

# RADIONUCLIDE DATA

## PURPOSE

This procedure provides a ready reference to radiation protection data for commonly used radionuclides. Data for nuclides not listed herein may be obtained from the RSO.

## POLICY

Radionuclide data used for radiation protection calculations shall be obtained from regulatory authorities or reputable scientific advisory organizations.

## DEFINITIONS

**Reference Quantity (RQ):** The exempt quantity of a radionuclide (expressed in microcuries) related to its relative hazard potential and used to prescribe requirements for handling, monitoring, labeling and disposal.

**Removable Contamination Limit (RCL):** A quantity of removable radioactive contamination related to its relative radiotoxicity used to prescribe corrective actions for contamination situations.

**Annual Limit on Intake (ALI):** The quantity of a radionuclide (expressed in millicuries) which, if taken into the body, produces an effective dose equivalent in risk to the annual whole body dose limit of 5 rems. Because of differences in physiological transport mechanisms, the ALIs vary depending on the route of intake. For purposes of contamination control and bioassay procedures, the ALI for ingestion is used, since that is the most common route of accidental intake in research laboratories.

## Dose Rates (mrem/hour):

**Penetrating** - the dose rate from photons at 1 meter from a point source of 1 millicurie, assumed to be proportional to the inverse of the square of the distance between the point source and the receptor.

**Skin dose** - dose rate to the basal epidermal cells from contamination on the skin, expressed in microcuries per unit area of skin ( $\mu\text{Ci}/\text{cm}^2$ ) over an area of at least 1  $\text{cm}^2$ .

## REFERENCES

International Commission on Radiological Protection, *Recommendations of the ICRP*, Publ. No. 26, 1977.

*Ibid.*, *Limits for Intakes of Radionuclides by Workers*, Publ. No. 30, in 4 parts with supplements, 1979-88.

Kocher, D.C.; Eckerman, K.F. Electron dose-rate conversion factors for external exposure of the skin from uniformly deposited activity on the body surface, *Health Physics* 53:135-141, 1987.

US Environmental Protection Agency, *Limiting of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, Federal Guidance Report No. 11, EPA-520/1-88-020, September 1988.

Utah Division of Radiation Control, *Utah Radiation Control Rules, Standards for Protection Against Radiation*, R313-15.

## RPR 10A. RADIONUCLIDE CATEGORIES AND DATA

(For data on radionuclides not listed below, contact the RSO.)

<u>Nuclide</u>	<u>Half-life</u>	<u>Reference Quantity (<math>\mu</math>Ci)</u>	<u>Ingestion ALI (mCi)</u>	<u>Dose rates (mrem/hour):</u>	
				<u>Penetrating At 1 meter from 1 mCi</u>	<u>Skin dose at 0.07 mm per <math>\mu</math>Ci/cm<sup>2</sup></u>

"LO-BETAS" - low-energy beta or electron emitters with negligible external exposure potential and ALI's  $\geq 1$  millicurie.

H-3	12 yrs	1000.	80.	0.	
C-14	5730 yrs	100.	2.	0.	1200
P-33	<b>25.4 days</b>	100.	6.	0.	
S-35	<b>87 days</b>	100.	6.	0.	1300
Cl-36	$3 \times 10^5$ yrs	10.	2.	0.	7200
Ca-45	165 days	10.	2.	0.	
Cr-51	<b>28 days</b>	1000.	40.*	0.02	
Fe-55	2.7 yrs	100.	9.	0.	
Ni-63	100 yrs	10.	9.	0.	
Tc-99	$2 \times 10^5$ yrs	10.	4.	0.	
Pm-147	2.6 yrs	10.	4.	0.	

"HI-BETAS" - high-energy beta emitters with negligible gamma emission but capable of significant *bremsstrahlung* production if not properly shielded. Emphasis is on control of doses to extremities and prevention of intake.

P-32	<b>14.3 days</b>	10.	0.6	0.	8900
Rb-86	<b>18.7 days</b>	100.	0.5	0.05	
Sr-90	28.6 yrs	0.1	0.03	0.	
Y-90	64.1 hours	10	0.4*	0.	8862

"IODINES" - radioiodines are treated as a separate category for exposure evaluation. Emphasis is on prevention of intake by ingestion or inhalation.

I-125	<b>60 days</b>	1.	0.04	0.07	
I-129	$6 \times 10^9$ yrs	0.1	0.005	0.13	
I-131	<b>8 days</b>	1.	0.03	0.22	6300

"GASES" - noble gases present minimal exposure potential or waste disposal problems.

Kr-85	10.7 yrs	100.	NA	0.	
Xe-133	<b>5.2 days</b>	100.	NA	0.1	

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"NATURAL" - naturally occurring nuclides, primarily alpha emitters. Emphasis is on prevention of intake by ingestion or inhalation.

Th-232 (nat)	14x10 <sup>9</sup> yrs	100.	0.0007	0.	
U-238 (nat)	4.5x10 <sup>9</sup> yrs	100.	0.001	0.	

"GAMMAS" - gamma emitters with ALI  $\geq$  1 millicurie; emphasis is on external exposure control and monitoring.

Na-24	<b>0.625 days</b>	10.	4.	1.89	
Mn-54	312 days	10.	2.	0.51	
Co-57	271 days	100.	4.*	0.15	290
Ga-67	<b>3.3 days</b>	100.	7.	0.11	1100
Ga-68	<b>68 min</b>	100.	20.	0.54	
Ge-68	288 days	100.	5.	0.06	
Sr-85	<b>64.8 days</b>	10.	3.*	0.75	55
Nb-95	<b>35 days</b>	10.	2.*	0.48	970
Mo-99	<b>2.8 days</b>	100.	1.	0.11	
Tc-99m	<b>0.25 days</b>	100.	80.	0.12	890
Ru-103	<b>39 days</b>	10.	2.*	0.33	2400
In-111	<b>2.8 days</b>	100.	4.*	0.5	1400
Sn-113	115 days	10.	2.*	0.18	
I-123	<b>0.542 days</b>	100.	3.	0.28	
Gd-153	242 days	10.	5.*	0.17	460
Au-195	183 days	10.	5.	0.09	
Hg-195m	<b>1.7 days</b>	10.	2.	0.1	
Hg-197	<b>2.7 days</b>	100.	3.	0.07	
Au-198	<b>2.7 days</b>	100.	1.	0.29	
Tl-201	<b>3 days</b>	100.	20.	0.09	970
Pb-203	<b>2.2 days</b>	10.	5.	0.68	

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				<u>Penetrating At 1 meter from 1 mCi</u>	<u>Skin dose at 0.07 mm per <math>\mu</math>Ci/cm<sup>2</sup></u>

**ALL OTHER NUCLIDES** not included in one of the above groups are assumed to have significant potentials for both external and internal exposures and must be evaluated individually.

Na-22	2.6 yrs	10.	0.4	1.33	7200
Sc-46	<b>84 days</b>	10.	0.9*	1.17	5100
Fe-59	<b>44.6 days</b>	10.	0.8	0.66	4600
Co-60	5.27 yrs	1.	0.2	1.37	
Zn-65	244 days	10.	0.4	0.33	
Se-75	118 days	10.	0.5	0.86	360
Ru-106	367 days	1.	0.2	0.	
Cd-109	453 days	10.	0.3*	0.18	
Ir-192	<b>74 days</b>	10.	0.9	0.59	
Hg-203	<b>47 days</b>	10.	0.5	0.25	

\* The ALI is not applicable to microspheres, which are highly insoluble particles, typically greater than 0.01 mm diameter. They require external exposure control and monitoring, but are not readily absorbed from the gastrointestinal tract. If inhaled, because of their size, they are most likely to be deposited in the upper respiratory tract, from which they would be cleared by the mucous transport and swallowed.

# RPR 10B. CONTAMINATION LIMITS AND ACTION LEVELS<sup>1</sup>

<u>NUCLIDE CATEGORY</u>	<u>REMOVABLE CONTAMINATION LIMIT (RCL)<sup>2</sup></u>
Beta and/or gamma emitters:	
with ingestion ALI $\geq$ 1 mCi	2,000 dpm per 100 cm <sup>2</sup>
with ingestion ALI $<$ 1 mCi	200 dpm per 100 cm <sup>2</sup>
Alpha-particle emitters:	20 dpm per 100 cm <sup>2</sup>

Non-Removable Contamination Limit (NCRL) is the RCL multiplied by 5.

<u>LOCATION</u>	<u>QUANTITY</u>	<u>REQUIRED ACTION</u>
Skin or hair	Any	Immediate removal by gentle washing
	$>$ 1 RCL	Immediate removal and bioassay <sup>3</sup> within normal interval
	$>$ 10 RCL	Immediate removal and bioassay <sup>3</sup> within 5 days
Clothing, personal or protective	$>$ 1 RCL	Do not remove clothing from the lab; wash in the lab or store for decay of activity
Skin contact likely	$>$ 10 RCL	Bioassay <sup>3</sup> within five (5) days
Skin contact unlikely	$>$ 10 RCL	Bioassay <sup>3</sup> within normal interval
Surfaces or objects that are readily accessible or normally touched, e.g. bench tops, handles, etc.	$>$ 1 RCL	Until decontaminated, isolate, cover, label, etc. to prevent personnel contact; indicate location and activity in survey record.
	$>$ 10 RCL	Decontaminate immediately; bioassay <sup>3</sup> required within normal interval for potentially exposed individuals
	$>$ 100 RCL	Decontaminate immediately; bioassay <sup>3</sup> required within 5 days for potentially exposed individuals
Equipment or facilities to be released for unrestricted use	$>$ 0.5 RCL removable; $>$ 5 RCL fixed	Do not release until criteria are satisfied
Other surfaces or objects (not readily accessible or normally touched)	$>$ 1 RCL	Label the contaminated area or object; indicate location and activity on survey record
	$>$ 10 RCL	Decontaminate within one week

<sup>1</sup> Based on NRC Reg. Guide 8.23, Radiation Safety Surveys at Medical Institutions, Rev. 1, Jan. 1981.

<sup>2</sup> All contamination is presumed to be removable until proven otherwise. The limits are expressed as activity per 100 square centimeters, rounded to one significant figure. For all surfaces except skin, the contamination may be averaged over no more than 300 cm<sup>2</sup> for determining the appropriate action.

<sup>3</sup> All requirements for bioassays in this table are for screening bioassays.