	---	
Y, oxides and hydroxides	---	5E+1	2E-8	6E-11	---	---	
Actinium-225							
D, see <sup>224</sup> Ac	5E+1	3E-1	1E-10	---	---	---	
		Bone LLI (5E+1)	(5E-1)	---	7E-13	7E-7	7E-6

W, see <sup>224</sup> Ac	---	6E-1	3E-10	9E-13	---	---
Y, see <sup>224</sup> Ac	---	6E-1	3E-10	9E-13	---	---
Actinium-226						
D, see <sup>224</sup> Ac	1E+2	3E+0	1E-9	---	---	---
		Bone				
	LLI (1E+2)	(4E+0)	---	5E-12	2E-6	2E-5
W, see <sup>224</sup> Ac	---	5E+0	2E-9	7E-12	---	---
Y, see <sup>224</sup> Ac	---	5E+0	2E-9	6E-12	---	---
Actinium-227						
D, see <sup>224</sup> Ac	2E-1	4E-4	2E-13	---	---	---
	Bone	Bone				
	(4E-1)	(8E-4)	---	1E-15	5E-9	5E-8
W, see <sup>224</sup> Ac	---	2E-3	7E-13	---	---	---
		Bone				
	---	(3E-3)	---	4E-15	---	---
Y, see <sup>224</sup> Ac	---	4E-3	2E-12	6E-15	---	---
Actinium-228						
D, see <sup>224</sup> Ac	2E+3	9E+0	4E-9	---	3E-5	3E-4
		Bone				
	---	(2E+1)	---	2E-11	---	---
W, see <sup>224</sup> Ac	---	4E+1	2E-8	---	---	---
		Bone				
	---	(6E+1)	---	8E-11	---	---
Y, see <sup>224</sup> Ac	---	4E+1	2E-8	6E-11	---	---

**AN 90**Thorium-226<sup>2</sup>



W, all compounds except those given for Y	5E+3	2E+2	6E-8	2E-10	---	---
	Stom (5E+3)	---	---	---	7E-5	7E-4
Y, oxides and hydroxides	---	1E+2	6E-8	2E-10	---	---
Thorium-227						
W, see <sup>226</sup> Th	1E+2	3E-1	1E-10	5E-13	2E-6	2E-5
Y, see <sup>226</sup> Th	---	3E-1	1E-10	5E-13	---	---
Thorium-228						
W, see <sup>226</sup> Th	6E+0	1E-2	4E-12	---	---	---
	Bone (1E+1)	Bone (2E-2)	---	3E-14	2E-7	2E-6
Y, see <sup>226</sup> Th	---	2E-2	7E-12	2E-14	---	---
Thorium-229						
W, see <sup>226</sup> Th	6E-1	9E-4	4E-13	---	---	---
	Bone (1E+0)	Bone (2E-3)	---	3E-15	2E-8	2E-7
Y, see <sup>226</sup> Th	---	2E-3	1E-12	---	---	---
	---	Bone (3E-3)	---	4E-15	---	---
Thorium-230						
W, see <sup>226</sup> Th	4E+0	6E-3	3E-12	---	---	---
	Bone (9E+0)	Bone (2E-2)	---	2E-14	1E-7	1E-6
Y, see <sup>226</sup> Th	---	2E-2	6E-12	---	---	---
	---	Bone (2E-2)	---	3E-14	---	---

## Thorium-231

W, see <sup>226</sup> Th	4E+3	6E+3	3E-6	9E-9	5E-5	5E-4
--------------------------	------	------	------	------	------	------

Y, see <sup>226</sup> Th	---	6E+3	3E-6	9E-9	---	---
--------------------------	-----	------	------	------	-----	-----

## Thorium-232

W, see <sup>226</sup> Th	7E-1	1E-3	5E-13	---	---	---
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	Bone (2E+0)	Bone (3E-3)	---	4E-15	3E-8	3E-7
--	----------------	----------------	-----	-------	------	------

Y, see <sup>226</sup> Th	---	3E-3	1E-12	---	---	---
--------------------------	-----	------	-------	-----	-----	-----

	---	Bone (4E-3)	---	6E-15	---	---
--	-----	----------------	-----	-------	-----	-----

## Thorium-234

W, see <sup>226</sup> Th	3E+2	2E+2	8E-8	3E-10	---	---
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	LLI (4E+2)	---	---	---	5E-6	5E-5
--	------------	-----	-----	-----	------	------

Y, see <sup>226</sup> Th	---	2E+2	6E-8	2E-10	---	---
--------------------------	-----	------	------	-------	-----	-----

**AN 91**Protactinium-227<sup>2</sup>

W, all compounds except those given for Y	4E+3	1E+2	5E-8	2E-10	5E-5	5E-4
--	------	------	------	-------	------	------

Y, oxides and hydroxides	---	1E+2	4E-8	1E-10	---	---
--------------------------	-----	------	------	-------	-----	-----

## Protactinium-228

W, see <sup>227</sup> Pa	1E+3	1E+1	5E-9	---	2E-5	2E-4
--------------------------	------	------	------	-----	------	------

	---	Bone (2E+1)	---	3E-11	---	---
--	-----	----------------	-----	-------	-----	-----

Y, see <sup>226</sup> Pa	---	1E+1	5E-9	2E-11	---	---
--------------------------	-----	------	------	-------	-----	-----

## Protactinium-230

W, see <sup>227</sup> Pa	6E+2	5E+0	2E-9	7E-12	---	---
	Bone (9E+2)	---	---	---	1E-5	1E-4
Y, see <sup>227</sup> Pa	---	4E+0	1E-9	5E-12	---	---
Protactinium-231						
W, see <sup>227</sup> Pa	2E-1	2E-3	6E-13	---	---	---
	Bone (5E-1)	Bone (4E-3)	---	6E-15	6E-9	6E-8
Y, see <sup>227</sup> Pa	---	4E-3	2E-12	---	---	---
	---	Bone (6E-3)	---	8E-15	---	---
Protactinium-232						
W, see <sup>227</sup> Pa	1E+3	2E+1	9E-9	---	2E-5	2E-4
	---	Bone (6E+1)	---	8E-11	---	---
Y, see <sup>227</sup> Pa	---	6E+1	2E-8	---	---	---
	---	Bone (7E+1)	---	1E-10	---	---
Protactinium-233						
W, see <sup>227</sup> Pa	1E+3	7E+2	3E-7	1E-9	---	---
	LLI (2E+3)	---	---	---	2E-5	2E-4
Y, see <sup>227</sup> Pa	---	6E+2	2E-7	8E-10	---	---
Protactinium-234						
W, see <sup>227</sup> Pa	2E+3	8E+3	3E-6	1E-8	3E-5	3E-4
Y, see <sup>227</sup> Pa	---	7E+3	3E-6	9E-9	---	---

**AN 92**

## Uranium-230

D, UF <sub>6</sub> , UO <sub>2</sub> F <sub>2</sub> , UO <sub>2</sub> (NO <sub>3</sub> ) <sub>2</sub>	4E+0	4E-1	2E-10	---	---	---
	Bone (6E+0)	Bone (6E-1)	---	8E-13	8E-8	8E-7
W, UO <sub>3</sub> , UF <sub>4</sub> , UCl <sub>4</sub>	---	4E-1	1E-10	5E-13	---	---
Y, UO <sub>2</sub> , U <sub>3</sub> O <sub>8</sub>	---	3E-1	1E-10	4E-13	---	---

## Uranium-231

D, see <sup>230</sup> U	5E+3	8E+3	3E-6	1E-8	---	---
	LLI(4E+3)	---	---	---	6E-5	6E-4
W, see <sup>230</sup> U	---	6E+3	2E-6	8E-9	---	---
Y, see <sup>230</sup> U	---	5E+3	2E-6	6E-9	---	---

## Uranium-232

D, see <sup>230</sup> U	2E+0	2E-1	9E-11	---	---	---
	Bone (4E+0)	Bone (4E-1)	---	6E-13	6E-8	6E-7
W, see <sup>230</sup> U	---	4E-1	2E-10	5E-13	---	---
Y, see <sup>230</sup> U	---	8E-3	3E-12	1E-14	---	---

## Uranium-233

D, see <sup>230</sup> U	1E+1	1E+0	5E-10	---	---	---
	Bone (2E+1)	Bone (2E+0)	---	3E-12	3E-7	3E-6
W, see <sup>230</sup> U	---	7E-1	3E-10	1E-12	---	---
Y, see <sup>230</sup> U	---	4E-2	2E-11	5E-14	---	---

Uranium-234<sup>3</sup>

D, see <sup>230</sup> U	1E+1	1E+0	5E-10	---	---	---
	Bone (2E+1)	Bone (2E+0)	---	3E-12	3E-7	3E-6
W, see <sup>230</sup> U	---	7E-1	3E-10	1E-12	---	---
Y, see <sup>230</sup> U	---	4E-2	2E-11	5E-14	---	---
Uranium-235 <sup>3</sup>						
D, see <sup>230</sup> U	1E+1	1E+0	6E-10	---	---	---
	Bone (2E+1)	Bone (2E+0)	---	3E-12	3E-7	3E-6
W, see <sup>230</sup> U	---	8E-1	3E-10	1E-12	---	---
Y, see <sup>230</sup> U	---	4E-2	2E-11	6E-14	---	---
Uranium-236						
D, see <sup>230</sup> U	1E+1	1E+0	5E-10	---	---	---
	Bone (2E+1)	Bone (2E+0)	---	3E-12	3E-7	3E-6
W, see <sup>230</sup> U	---	8E-1	3E-10	1E-12	---	---
Y, see <sup>230</sup> U	---	4E-2	2E-11	6E-14	---	---
Uranium-237						
D, see <sup>230</sup> U	2E+3	3E+3	1E-6	4E-9	---	---
	LLI (2E+3)	---	---	---	3E-5	3E-4
W, see <sup>230</sup> U	---	2E+3	7E-7	2E-9	---	---
Y, see <sup>230</sup> U	---	2E+3	6E-7	2E-9	---	---
Uranium-238 <sup>3</sup>						
D, see <sup>230</sup> U	1E+1	1E+0	6E-10	---	---	---
	Bone (2E+1)	Bone (2E+0)	---	3E-12	3E-7	3E-6

W, see $^{230}\text{U}$	---	8E-1	3E-10	1E-12	---	---
Y, see $^{230}\text{U}$	---	4E-2	2E-11	6E-14	---	---
Uranium-239 <sup>2</sup>						
D, see $^{230}\text{U}$	7E+4	2E+5	8E-5	3E-7	9E-4	9E-3
W, see $^{230}\text{U}$	---	2E+5	7E-5	2E-7	---	---
Y, see $^{230}\text{U}$	---	2E+5	6E-5	2E-7	---	---
Uranium-240						
D, see $^{230}\text{U}$	1E+3	4E+3	2E-6	5E-9	2E-5	2E-4
W, see $^{230}\text{U}$	---	3E+3	1E-6	4E-9	---	---
Y, see $^{230}\text{U}$	---	2E+3	1E-6	3E-9	---	---
Uranium-natural <sup>3</sup>						
D, see $^{230}\text{U}$	1E+1	1E+0	5E-10	---	---	---
	Bone (2E+1)	Bone (2E+0)	---	3E-12	3E-7	3E-6
W, see $^{230}\text{U}$	---	8E-1	3E-10	9E-13	---	---
Y, see $^{230}\text{U}$	---	5E-2	2E-11	9E-14	---	---
<b>AN 93</b>						
Neptunium-232 <sup>2</sup>						
W, all compounds	1E+5	2E+3	7E-7	---	2E-3	2E-2
	---	Bone (5E+2)	---	6E-9	---	---
Neptunium-233 <sup>2</sup>						
W, all compounds	8E+5	3E+6	1E-3	4E-6	1E-2	1E-1
Neptunium-234						

W, all compounds	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
Neptunium-235						
W, all compounds	2E+4	8E+2	3E-7	---	---	---
	Bone LLI (2E+4) (1E+3)		---	2E-9	3E-4	3E-3
Neptunium-236 (1.15E+5 y)						
W, all compounds	3E+0	2E-2	9E-12	---	---	---
	Bone (6E+0)	Bone (5E-2)	---	8E-14	9E-8	9E-7
Neptunium-236 (22.5 h)						
W, all compounds	3E+3	3E+1	1E-8	---	---	---
	Bone (4E+3)	Bone (7E+1)	---	1E-10	5E-5	5E-4
Neptunium-237						
W, all compounds	5E-1	4E-3	2E-12	---	---	---
	Bone (1E+0)	Bone (1E-2)	---	1E-14	2E-8	2E-7
Neptunium-238						
W, all compounds	1E+3	6E+1	3E-8	---	2E-5	2E-4
	---	Bone (2E+2)	---	2E-10	---	---
Neptunium-239						
W, all compounds	2E+3	2E+3	9E-7	3E-9	---	---
	LLI (2E+3)	---	---	---	2E-5	2E-4
Neptunium-240 <sup>2</sup>						

W, all compounds	2E+4	8E+4	3E-5	1E-7	3E-4	3E-3
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**AN 94**

## Plutonium-234

W, all compounds except PuO <sub>2</sub>	8E+3	2E+2	9E-8	3E-10	1E-4	1E-3
--	------	------	------	-------	------	------

Y, PuO <sub>2</sub>	---	2E+2	8E-8	3E-10	---	---
---------------------	-----	------	------	-------	-----	-----

Plutonium-235<sup>2</sup>

W, see <sup>234</sup> Pu	9E+5	3E+6	1E-3	4E-6	1E-2	1E-1
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Y, see <sup>234</sup> Pu	---	3E+6	1E-3	3E-6	---	---
--------------------------	-----	------	------	------	-----	-----

## Plutonium-236

W, see <sup>234</sup> Pu	2E+0	2E-2	8E-12	---	---	---
--------------------------	------	------	-------	-----	-----	-----

	Bone (4E+0)	Bone (4E-2)	---	5E-14	6E-8	6E-7
--	----------------	----------------	-----	-------	------	------

Y, see <sup>234</sup> Pu	---	4E-2	2E-11	6E-14	---	---
--------------------------	-----	------	-------	-------	-----	-----

## Plutonium-237

W, see <sup>234</sup> Pu	1E+4	3E+3	1E-6	5E-9	2E-4	2E-3
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Y, see <sup>234</sup> Pu	---	3E+3	1E-6	4E-9	---	---
--------------------------	-----	------	------	------	-----	-----

## Plutonium-238

W, see <sup>234</sup> Pu	9E-1	7E-3	3E-12	---	---	---
--------------------------	------	------	-------	-----	-----	-----

	Bone (2E+0)	Bone (1E-2)	---	2E-14	2E-8	2E-7
--	----------------	----------------	-----	-------	------	------

Y, see <sup>234</sup> Pu	---	2E-2	8E-12	2E-14	---	---
--------------------------	-----	------	-------	-------	-----	-----

## Plutonium-239

W, see <sup>234</sup> Pu	8E-1	6E-3	3E-12	---	---	---
--------------------------	------	------	-------	-----	-----	-----



	Bone (1E+0)	Bone (1E-2)	---	2E-14	2E-8	2E-7
Y, see <sup>234</sup> Pu	---	2E-2	7E-12	---	---	---
	---	Bone (2E-2)	---	2E-14	---	---
Plutonium-240						
W, see <sup>234</sup> Pu	8E-1	6E-3	3E-12	---	---	---
	Bone (1E+0)	Bone (1E-2)	---	2E-14	2E-8	2E-7
Y, see <sup>234</sup> Pu	---	2E-2	7E-12	---	---	---
	---	Bone (2E-2)	---	2E-14	---	---
Plutonium-241						
W, see <sup>234</sup> Pu	4E+1	3E-1	1E-10	---	---	---
	Bone (7E+1)	Bone (6E-1)	---	8E-13	1E-6	1E-5
Y, see <sup>234</sup> Pu	---	8E-1	3E-10	---	---	---
	---	Bone (1E+0)	---	1E-12	---	---
Plutonium-242						
W, see <sup>234</sup> Pu	8E-1	7E-3	3E-12	---	---	---
	Bone (1E+0)	Bone (1E-2)	---	2E-14	2E-8	2E-7
Y, see <sup>234</sup> Pu	---	2E-2	7E-12	---	---	---
	---	Bone (2E-2)	---	2E-14	---	---
Plutonium-243						
W, see <sup>234</sup> Pu	2E+4	4E+4	2E-5	5E-8	2E-4	2E-3

Y, see <sup>234</sup> Pu	---	4E+4	2E-5	5E-8	---	---
Plutonium-244						
W, see <sup>234</sup> Pu	8E-1	7E-3	3E-12	---	---	---
	Bone (2E+0)	Bone (1E-2)	---	2E-14	2E-8	2E-7
Y, see <sup>234</sup> Pu	---	2E-2	7E-12	---	---	---
	---	Bone (2E-2)	---	2E-14	---	---
Plutonium-245						
W, see <sup>234</sup> Pu	2E+3	5E+3	2E-6	6E-9	3E-5	3E-4
Y, see <sup>234</sup> Pu	---	4E+3	2E-6	6E-9	---	---
Plutonium-246						
W, see <sup>234</sup> Pu	4E+2	3E+2	1E-7	4E-10	---	---
	LLI (4E+2)	---	---	---	6E-6	6E-5
Y, see <sup>234</sup> Pu	---	3E+2	1E-7	4E-10	---	---
<b>AN 95</b>						
Americium-237 <sup>2</sup>						
W, all compounds	8E+4	3E+5	1E-4	4E-7	1E-3	1E-2
Americium-238 <sup>2</sup>						
W, all compounds	4E+4	3E+3	1E-6	---	5E-4	5E-3
	---	Bone (6E+3)	---	9E-9	---	---
Americium-239						
W, all compounds	5E+3	1E+4	5E-6	2E-8	7E-5	7E-4

## Americium-240

W, all compounds	2E+3	3E+3	1E-6	4E-9	3E-5	3E-4
------------------	------	------	------	------	------	------

## Americium-241

W, all compounds	8E-1	6E-3	3E-12	---	---	---
	Bone (1E+0)	Bone (1E-2)	---	2E-14	2E-8	2E-7

## Americium-242m

W, all compounds	8E-1	6E-3	3E-12	---	---	---
	Bone (1E+0)	Bone (1E-2)	---	2E-14	2E-8	2E-7

## Americium-242

W, all compounds	4E+3	8E+1	4E-8	---	5E-5	5E-4
	---	Bone (9E+1)	---	1E-10	---	---

## Americium-243

W, all compounds	8E-1	6E-3	3E-12	---	---	---
	Bone (1E+0)	Bone (1E-2)	---	2E-14	2E-8	2E-7

Americium-244m<sup>2</sup>

W, all compounds	6E+4	4E+3	2E-6	---	---	---
	Stom (8E+4)	Bone (7E+3)	---	1E-8	1E-3	1E-2

## Americium-244

W, all compounds	3E+3	2E+2	8E-8	---	4E-5	4E-4
------------------	------	------	------	-----	------	------

	---	Bone (3E+2)	---	4E-10	---	---
Americium-245						
W, all compounds	3E+4	8E+4	3E-5	1E-7	4E-4	4E-3
Americium-246m <sup>2</sup>						
W, all compounds	5E+4	2E+5	8E-5	3E-7	---	---
	Stom (6E+4)	---	---	---	8E-4	8E-3
Americium-246 <sup>2</sup>						
W, all compounds	3E+4	1E+5	4E-5	1E-7	4E-4	4E-3
<b>AN 96</b>						
Curium-238						
W, all compounds	2E+4	1E+3	5E-7	2E-9	2E-4	2E-3
Curium-240						
W, all compounds	6E+1	6E-1	2E-10	---	---	---
	Bone (8E+1)	Bone (6E-1)	---	9E-13	1E-6	1E-5
Curium-241						
W, all compounds	1E+3	3E+1	1E-8	---	2E-5	2E-4
	---	Bone (4E+1)	---	5E-11	---	---
Curium-242						
W, all compounds	3E+1	3E-1	1E-10	---	---	---

	Bone (5E+1)	Bone (3E-1)	---	4E-13	7E-7	7E-6
Curium-243						
W, all compounds	1E+0	9E-3	4E-12	---	---	---
	Bone (2E+0)	Bone (2E-2)	---	2E-14	3E-8	3E-7
Curium-244						
W, all compounds	1E+0	1E-2	5E-12	---	---	---
	Bone (3E+0)	Bone (2E-2)	---	3E-14	3E-8	3E-7
Curium-245						
W, all compounds	7E-1	6E-3	3E-12	---	---	---
	Bone (1E+0)	Bone (1E-2)	---	2E-14	2E-8	2E-7
Curium-246						
W, all compounds	7E-1	6E-3	3E-12	---	---	---
	Bone (1E+0)	Bone (1E-2)	---	2E-14	2E-8	2E-7
Curium-247						
W, all compounds	8E-1	6E-3	3E-12	---	---	---
	Bone (1E+0)	Bone (1E-2)	---	2E-14	2E-8	2E-7
Curium-248						
W, all compounds	2E-1	2E-3	7E-13	---	---	---
	Bone (4E-1)	Bone (3E-3)	---	4E-15	5E-9	5E-8

Curium-249<sup>2</sup>

W, all compounds	5E+4	2E+4	7E-6	---	7E-4	7E-3
	---	Bone (3E+4)	---	4E-8	---	---

## Curium-250

W, all compounds	4E-2	3E-4	1E-13	---	---	---
	Bone (6E-2)	Bone (5E-4)	---	8E-16	9E-10	9E-9

## AN 97

## Berkelium-245

W, all compounds	2E+3	1E+3	5E-7	2E-9	3E-5	3E-4
------------------	------	------	------	------	------	------

## Berkelium-246

W, all compounds	3E+3	3E+3	1E-6	4E-9	4E-5	4E-4
------------------	------	------	------	------	------	------

## Berkelium-247

W, all compounds	5E-1	4E-3	2E-12	---	---	---
	Bone (1E+0)	Bone (9E-0)	---	1E-14	2E-8	2E-7

## Berkelium-249

W, all compounds	2E+2	2E+0	7E-10	---	---	---
	Bone (5E+2)	Bone (4E+0)	---	5E-12	6E-6	6E-5

## Berkelium-250

W, all compounds	9E+3	3E+2	1E-7	---	1E-4	1E-3
	---	Bone (7E+2)	---	1E-9	---	---

**AN 98**Californium-244<sup>2</sup>W, all compounds except those  
given for Y

3E+4      6E+2      2E-7      8E-10      ---      ---

Stom  
(3E+4)      ---      ---      ---      4E-4      4E-3

Y, oxides and hydroxides

---      6E+2      2E-7      8E-10      ---      ---

## Californium-246

W, see <sup>244</sup>Cf      4E+2      9E+0      4E-9      1E-11      5E-6      5E-5Y, see <sup>244</sup>Cf      ---      9E+0      4E-9      1E-11      ---      ---

## Californium-248

W, see <sup>244</sup>Cf      8E+0      6E-2      3E-11      ---      ---      ---Bone  
(2E+1)      Bone  
(1E-1)      ---      2E-13      2E-7      2E-6Y, see <sup>244</sup>Cf      ---      1E-1      4E-11      1E-13      ---      ---

## Californium-249

W, see <sup>244</sup>Cf      5E-1      4E-3      24E-12      ---      ---      ---Bone  
(1E+0)      Bone  
(9E-3)      ---      1E-14      2E-8      2E-7Y, see <sup>244</sup>Cf      ---      1E-2      4E-12      ---      ---      ---Bone  
(1E-2)      ---      2E-14      ---      ---

## Californium-250

W, see <sup>244</sup>Cf      1E+0      9E-3      4E-12      ---      ---      ---Bone  
(2E+0)      Bone  
(2E-2)      ---      3E-14      3E-8      3E-7

Y, see <sup>244</sup> Cf	---	3E-2	1E-11	4E-14	---	---
Californium-251						
W, see <sup>244</sup> Cf	5E-1	4E-3	2E-12	---	---	---
	Bone (1E+0)	Bone (9E-3)	---	1E-14	2E-8	2E-7
Y, see <sup>244</sup> Cf	---	1E-2	4E-12	---	---	---
	---	Bone (1E-2)	---	2E-14	---	---
Californium-252						
W, see <sup>244</sup> Cf	2E+0	2E-2	8E-12	---	---	---
	Bone (5E+0)	Bone (4E-2)	---	5E-14	7E-8	7E-7
Y, see <sup>244</sup> Cf	---	3E-2	1E-11	5E-14	---	---
Californium-253						
W, see <sup>244</sup> Cf	2E+2	2E+0	8E-10	3E-12	---	---
	Bone (4E+2)	---	---	---	5E-6	5E-5
Y, see <sup>244</sup> Cf	---	2E+0	7E-10	2E-12	---	---
Californium-254						
W, see <sup>244</sup> Cf	2E+0	2E-2	9E-12	3E-14	3E-8	3E-7
Y, see <sup>244</sup> Cf	---	2E-2	7E-12	2E-14	---	---
<b>AN 99</b>						
Einsteinium-250						
W, all compounds	4E+4	5E+2	2E-7	---	6E-4	6E-3
	---	Bone (1E+3)	---	2E-9	---	---



## Einsteinium-251

W, all compounds	7E+3	9E+2	4E-7	---	1E-4	1E-3
	---	Bone (1E+3)	---	2E-9	---	---

## Einsteinium-253

W, all compounds	2E+2	1E+0	6E-10	2E-12	2E-6	2E-5
------------------	------	------	-------	-------	------	------

## Einsteinium-254m

W, all compounds	3E+2	1E+1	4E-9	1E-11	---	---
	LLI(3E+2)	---	---	---	4E-6	4E-5

## Einsteinium-254

W, all compounds	8E+0	7E-2	3E-11	---	---	---
	Bone (2E+1)	Bone (1E-1)	---	2E-13	2E-7	2E-6

**AN 100**

## Fermium-252

W, all compounds	5E+2	1E+1	5E-9	2E-11	6E-6	6E-5
------------------	------	------	------	-------	------	------

## Fermium-253

W, all compounds	1E+3	1E+1	4E-9	1E-11	1E-5	1E-4
------------------	------	------	------	-------	------	------

## Fermium-254

W, all compounds	3E+3	9E+1	4E-8	1E-10	4E-5	4E-4
------------------	------	------	------	-------	------	------

## Fermium-255

W, all compounds	5E+2	2E+1	9E-9	3E-11	7E-6	7E-5
------------------	------	------	------	-------	------	------

## Fermium-257

W, all compounds	2E+1	2E-1	7E-11	---	---	---
	Bone (4E+1)	Bone (2E-1)	---	3E-13	5E-7	5E-6

**AN 101**

## Mendelevium-257

W, all compounds	7E+3	8E+1	4E-8	---	1E-4	1E-3
	---	Bone (9E+1)	---	1E-10	---	---

## Mendelevium-258

W, all compounds	3E+1	2E-1	1E-10	---	---	---
	Bone (5E+1)	Bone (3E-1)	---	5E-13	6E-7	6E-6

---Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours

Submersion <sup>1</sup>	---	2E+2	1E-7	1E-9	---	---
-------------------------	-----	------	------	------	-----	-----

---Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours

	---	2E-1	1E-10	1E-12	1E-8	1E-7
--	-----	------	-------	-------	------	------

---Any single radionuclide not listed above that decays by alpha emission or spontaneous fission or any mixture for which either the identity or the concentration

	---	4E-4	2E-13	1E-15	2E-9	2E-8
--	-----	------	-------	-------	------	------

of any radionuclide in the mixture is not known

FOOTNOTES:

<sup>1</sup> "Submersion" means that values given are for submersion in a hemispherical semi-infinite cloud of airborne material.

<sup>2</sup> These radionuclides have radiological half-lives of less than two hours. The total effective dose equivalent received during operations with these radionuclides might include a significant contribution from external exposure. The DAC values for all radionuclides, other than those designated Class "Submersion," are based upon the committed effective dose equivalent due to the intake of the radionuclide into the body and do not include potentially significant contributions to dose equivalent from external exposures. The licensee may substitute  $1\text{E-}7$   $\mu\text{Ci/ml}$  for the listed DAC to account for the submersion dose prospectively, but must use individual monitoring devices or other radiation measuring instruments that measure external exposure to demonstrate compliance with the limits according to part 4731.2040.

<sup>3</sup> For soluble mixtures of U-238, U-234, and U-235 in air, chemical toxicity may be the limiting factor according to part 4731.2020, subpart 5. If the percent by weight (enrichment) of U-235 is not greater than five, the concentration value for a 40-hour work week is 0.2 milligrams uranium per cubic meter of air average. For any enrichment, the product of the average concentration and time of exposure during a 40-hour work week must not exceed  $8\text{E-}3$  (SA)  $\mu\text{Ci-hr/ml}$ , where SA is the specific activity of the uranium inhaled. The specific activity for natural uranium is  $6.77\text{E-}7$  curies per gram U. The specific activity for other mixtures of U-238, U-235, and U-234, if not known, is:

$$\text{SA} = 3.6\text{E-}7 \text{ curies/gram U U-depleted}$$

$$\text{SA} = [0.4 + 0.38 (\text{enrichment}) + 0.0034 (\text{enrichment})^2] \text{E-}6, \text{ enrichment} > 0.72$$

where enrichment is the percentage by weight of U-235, expressed as percent.

Subp. 8. **Additional explanations.**

A. If the identity of each radionuclide in a mixture is known, but the concentration of one or more of the radionuclides in the mixture is not known, the DAC for the mixture is the most restrictive DAC of any radionuclide in the mixture.

B. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in this part are not present in the mixture, the inhalation ALI, DAC, and effluent and sewage concentrations for the mixture are the lowest values specified in this part for any radionuclide that is not known to be absent from the mixture; or

Radionuclide and Class	Table 1			Table 2		Table 3
	1	2	3	1	2	3
If it is known that Ac-227-D and Cm-250-W are not present	---	7E-4	3E-13	---	---	---
If, in addition, it is known that Ac-227-W, Y; Th-229-W, Y; Th-230-W; Th-232-W, Y; Pa-231-W, Y; Np-237-W; Pu-239-W; Pu-240-W; Pu-242-W; Am-241-W; Am-242m-W; Am-243-W; Cm-245-W; Cm-246-W; Cm-247-W; Cm-248-W; Bk-247-W; Cf-249-W; and Cf-251-W are not present	---	7E-3	3E-12	---	---	---
If, in addition, it is known that Sm-146-W; Sm-147-W; Gd-148-D, W; Gd-152-D, W; Th-228-W, Y; Th-230-Y; U-232-Y; U-233-Y; U-234-Y; U-235-Y; U-236-Y; U-238-Y; Np-236-W; Pu-236-W, Y; Pu-238-W, Y; Pu-239-Y; Pu-240-Y; Pu-242-Y; Pu-244-W, Y; Cm-243-W; Cm-244-W; Cf-248-W; Cf-249-Y; Cf-250-W, Y; Cf-251-Y; Cf-252-W, Y; and Cf-254-W, Y are not present	---	7E-2	3E-11	---	---	---
If, in addition, it is known that Pb-210-D; Bi-210m-W; Po-210-D, W; Ra-223-W; Ra-225-W; Ra-226-W; Ac-225-D, W, Y; Th-227-W, Y; U-230-D, W, Y; U-232-D, W; Pu-241-W; Cm-240-W; Cm-242-W; Cf-248-Y; Es-254-W; Fm-257-W; and Md-258-W are not present	---	7E-1	3E-10	---	---	---
If, in addition, it is known that Si-32-Y; Ti-44-Y; Fe-60-D; Sr-90-Y; Zr-93-D; Cd-113m-D; Cd-113-D; In-115-D, W; La-138-D; Lu-176-W; Hf-178m-D, W; Hf-182-D, W; Bi-210m-D; Ra-224-W; Ra-228-W; Ac-226-D, W, Y; Pa-230-W, Y; U-233-D, W; U-234-D, W; U-235-D, W; U-236-D, W; U-238-D, W; Pu-241-Y; Bk-249-W; Cf-253-W, Y; and Es-253-W are not present	---	7E-0	3E-9	---	---	---

If it is known that Ac-227-D, W, Y; Th-229-W, Y; Th-232-W, Y; Pa-231-W, Y; Cm-248-W; and Cm-250-W are not present

	---	---	---	1E-14	---	---
--	-----	-----	-----	-------	-----	-----

If, in addition, it is known that Sm-146-W; Gd-148-D, W; Gd-152-D; Th-228-W, Y; Th-230-W, Y; U-232-Y; U-233-Y; U-234-Y; U-235-Y; U-236-Y; U-238-Y; U-Nat-Y; Np-236-W; Np-237-W; Pu-236-W, Y; Pu-238-W, Y; Pu-239-W, Y; Pu-240-W, Y; Pu-242-W, Y; Pu-244-W, Y; Am-241-W; Am-242m-W; Am-243-W; Cm-243-W; Cm-244-W; Cm-245-W; Cm-246-W; Cm-247-W; Bk-247-W; Cf-249-W, Y; Cf-250-W, Y; Cf-251-W, Y; Cf-252-W, Y; and Cf-254-W, Y are not present

	---	---	---	1E-13	---	---
--	-----	-----	-----	-------	-----	-----

If, in addition, it is known that Sm-147-W; Gd-152-W; Pb-210-D; Bi-210m-W; Po-210-D, W; Ra-223-W; Ra-225-W; Ra-226-W; Ac-225-D, W, Y; Th-227-W, Y; U-230-D, W, Y; U-232-D, W; U-Nat-W; Pu-241-W; Cm-240-W; Cf-242-W; Cf-248-W, Y; Es-254-W; Fm-257-W; and Md-258-W are not present

	---	---	---	1E-12	---	---
--	-----	-----	-----	-------	-----	-----

If, in addition, it is known that Fe-60; Sr-90; Cd-113m; Cd-113; In-115; I-129; Cs-134; Sm-145; Sm-147; Gd-148; Gd-152; Hg-194 (organic); Bi-210m; Ra-223; Ra-224; Ra-225; Ac-225; Th-228; Th-230; U-233; U-234; U-235; U-236; U-238; U-Nat; Cm-242; Cf-248; Es-254; Fm-257; and Md-258 are not present

	---	---	---	---	1E-6	1E-5
--	-----	-----	-----	-----	------	------

C. If a mixture of radionuclides consists of uranium and its daughters in ore dust (10  $\mu\text{m}$  AMAD particle distribution assumed) prior to chemical separation of the uranium from the ore, the following values may be used for the DAC of the mixture: 6E-11  $\mu\text{Ci}$  of gross alpha activity from uranium-238, uranium-234, thorium-230, and radium-226 per milliliter of air; 3E-11  $\mu\text{Ci}$  of natural uranium per milliliter of air; or 45 micrograms of natural uranium per cubic meter of air.

D. If the identity and concentration of each radionuclide in a mixture are known, the limiting values should be derived as follows: determine, for each radionuclide in the mixture, the ratio between the concentration present in the mixture and the concentration otherwise established in

this part for the specific radionuclide when not in a mixture. The sum of such ratios for all of the radionuclides in the mixture may not exceed one.

Example: If radionuclides A, B, and C are present in concentrations  $C_A$ ,  $C_B$ ,  $C_C$ , and if the applicable DACs are  $DAC_A$ ,  $DAC_B$ , and  $DAC_C$ , respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_A}{DAC_A} + \frac{C_B}{DAC_B} + \frac{C_C}{DAC_C} < 1$$

**Statutory Authority:** *MS s 144.1202; 144.1203*

**History:** *29 SR 755; 33 SR 1440; 46 SR 791*

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