

<b>RADIONUCLIDE SAFETY DATA SHEET</b>					
<b>RADIONUCLIDE: Zr-89</b>			<b>FORMS: Soluble</b>		
<b>PHYSICAL CHARACTERISTICS</b>					
HALF-LIFE: 78.4 hours					
<b>DECAY EMISSIONS</b>					
Gammas / X-rays		Betas / Positrons (+) / Electrons*		Alphas	
E (keV)	%	E (keV, Ave)	%	E (keV)	%
909	99	395(+)	23		
511	46	13*	15		
15	41	15*	5		
17	7				
- Only 4 most probable emissions per decay type included. Emissions below 10 keV or 1% excluded.					
<b>STANFORD HAZARD CATEGORY</b>					
C – level (low hazard): ≤ 20 mCi					
B – level (moderate hazard): > 20 mCi, ≤ 1 Ci					
A – level (high hazard): > 1 Ci					
<b>EXTERNAL RADIATION HAZARDS</b>			<b>INTERNAL RADIATION HAZARDS</b>		
Gamma dose rate, point source at 1 ft, 1 mCi: <b>6.16 mrem/h</b>			Annual Limit on Intake: <b>2000 µCi</b> (Ingestion) <b>2000 µCi</b> (Inhalation)		
Beta dose rate to skin, point source at 1 ft, 1 mCi: ~ <b>70 mrem/h</b> (thumb rule approx.)			The values above indicate the activity taken into the body that would result in either 5 rem to the whole body (CEDE) or 50 rem to an organ or tissue (CDE).		
Contamination skin dose, uniform deposit of 1 µCi per cm <sup>2</sup> : ~ <b>2800 mrem/h</b> (estimate from Mn-52 data)					
<b>SHIELDING</b>			<b>DOSIMETRY AND BIOASSAY REQS</b>		
<b>Gammas/X-rays:</b> 3 cm of lead will reduce the gamma dose rate by 90%.			Whole-body and finger-ring dosimeters are required for handling <b>5 mCi</b> or more, or <b>1 mCi amounts weekly</b> . Urine assays may be required after large spills or contaminations.		
<b>Betas/electrons:</b> 4.5 mm of plastic will absorb all emissions. Bremsstrahlung may be created and require additional shielding.					
<b>SPECIAL PROBLEMS AND PRECAUTIONS:</b>					
<ol style="list-style-type: none"> <li>1. Recommended survey probe: <b>PGM, NaI</b></li> <li>2. Always wear protective gloves, a lab coat, and safety eyewear to protect the skin and eyes from contamination. Change gloves often.</li> <li>3. Survey work areas before, during, and after work. Work areas may require shielding to keep dose ALARA. Instrument and smear surveys are required.</li> <li>4. Segregate waste to those with half-lives of between <b>1 and 8 days</b>. Survey the waste disposal area to ensure exposure rates are less than 2 mR/hr at 1 foot.</li> <li>5. Limit soluble waste to the sewer to less than <b>100 µCi/day</b> per lab.</li> </ol>					

**References:**

- Delacroix, D., Guerre, J.P., Leblanc, P., Hickman, C. (2002). Radionuclide and Radiation Protection Data Handbook (2<sup>nd</sup> ed.). Ashford, Kent: Nuclear Technology Publishing.
- Johnson, T.E., Birky, B.K. (2012). Health Physics and Radiological Health (4<sup>th</sup> ed.). Baltimore, MD: Lippincott Williams & Wilkins.
- ICRP, 2008. Nuclear Decay Data for Dosimetric Calculations. ICRP Publication 107. Ann. ICRP 38 (3).
- Peplow, D. (2020) Specific Gamma-Ray Dose Constants with Current Emission Data. *Health Physics*, 118(4):402-416; 2020.
- Smith, D., Stabin, M. (2012) Exposure Rate Constants and Lead Shielding Values for Over 1,100 Radionuclides. *Health Physics*, 102(3): 271-291.
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