

Chapter DHS 157

APPENDIX A

Exempt Concentrations

Element (atomic number)	Radionuclide	Column I Gas concentration $\mu\text{Ci/ml 1/}$	Column II Liquid and solid concentration $\mu\text{Ci/ml 2/}$
Antimony (51)	Sb-122		3×10^{-4}
	Sb-124		2×10^{-4}
	Sb-125		1×10^{-3}
Argon (18)	Ar-37	1×10^{-3}	
	Ar-41	4×10^{-7}	
Arsenic (33)	As-73		5×10^{-3}
	As-74		5×10^{-4}
	As-76		2×10^{-4}
	As-77		8×10^{-4}
Barium (56)	Ba-131		2×10^{-3}
	Ba-140		3×10^{-4}
Beryllium (4)	Be-7		2×10^{-2}
Bismuth (83)	Bi-206		4×10^{-4}
Bromine (35)	Br-82	4×10^{-7}	3×10^{-3}
Cadmium (48)	Cd-109		2×10^{-3}
	Cd-115m		3×10^{-4}
	Cd-115		3×10^{-4}
Calcium (20)	Ca-45		9×10^{-5}
	Ca-47		5×10^{-4}
Carbon (6)	C-14	1×10^{-6}	8×10^{-3}
Cerium (58)	Ce-141		9×10^{-4}
	Ce-143		4×10^{-4}
	Ce-144		1×10^{-4}
Cesium (55)	Cs-131		2×10^{-2}
	Cs-134m		6×10^{-2}
	Cs-134		9×10^{-5}
Chlorine (17)	Cl-38	9×10^{-7}	4×10^{-3}
Chromium (24)	Cr-51		2×10^{-2}
Cobalt (27)	Co-57		5×10^{-3}
	Co-58		1×10^{-3}
	Co-60		5×10^{-4}
Copper (29)	Cu-64		3×10^{-3}
Dysprosium (66)	Dy-165		4×10^{-3}
	Dy-166		4×10^{-4}
Erbium (68)	Er-169		9×10^{-4}
	Er-171		1×10^{-3}
Europium (63)	Eu-152(9.2 h)		6×10^{-4}
	Eu-155		2×10^{-3}
Fluorine (9)	F-18	2×10^{-6}	8×10^{-3}

1/ Values are given in Column I only for those materials normally used as gases.

2/ $\mu\text{Ci/g}$ for solids

Element (atomic number)	Radionuclide	Column I Gas concentration μCi/ml 1/	Column II Liquid and solid concentration μCi/ml 2/
Gadolinium (64)	Gd-153		2X10 ⁻³
	Gd-159		8X10 ⁻⁴
Gallium (31)	Ga-72		4X10 ⁻⁴
Germanium (32)	Ge-71		2X10 ⁻²
Gold (79)	Au-196		2X10 ⁻³
	Au-198		5X10 ⁻⁴
	Au-199		2X10 ⁻³
Hafnium (72)	Hf-181		7X10 ⁻⁴
Hydrogen (1)	H-3	5X10 ⁻⁶	3X10 ⁻²
Indium (49)	In-113m		1X10 ⁻²
	In-114m		2X10 ⁻⁴
Iodine (53)	I-126	3X10 ⁻⁹	X10 ⁻⁵
	I-131	3X10 ⁻⁹	2X10 ⁻⁵
	I-132	8X10 ⁻⁸	6X10 ⁻⁴
	I-133	1X10 ⁻⁸	7X10 ⁻⁵
	I-134	2X10 ⁻⁷	1X10 ⁻³
Iridium (77)	Ir-190		2X10 ⁻³
	Ir-192		4X10 ⁻⁴
	Ir-194		3X10 ⁻⁴
Iron (26)	Fe-55		8X10 ⁻³
	Fe-59		6X10 ⁻⁴
Krypton (36)	Kr-85m	1X10 ⁻⁶	
	Kr-85	3X10 ⁻⁶	
Lanthanum (57)	La-140		2X10 ⁻⁴
Lead (82)	Pb-203		4X10 ⁻
Lutetium (71)	Lu-177		1X10 ⁻³
Manganese (25)	Mn-52		3X10 ⁻⁴
	Mn-54		1X10 ⁻³
	Mn-56		1X10 ⁻³
Mercury (80)	Hg-197m		2X10 ⁻³
	Hg-197		3X10 ⁻³
	Hg-203		2X10 ⁻⁴
Molybdenum (42)	Mo-99		2X10 ⁻³
Neodymium (60)	Nd-147		6X10 ⁻⁴
	Nd-149		3X10 ⁻³
Nickel (28)	Ni-65		1X10 ⁻³
Niobium (Columbium) (41)	Nb-95		1X10 ⁻³
	Nb-97		9X10 ⁻³
Osmium (76)	Os-185		7X10 ⁻⁴
	Os-191m		3X10 ⁻²
	Os-191		2X10 ⁻³
	Os-193		6X10 ⁻⁴
Palladium (46)	Pd-103		3X10 ⁻³
	Pd-109		9X10 ⁻⁴
Phosphorus (15)	P-32		2X10 ⁻⁴
Platinum (78)	Pt-191		1X10 ⁻³
	Pt-193m		1X10 ⁻²

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2/ μCi/g for solids

Element (atomic number)	Radionuclide	Column I Gas concentration μCi/ml 1/	Column II Liquid and solid concentration μCi/ml 2/
	Pt-197m		1X10 ⁻²
	Pt-197		1X10 ⁻³
Potassium (19)	K-42		3X10 ⁻³
Praseodymium (59)	Pr-142		3X10 ⁻⁴
	Pr-143		5X10 ⁻⁴
Promethium (61)	Pm-147		2X10 ⁻³
	Pm-149		4X10 ⁻⁴
Rhenium (75)	Re-183		6X10 ⁻³
	Re-186		9X10 ⁻⁴
	Re-188		6X10 ⁻⁴
Rhodium (45)	Rh-103m		1X10 ⁻¹
	Rh-105		1X10 ⁻³
Rubidium (37)	Rb-86		7X10 ⁻⁴
Ruthenium (44)	Ru-97		4X10 ⁻³
	Ru-103		8X10 ⁻⁴
	Ru-105		1X10 ⁻³
	Ru-106		1X10 ⁻⁴
Samarium (62)	Sm-153		8X10 ⁻⁴
Scandium (21)	Sc-46		4X10 ⁻⁴
	Sc-47		9X10 ⁻⁴
	Sc-48		3X10 ⁻⁴
Selenium (34)	Se-75		3X10 ⁻³
Silicon (14)	Si-31		9X10 ⁻³
Silver (47)	Ag-105		1X10 ⁻³
	Ag-110m		3X10 ⁻⁴
	Ag-111		4X10 ⁻⁴
Sodium (11)	Na-24		2X10 ⁻³
Strontium (38)	Sr-85		1X10 ⁻³
	Sr-89		1X10 ⁻⁴
	Sr-91		7X10 ⁻⁴
	Sr-92		7X10 ⁻⁴
Sulfur (16)	S-35	9X10 ⁻⁸	6X10 ⁻⁴
Tantalum (73)	Ta-182		4X10 ⁻⁴
Technetium (43)	Tc-96m		1X10 ⁻¹
	Tc-96		1X10 ⁻³
Tellurium (52)	Te-125m		2X10 ⁻³
	Te-127m		6X10 ⁻⁴
	Te-127		3X10 ⁻³
	Te-129m		3X10 ⁻⁴
	Te-131m		6X10 ⁻⁴
	Te-132		3X10 ⁻⁴
Terbium (65)	Tb-160		4X10 ⁻⁴
Thallium (81)	Tl-200		4X10 ⁻³
	Tl-201		3X10 ⁻³
	Tl-202		1X10 ⁻³
	Tl-204		1X10 ⁻³
Thulium (69)	Tm-170		5X10 ⁻⁴

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2/ μCi/g for solids

Element (atomic number)	Radionuclide	Column I Gas concentration μCi/ml 1/	Column II Liquid and solid concentration μCi/ml 2/
Tin (50)	Tm-171		5X10 ⁻³
	Sn-113		9X10 ⁻⁴
Tungsten (Wolfram) (74)	Sn-125		2X10 ⁻⁴
	W-181		4X10 ⁻³
	W-187		7X10 ⁻⁴
Vanadium (23)	V-48		3X10 ⁻⁴
Xenon (54)	Xe-131m	4X10 ⁻⁶	
	Xe-133	3X10 ⁻⁶	
	Xe-135	1X10 ⁻⁶	
Ytterbium (70)	Yb-175		1X10 ⁻³
Yttrium (39)	Y-90		2X10 ⁻⁴
	Y-91m		3X10 ⁻²
	Y-91		3X10 ⁻⁴
	Y-92		6X10 ⁻⁴
	Y-93		3X10 ⁻⁴
Zinc (30)	Zn-65		1X10 ⁻³
	Zn-69m		7X10 ⁻⁴
	Zn-69		2X10 ⁻²
Zirconium (40)	Zr-95		6X10 ⁻⁴
	Zr-97		2X10 ⁻⁴

Beta- and gamma-emitting radioactive material not listed above with half-life of less than 3 years.

1X10⁻¹⁰

1X10⁻⁶

Note 1: Many radionuclides transform into other radionuclides. In expressing the concentrations in Appendix A, the activity stated is that of the parent radionuclide and takes into account the radioactive decay products.

Note 2: For purposes of s. DHS 157.09 (2) where there is involved a combination of radionuclides, the limit for the combination should be derived as follows: Determine for each radionuclide in the product the ratio between the radioactivity concentration present in the product and the exempt radioactivity concentration established in Appendix A for the specific radionuclide when not in combination. The sum of such ratios may not exceed "1".

Example: $\frac{\text{Concentration of Radionuclide A in Product}}{\text{Exempt concentration of Radionuclide A}} + \frac{\text{Concentration of Radionuclide B in Product}}{\text{Exempt concentration of Radionuclide B}} \leq 1$

Note 3: To convert μCi/ml to SI units of megabecquerels per liter multiply the above values by 37.

Example: Zirconium (40) Zr-97 (2x10⁻⁴ μCi/ml multiplied by 37 is equivalent to 74 x 10⁻⁴ MBq/l).

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2/ μCi/g for solids.