§336.360. Appendix C.
Quantities[1] of Licensed Material Requiring Labeling

Radionuclide	Quantity (μCi)[2]	Radionuclide	Quantity (μCi)[2]
Hydrogen-3	1,000	Vanadium-47	1,000
Beryllium-7	1,000	Vanadium-48	100
Beryllium-10	1	Vanadium-49	1,000
Carbon-11	1,000	Chromium-48	1,000
Carbon-14	100	Chromium-49	1,000
Fluorine-18	1,000	Chromium-51	1,000
Sodium-22	10	Manganese-51	1,000
Sodium-24	100	Manganese-52m	1,000
Magnesium-28	100	Manganese-52	100
Aluminum-26	10	Manganese-53	1,000
Silicon-31	1,000	Manganese-54	100
Silicon-32	1	Manganese-56	1,000
Phosphorus-32	10	Iron-52	100
Phosphorus-33	100	Iron-55	100
Sulfur-35	100	Iron-59	10
Chlorine-36	10	Iron-60	1
Chlorine-38	1,000	Cobalt-55	100
Chlorine-39	1,000	Cobalt-56	10
Argon-39	1,000	Cobalt-57	100
Argon-41	1,000	Cobalt-58m	1,000
Potassium-40	100	Cobalt-58	100
Potassium-42	1,000	Cobalt-60m	1,000
Potassium-43	1,000	Cobalt-60	1
Potassium-44	1,000	Cobalt-61	1,000

Potassium-45	1,000	Cobalt-62m	1,000
Calcium-41	100	Nickel-56	100
Calcium-45	100	Nickel-57	100
Calcium-47	100	Nickel-59	100
Scandium-43	1,000	Nickel-63	100
Scandium-44m	100	Nickel-65	1,000
Scandium-44	100	Nickel-66	10
Scandium-46	10	Copper-60	1,000
Scandium-47	100	Copper-61	1,000
Scandium-48	100	Copper-64	1,000
Scandium-49	1,000	Copper-67	1,000
Titanium-44	1	Zinc-62	100
Titanium-45	1,000	Zinc-63	1,000

Radionuclide	Quantity (μCi)[2]	Radionuclide	Quantity (μCi)[2]
Zinc-65	10	Bromine-74m	1,000
Zinc-69m	100	Bromine-74	1,000
Zinc-69	1,000	Bromine-75	1,000
Zinc-71m	1,000	Bromine-76	100
Zinc-72	100	Bromine-77	1,000
Gallium-65	1,000	Bromine-80m	1,000
Gallium-66	100	Bromine-80	1,000
Gallium-67	1,000	Bromine-82	100
Gallium-68	1,000	Bromine-83	1,000
Gallium-70	1,000	Bromine-84	1,000
Gallium-72	100	Krypton-74	1,000
Gallium-73	1,000	Krypton-76	1,000

Germanium-66	1,000	Krypton-77	1,000
Germanium-67	1,000	Krypton-79	1,000
Germanium-68	10	Krypton-81	1,000
Germanium-69	1,000	Krypton-83m	1,000
Germanium-71	1,000	Krypton-85m	1,000
Germanium-75	1,000	Krypton-85	1,000
Germanium-77	1,000	Krypton-87	1,000
Germanium-78	1,000	Krypton-88	1,000
Arsenic-69	1,000	Rubidium-79	1,000
Arsenic-70	1,000	Rubidium-81m	1,000
Arsenic-71	100	Rubidium-81	1,000
Arsenic-72	100	Rubidium-82m	1,000
Arsenic-73	100	Rubidium-83	100
Arsenic-74	100	Rubidium-84	100
Arsenic-76	100	Rubidium-86	100
Arsenic-77	100	Rubidium-87	100
Arsenic-78	1,000	Rubidium-88	1,000
Selenium-70	1,000	Rubidium-89	1,000
Selenium-73m	1,000	Strontium-80	100
Selenium-73	100	Strontium-81	1,000
Selenium-75	100	Strontium-83	100
Selenium-79	100	Strontium-85m	1,000
Selenium-81m	1,000	Strontium-85	100
Selenium-81	1,000	Strontium-87m	1,000
Selenium-83	1,000	Strontium-89	10

Radionuclide	Quantity (μCi)[2]	Radionuclide	Quantity (μCi)[2]

Strontium-90	0.1	Molybdenum-99	100
Strontium-91	100	Molybdenum-101	1,000
Strontium-92	100	Technetium-93m	1,000
Yttrium-86m	1,000	Technetium-93	1,000
Yttrium-86	100	Technetium-94m	1,000
Yttrium-87	100	Technetium-94	1,000
Yttrium-88	10	Technetium-96m	1,000
Yttrium-90m	1,000	Technetium-96	100
Yttrium-90	10	Technetium-97m	100
Yttrium-91m	1,000	Technetium-97	1,000
Yttrium-91	10	Technetium-98	10
Yttrium-92	100	Technetium-99m	1,000
Yttrium-93	100	Technetium-99	100
Yttrium-94	1,000	Technetium-101	1,000
Yttrium-95	1,000	Technetium-104	1,000
Zirconium-86	100	Ruthenium-94	1,000
Zirconium-88	10	Ruthenium-97	1,000
Zirconium-89	100	Ruthenium-103	100
Zirconium-93	1	Ruthenium-105	1,000
Zirconium-95	10	Ruthenium-106	1
Zirconium-97	100	Rhodium-99m	1,000
Niobium-88	1,000	Rhodium-99	100
Niobium-89m (66 minutes)	1,000	Rhodium-100	100
		Rhodium-101m	1,000
Niobium-89 (122 minutes)	1,000	Rhodium-101	10
	100	Rhodium-102m	10
Niobium-90	10	Rhodium-102	10
Niobium-93m	1	Rhodium-103m	1,000
Niobium-94	100	Rhodium-105	100

Niobium-95m	100	Rhodium-106m	1,000
Niobium-95	100	Rhodium-107	1,000
Niobium-96	1,000	Palladium-100	100
Niobium-97	1,000	Palladium-101	1,000
Niobium-98	100	Palladium-103	100
Molybdenum-90	100	Palladium-107	10
Molybdenum-93m	10	Palladium-109	100
Molybdenum-93		Silver-102	1,000

Radionuclide	Quantity (μCi)[2]	Radionuclide	Quantity (μCi)[2]
Silver-103	1,000	Tin-113	100
Silver-104m	1,000	Tin-117m	100
Silver-104	1,000	Tin-119m	100
Silver-105	100	Tin-121m	100
Silver-106m	100	Tin-121	1,000
Silver-106	1,000	Tin-123m	1,000
Silver-108m	1	Tin-123	10
Silver 110m	10	Tin-125	10
Silver-111	100	Tin-126	10
Silver-112	100	Tin-127	1,000
Silver-115	1,000	Tin-128	1,000
Cadmium-104	1,000	Antimony-115	1,000
Cadmium-107	1,000	Antimony-116m	1,000
Cadmium-109	1	Antimony-116	1,000
Cadmium-113m	0.1	Antimony-117	1,000
Cadmium-113	100	Antimony-118m	1,000
Cadmium-115m	10	Antimony-119	1,000

Cadmium-115	100	Antimony-120	
Cadmium-117m	1,000	(16 minutes)	
Cadmium-117	1,000	Antimony-120	1,000
Indium-109	1,000	(5.76 days)	
Indium-110		Antimony-122	100
(69.1 minutes)	1,000	Antimony-124m	100
Indium-110		Antimony-124	1,000
(4.9 hours)		Antimony-125	10
Indium-111	1,000	Antimony-126m	100
Indium-112	100	Antimony-126	1,000
Indium-113m	1,000	Antimony-127	100
Indium-114m	1,000	Antimony-128	100
Indium-115m	10	(10.4 minutes)	
Indium-115	1,000	Antimony-128	
Indium-116m	100	(9.01 hours)	1,000
Indium-117m	1,000	Antimony-129	
Indium-117	1,000	Antimony-130	
Indium-119m	1,000	Antimony-131	100
Tin-110	1,000	Tellurium-116	100
Tin-111	100	Tellurium-121m	1,000
	1,000		1,000
			1,000
			10

Radionuclide	Quantity (μCi)[2]	Radionuclide	Quantity (μCi)[2]
Tellurium-121	100	Xenon-131m	1,000
Tellurium-123m	10	Xenon-133m	1,000
Tellurium-123	100	Xenon-133	1,000

Tellurium-125m	10	Xenon-135m	1,000
Tellurium-127m	10	Xenon-135	1,000
Tellurium-127	1,000	Xenon-138	1,000
Tellurium-129m	10	Cesium-125	1,000
Tellurium-129	1,000	Cesium-127	1,000
Tellurium-131m	10	Cesium-129	1,000
Tellurium-131	100	Cesium-130	1,000
Tellurium-132	10	Cesium-131	1,000
Tellurium-133m	100	Cesium-132	100
Tellurium-133	1,000	Cesium-134m	1,000
Tellurium-134	1,000	Cesium-134	10
Iodine-120m	1,000	Cesium-135m	1,000
Iodine-120	100	Cesium-135	100
Iodine-121	1,000	Cesium-136	10
Iodine-123	100	Cesium-137	10
Iodine-124	10	Cesium-138	1,000
Iodine-125	1	Barium-126	1,000
Iodine-126	1	Barium-128	100
Iodine-128	1,000	Barium-131m	1,000
Iodine-129	1	Barium-131	100
Iodine-130	10	Barium-133m	100
Iodine-131	1	Barium-133	100
Iodine-132m	100	Barium-135m	100
Iodine-132	100	Barium-139	1,000
Iodine-133	10	Barium-140	100
Iodine-134	1,000	Barium-141	1,000
Iodine-135	100	Barium-142	1,000
Xenon-120	1,000	Lanthanum-131	1,000

Xenon-121	1,000	Lanthanum-132	100
Xenon-122	1,000	Lanthanum-135	1,000
Xenon-123	1,000	Lanthanum-137	10
Xenon-125	1,000	Lanthanum-138	100
Xenon-127	1,000	Lanthanum-140	100
Xenon-129m	1,000	Lanthanum-141	100

Radionuclide	Quantity (μCi)[2]	Radionuclide	Quantity (μCi)[2]
Lanthanum-142	1,000	Promethium-150	1,000
Lanthanum-143	1,000	Promethium-151	100
Cerium-134	100	Samarium-141m	1,000
Cerium-135	100	Samarium-141	1,000
Cerium-137m	100	Samarium-142	1,000
Cerium-137	1,000	Samarium-145	100
Cerium-139	100	Samarium-146	1
Cerium-141	100	Samarium-147	100
Cerium-143	100	Samarium-151	10
Cerium-144	1	Samarium-153	100
Praseodymium-136	1,000	Samarium-155	1,000
Praseodymium-137	1,000	Samarium-156	1,000
Praseodymium-138m	1,000	Europium-145	100
Praseodymium-139	1,000	Europium-146	100
Praseodymium-142m	1,000	Europium-147	100
Praseodymium-142	100	Europium-148	10
Praseodymium-143	100	Europium-149	100
Praseodymium-144	1,000	Europium-150	
Praseodymium-145	100	(12.62 hours)	

Praseodymium-147	1,000	Europium-150 (34.2 years)	100
Neodymium-136	1,000		
Neodymium-138	100	Europium-152m	1
Neodymium-139m	1,000	Europium-152	100
Neodymium-139	1,000	Europium-154	1
Neodymium-141	1,000	Europium-155	1
Neodymium-147	100	Europium-156	10
Neodymium-149	1,000	Europium-157	100
Neodymium-151	1,000	Europium-158	100
Promethium-141	1,000	Gadolinium-145	1,000
Promethium-143	100	Gadolinium-146	1,000
Promethium-144	10	Gadolinium-147	10
Promethium-145	10	Gadolinium-148	100
Promethium-146	1	Gadolinium-149	0.001
Promethium-147	10	Gadolinium-151	100
Promethium-148m	10	Gadolinium-152	10
Promethium-148	10	Gadolinium-153	100
Promethium-149	100	Gadolinium-159	10
			100

Radionuclide	Quantity (μCi)[2]	Radionuclide	Quantity (μCi)[2]
Terbium-147	1,000	Thulium-162	1,000
Terbium-149	100	Thulium-166	100
Terbium-150	1,000	Thulium-167	100
Terbium-151	100	Thulium-170	10
Terbium-153	1,000	Thulium-171	10

Terbium-154	100	Thulium-172	100
Terbium-155	1,000	Thulium-173	100
Terbium-156m (5.0 hours)	1,000	Thulium-175	1,000
		Ytterbium-162	1,000
Terbium-156m (24.4 hours)		Ytterbium-166	100
		Ytterbium-167	1,000
Terbium-156	1,000	Ytterbium-169	100
Terbium-157	100	Ytterbium-175	100
Terbium-158	10	Ytterbium-177	1,000
Terbium-160	1	Ytterbium-178	1,000
Terbium-161	10	Lutetium-169	100
Dysprosium-155	100	Lutetium-170	100
Dysprosium-157	1,000	Lutetium-171	100
Dysprosium-159	1,000	Lutetium-172	100
Dysprosium-165	100	Lutetium-173	10
Dysprosium-166	1,000	Lutetium-174m	10
Holmium-155	100	Lutetium-174	10
Holmium-157	1,000	Lutetium-176m	1,000
Holmium-159	1,000	Lutetium-176	100
Holmium-161	1,000	Lutetium-177m	10
Holmium-162m	1,000	Lutetium-177	100
Holmium-162	1,000	Lutetium-178m	1,000
Holmium-164m	1,000	Lutetium-178	1,000
Holmium-164	1,000	Lutetium-179	1,000
Holmium-166m	1,000	Hafnium-170	100
Holmium-166	1	Hafnium-172	1
Holmium-167	100	Hafnium-173	1,000
Erbium-161	1,000	Hafnium-175	100
Erbium-165		Hafnium-177m	1,000

	1,000		
Erbium-169	1,000	Hafnium-178m	0.1
Erbium-171	100	Hafnium-179m	10
Erbium-172	100	Hafnium-180m	1,000
	100		

Radionuclide	Quantity (μCi)[2]	Radionuclide	Quantity (μCi)[2]
Hafnium-181	10	Rhenium-184	100
Hafnium-182m	1,000	Rhenium-186m	10
Hafnium-182	0.1	Rhenium-186	100
Hafnium-183	1,000	Rhenium-187	1,000
Hafnium-184	100	Rhenium-188m	1,000
Tantalum-172	1,000	Rhenium-188	100
Tantalum-173	1,000	Rhenium-189	100
Tantalum-174	1,000	Osmium-180	1,000
Tantalum-175	1,000	Osmium-181	1,000
Tantalum-176	100	Osmium-182	100
Tantalum-177	1,000	Osmium-185	100
Tantalum-178	1,000	Osmium-189m	1,000
Tantalum-179	100	Osmium-191m	1,000
Tantalum-180m	1,000	Osmium-191	100
Tantalum-180	100	Osmium-193	100
Tantalum-182m	1,000	Osmium-194	1
Tantalum-182	10	Iridium-182	1,000
Tantalum-183	100	Iridium-184	1,000
Tantalum-184	100	Iridium-185	1,000
Tantalum-185	1,000	Iridium-186	100

Tantalum-186	1,000	Iridium-187	1,000
Tungsten-176	1,000	Iridium-188	100
Tungsten-177	1,000	Iridium-189	100
Tungsten-178	1,000	Iridium-190m	1,000
Tungsten-179	1,000	Iridium-190	100
Tungsten-181	1,000	Iridium-192	1
Tungsten-185	100	(73.8 days)	
Tungsten-187	100	Iridium-192m	10
Tungsten-188	10	(1.4 minutes)	10
Rhenium-177	1,000	Iridium-194m	100
Rhenium-178	1,000	Iridium-194	1,000
Rhenium-181	1,000	Iridium-195m	1,000
Rhenium-182	1,000	Iridium-195	1,000
(12.7 hours)		Platinum-186	100
Rhenium-182	100	Platinum-188	1,000
(64.0 hours)	10	Platinum-189	100
Rhenium-184m		Platinum-191	

Radionuclide	Quantity (μCi)[2]	Radionuclide	Quantity (μCi)[2]
Platinum-193m	100	Lead-198	1,000
Platinum-193	1,000	Lead-199	1,000
Platinum-195m	100	Lead-200	100
Platinum-197m	1,000	Lead-201	1,000
Platinum-197	100	Lead-202m	1,000
Platinum-199	1,000	Lead-202	10
Platinum-200	100	Lead-203	1,000
Gold-193	1,000	Lead-205	100

Gold-194	100	Lead-209	1,000
Gold-195	10	Lead-210	0.01
Gold-198m	100	Lead-211	100
Gold-198	100	Lead-212	1
Gold-199	100	Lead-214	100
Gold-200m	100	Bismuth-200	1,000
Gold-200	1,000	Bismuth-201	1,000
Gold-201	1,000	Bismuth-202	1,000
Mercury-193m	100	Bismuth-203	100
Mercury-193	1,000	Bismuth-205	100
Mercury-194	1	Bismuth-206	100
Mercury-195m	100	Bismuth-207	10
Mercury-195	1,000	Bismuth-210m	0.1
Mercury-197m	100	Bismuth-210	1
Mercury-197	1,000	Bismuth-212	10
Mercury-199m	1,000	Bismuth-213	10
Mercury-203	100	Bismuth-214	100
Thallium-194m	1,000	Polonium-203	1,000
Thallium-194	1,000	Polonium-205	1,000
Thallium-195	1,000	Polonium-207	1,000
Thallium-197	1,000	Polonium-210	0.1
Thallium-198m	1,000	Astatine-207	100
Thallium-198	1,000	Astatine-211	10
Thallium-199	1,000	Radon-220	1
Thallium-200	1,000	Radon-222	1
Thallium-201	1,000	Francium-222	100
Thallium-202	100	Francium-223	100
Thallium-204	100	Radium-223	0.1
Lead-195m	1,000	Radium-224	0.1

Radionuclide	Quantity (μCi)[2]	Radionuclide	Quantity (μCi)[2]
Radium-225	0.1	Neptunium-232	100
Radium-226	0.1	Neptunium-233	1,000
Radium-227	1,000	Neptunium-234	100
Radium-228	0.1	Neptunium-235	100
Actinium-224	1	Neptunium-236	
Actinium-225	0.01	(1.15×10^5 years)	0.001
Actinium-226	0.1	Neptunium-236	
Actinium-227	0.001	(22.5 hours)	
Actinium-228	1	Neptunium-237	1
Thorium-226	10	Neptunium-238	0.001
Thorium-227	0.01	Neptunium-239	10
Thorium-228	0.001	Neptunium-240	100
Thorium-229	0.001	Plutonium-234	1,000
Thorium-230	0.001	Plutonium-235	10
Thorium-231	100	Plutonium-236	1,000
Thorium-232	100	Plutonium-237	0.001
Thorium-234	10	Plutonium-238	100
Thorium-natural	100	Plutonium-239	0.001
Protactinium-227	10	Plutonium-240	0.001
Protactinium-228	1	Plutonium-241	0.001
Protactinium-230	0.1	Plutonium-242	0.01

Protactinium-231	0.001	Plutonium-243	0.001
Protactinium-232	1	Plutonium-244	1,000
Protactinium-233	100	Plutonium-245	0.001
Protactinium-234	100	Americium-237	100
Uranium-230	0.01	Americium-238	1,000
Uranium-231	100	Americium-239	100
Uranium-232	0.001	Americium-240	1,000
Uranium-233	0.001	Americium-241	100
Uranium-234	0.001	Americium-242m	0.001
Uranium-235	0.001	Americium-242	0.001
Uranium-236	0.001	Americium-243	10
Uranium-237	100	Americium-244m	0.001
Uranium-238	100	Americium-244	100
Uranium-239	1,000	Americium-245	10
Uranium-240	100	Americium-246m	1,000
Uranium-natural	100		1,000

Radionuclide	Quantity (μCi)[2]	Radionuclide	Quantity (μCi)[2]
Americium-246	1,000	Californium-248	0.01
Curium-238	100	Californium-249	0.001
Curium-240	0.1	Californium-250	0.001
Curium-241	1	Californium-251	0.001
Curium-242	0.01	Californium-252	0.001
Curium-243	0.001	Californium-253	0.1
Curium-244	0.001	Californium-254	0.001
Curium-245	0.001	Einsteinium-250	100
Curium-246	0.001	Einsteinium-251	100

Curium-247	0.001	Einsteinium-253	0.1
Curium-248	0.001	Einsteinium-254m	1
Curium-249	1,000	Einsteinium-254	0.01
Berkelium-245	100	Fermium-252	1
Berkelium-246	100	Fermium-253	1
Berkelium-247	0.001	Fermium-254	10
Berkelium-249	0.1	Fermium-255	1
Berkelium-250	10	Fermium-257	0.01
Californium-244	100	Mendelevium-257	10
Californium-246	1	Mendelevium-258	0.01
Any alpha-emitting radionuclide not listed above or mixtures of alpha emitters of unknown composition		0.001	
Any radionuclide other than alpha-emitting radionuclides not listed above, or mixtures of beta emitters of unknown composition		0.01	

Note

1. The quantities listed in this appendix were derived by taking 1/10th of the most restrictive ALI listed in §336.359, Appendix B, Table I, Columns 1 and 2, of this title (relating to Annual Limits on Intake (ALI) and Derived Air Concentrations (DAC) of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sanitary Sewerage), rounding to the nearest factor of 10, and arbitrarily constraining the values listed between 0.001 and 1,000 microcuries. Values of 100 microcuries have been assigned for radionuclides having a radioactive half-life in excess of 10^9 years (except rhenium, 1,000 microcuries) to take into account their low specific activities.

2. To convert microcuries to kilobecquerels, multiply the microcurie value by 37.

Note. For purposes of §336.326(e) of this title (relating to Posting Requirements), §336.329(a)(1) of this title (relating to Exemptions to Labeling Requirements), and §336.350(a) of this title (relating to Reports of Stolen, Lost, or Missing Licensed Radioactive Material) where there is involved a combination of radionuclides in known amounts, the limit for the combination shall be derived as follows: determine, for each radionuclide in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific radionuclide when not in combination. The sum of ratios for all radionuclides in the combination may not exceed 1.