

**Chapter DHS 157  
APPENDIX A**

Element (atomic number)	Exempt Concentrations		
	Radionuclide	Column I Gas concentration microcuries/ml 1/	Column II Liquid and solid concentration microcuries/ml 2/
Antimony (51)	Sb-122		3X10 <sup>-4</sup>
	Sb-124		2X10 <sup>-4</sup>
	Sb-125		1X10 <sup>-3</sup>
Argon (18)	Ar-37	1X10 <sup>-3</sup>	
	Ar-41	4X10 <sup>-7</sup>	
Arsenic (33)	As-73		5X10 <sup>-3</sup>
	As-74		5X10 <sup>-4</sup>
	As-76		2X10 <sup>-4</sup>
	As-77		8X10 <sup>-4</sup>
Barium (56)	Ba-131		2X10 <sup>-3</sup>
	Ba-140		3X10 <sup>-4</sup>
Beryllium (4)	Be-7		2X10 <sup>-2</sup>
Bismuth (83)	Bi-206		4X10 <sup>-4</sup>
Bromine (35)	Br-82	4X10 <sup>-7</sup>	3X10 <sup>-3</sup>
Cadmium (48)	Cd-109		2X10 <sup>-3</sup>
	Cd-115m		3X10 <sup>-4</sup>
	Cd-115		3X10 <sup>-4</sup>
Calcium (20)	Ca-45		9X10 <sup>-5</sup>
	Ca-47		5X10 <sup>-4</sup>
Carbon (6)	C-14	1X10 <sup>-6</sup>	8X10 <sup>-3</sup>
Cerium (58)	Ce-141		9X10 <sup>-4</sup>
	Ce-143		4X10 <sup>-4</sup>
	Ce-144		1X10 <sup>-4</sup>
Cesium (55)	Cs-131		2X10 <sup>-2</sup>
	Cs-134m		6X10 <sup>-2</sup>
	Cs-134		9X10 <sup>-5</sup>
Chlorine (17)	Cl-38	9X10 <sup>-7</sup>	4X10 <sup>-3</sup>
Chromium (24)	Cr-51		2X10 <sup>-2</sup>
Cobalt (27)	Co-57		5X10 <sup>-3</sup>
	Co-58		1X10 <sup>-3</sup>
	Co-60		5X10 <sup>-4</sup>
Copper (29)	Cu-64		3X10 <sup>-3</sup>
Dysprosium (66)	Dy-165		4X10 <sup>-3</sup>
	Dy-166		4X10 <sup>-4</sup>
Erbium (68)	Er-169		9X10 <sup>-4</sup>
	Er-171		1X10 <sup>-3</sup>
Europium (63)	Eu-152(9.2 h)		6X10 <sup>-4</sup>
	Eu-155		2X10 <sup>-3</sup>
Fluorine (9)	F-18	2X10 <sup>-6</sup>	8X10 <sup>-3</sup>
Gadolinium (64)	Gd-153		2X10 <sup>-3</sup>
	Gd-159		8X10 <sup>-4</sup>
Gallium (31)	Ga-72		4X10 <sup>-4</sup>
Germanium (32)	Ge-71		2X10 <sup>-2</sup>
Gold (79)	Au-196		2X10 <sup>-3</sup>
	Au-198		5X10 <sup>-4</sup>
	Au-199		2X10 <sup>-3</sup>

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

Element (atomic number)	Radionuclide	Column I Gas concentration microcuries/ml 1/	Column II Liquid and solid concentration microcuries/ml 2/
Hafnium (72)	Hf-181		7X10 <sup>-4</sup>
Hydrogen (1)	H-3	5X10 <sup>-6</sup>	3X10 <sup>-2</sup>
Indium (49)	In-113m		1X10 <sup>-2</sup>
	In-114m		2X10 <sup>-4</sup>
Iodine (53)	I-126	3X10 <sup>-9</sup>	2X10 <sup>-5</sup>
	I-131	3X10 <sup>-9</sup>	2X10 <sup>-5</sup>
	I-132	8X10 <sup>-8</sup>	6X10 <sup>-4</sup>
	I-133	1X10 <sup>-8</sup>	7X10 <sup>-5</sup>
	I-134	2X10 <sup>-7</sup>	1X10 <sup>-3</sup>
Iridium (77)	Ir-190		2X10 <sup>-3</sup>
	Ir-192		4X10 <sup>-4</sup>
	Ir-194		3X10 <sup>-4</sup>
Iron (26)	Fe-55		8X10 <sup>-3</sup>
	Fe-59		6X10 <sup>-4</sup>
Krypton (36)	Kr-85m	1X10 <sup>-6</sup>	
	Kr-85	3X10 <sup>-6</sup>	
Lanthanum (57)	La-140		2X10 <sup>-4</sup>
Lead (82)	Pb-203		4X10 <sup>-3</sup>
Lutetium (71)	Lu-177		1X10 <sup>-3</sup>
Manganese (25)	Mn-52		3X10 <sup>-4</sup>
	Mn-54		1X10 <sup>-3</sup>
	Mn-56		1X10 <sup>-3</sup>
Mercury (80)	Hg-197m		2X10 <sup>-3</sup>
	Hg-197		3X10 <sup>-3</sup>
	Hg-203		2X10 <sup>-4</sup>
Molybdenum (42)	Mo-99		2X10 <sup>-3</sup>
Neodymium (60)	Nd-147		6X10 <sup>-4</sup>
	Nd-149		3X10 <sup>-3</sup>
Nickel (28)	Ni-65		1X10 <sup>-3</sup>
Niobium (Columbium) (41)	Nb-95		1X10 <sup>-3</sup>
	Nb-97		9X10 <sup>-3</sup>
Osmium (76)	Os-185		7X10 <sup>-4</sup>
	Os-191m		3X10 <sup>-2</sup>
	Os-191		2X10 <sup>-3</sup>
	Os-193		6X10 <sup>-4</sup>
Palladium (46)	Pd-103		3X10 <sup>-3</sup>
	Pd-109		9X10 <sup>-4</sup>
Phosphorus (15)	P-32		2X10 <sup>-4</sup>
Platinum (78)	Pt-191		1X10 <sup>-3</sup>
	Pt-193m		1X10 <sup>-2</sup>
	Pt-197m		1X10 <sup>-2</sup>
	Pt-197		1X10 <sup>-3</sup>
Potassium (19)	K-42		3X10 <sup>-3</sup>
Praseodymium (59)	Pr-142		3X10 <sup>-4</sup>
	Pr-143		5X10 <sup>-4</sup>
Promethium (61)	Pm-147		2X10 <sup>-3</sup>
	Pm-149		4X10 <sup>-4</sup>
Rhenium (75)	Re-183		6X10 <sup>-3</sup>
	Re-186		9X10 <sup>-4</sup>

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

2/ microcuries /g for solids

Element (atomic number)	Radionuclide	Column I Gas concentration microcuries/ml 1/	Column II Liquid and solid concentration microcuries/ml 2/
Rhodium (45)	Rh-103m		1X10 <sup>-1</sup>
	Rh-105		1X10 <sup>-3</sup>
Rubidium (37)	Rb-86		7X10 <sup>-4</sup>
Ruthenium (44)	Ru-97		4X10 <sup>-4</sup>
	Ru-103		8X10 <sup>-4</sup>
	Ru-105		1X10 <sup>-3</sup>
	Ru-106		1X10 <sup>-4</sup>
Samarium (62)	Sm-153		8X10 <sup>-4</sup>
Scandium (21)	Sc-46		4X10 <sup>-4</sup>
	Sc-47		9X10 <sup>-4</sup>
	Sc-48		3X10 <sup>-4</sup>
Selenium (34)	Se-75		3X10 <sup>-3</sup>
Silicon (14)	Si-31		9X10 <sup>-3</sup>
Silver (47)	Ag-105		1X10 <sup>-3</sup>
	Ag-110m		3X10 <sup>-4</sup>
	Ag-111		4X10 <sup>-4</sup>
Sodium (11)	Na-24		2X10 <sup>-3</sup>
Strontium (38)	Sr-85		1X10 <sup>-4</sup>
	Sr-89		1X10 <sup>-4</sup>
	Sr-91		7X10 <sup>-4</sup>
	Sr-92		7X10 <sup>-4</sup>
Sulfur (16)	S-35	9X10 <sup>-8</sup>	6X10 <sup>-4</sup>
Tantalum (73)	Ta-182		4X10 <sup>-4</sup>
Technetium (43)	Tc-96m		1X10 <sup>-1</sup>
	Tc-96		1X10 <sup>-3</sup>
Tellurium (52)	Te-125m		2X10 <sup>-3</sup>
	Te-127m		6X10 <sup>-4</sup>
	Te-127		3X10 <sup>-3</sup>
	Te-129m		3X10 <sup>-4</sup>
	Te-131m		6X10 <sup>-4</sup>
	Te-132		3X10 <sup>-4</sup>
Terbium (65)	Tb-160		4X10 <sup>-4</sup>
Thallium (81)	Tl-200		4X10 <sup>-3</sup>
	Tl-201		3X10 <sup>-3</sup>
	Tl-202		1X10 <sup>-3</sup>
	Tl-204		1X10 <sup>-3</sup>
	Tm-170		5X10 <sup>-4</sup>
Thulium (69)	Tm-171		5X10 <sup>-3</sup>
	Tin (50)	Sn-113	
Tungsten (Wolfram) (74)	Sn-125		2X10 <sup>-4</sup>
	W-181		4X10 <sup>-3</sup>
	W-187		7X10 <sup>-4</sup>
Vanadium (23)	V-48		3X10 <sup>-4</sup>
Xenon (54)	Xe-131m	4X10 <sup>-6</sup>	
	Xe-133	3X10 <sup>-6</sup>	
	Xe-135	1X10 <sup>-6</sup>	
Ytterbium (70)	Yb-175		1X10 <sup>-3</sup>

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

2/ microcuries /g for solids

Element (atomic number)	Radionuclide	Column I Gas concentration microcuries/ml 1/	Column II Liquid and solid concentration microcuries/ml 2/
Yttrium (39)	Y-90		$2 \times 10^{-4}$
	Y-91m		$3 \times 10^{-2}$
	Y-91		$3 \times 10^{-4}$
	Y-92		$6 \times 10^{-4}$
	Y-93		$3 \times 10^{-4}$
Zinc (30)	Zn-65		$1 \times 10^{-3}$
	Zn-69m		$7 \times 10^{-4}$
	Zn-69		$2 \times 10^{-2}$
	Zr-95		$6 \times 10^{-4}$
Zirconium (40)	Zr-95		$6 \times 10^{-4}$
	Zr-97		$2 \times 10^{-4}$
Beta- and gamma-emitting radioactive material not listed above with half-life of less than 3 years.		$1 \times 10^{-10}$	$1 \times 10^{-6}$

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2/ microcuries /g for solids

**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 microcuries-/ml to SI units of megabecquerels per liter multiply the above values by 37.

**Example:** Zirconium (40) Zr-97 ( $2 \times 10^{-4}$  microcuries/ml multiplied by 37 is equivalent to  $74 \times 10^{-4}$  MBq/l).  
2/ microcuries/g for solids.