

## SAFETY PROTOCOL: SEALED SOURCES

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(For assistance, please contact EHS at (402) 472-4925, or visit our web site at <http://ehs.unl.edu/>)

Sealed source means radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material (NDHHS 180 NAC 1).

Use of radioactive materials requires a safety protocol be submitted to the UNL Radiation Safety Committee (RSC) for approval. This is a safety protocol. To obtain RSC approval:

- Submit an **Authorization for Radioactive Material Use** request for approval by the UNL RSC. Contact the UNL Radiation Safety Officer (RSO) for specific instructions.
- Agree to use this safety protocol or submit an alternative and equivalent procedure that you develop to meet your unique needs.

All radiation workers must be at least 18 years of age and have completed required radiation safety training. ***Never handle radioactive material prior to the completion of radiation safety training.***

All research protocols involving radioactive material must be approved by the RSC.

***This safety protocol is applicable only to those sources listed in Table 1. The use of other sealed sources requires development of specific safety protocols and RSC approval.***

### REGULATORY REQUIREMENTS

Regulatory requirements for the use of sealed sources can be found in chapters 1, 3 and 4 of Title 180 NAC (Nebraska Regulations for the “Control of Radiation”).

### RADIATION PROTECTION PROCEDURES

The following safety and security protocols shall be implemented when working with sealed sources:

1. Implement good ALARA practices (time, distance and shielding) to minimize exposure when using sealed sources.
2. Wear gloves when working with a plated or deposited source. Monitor hands and

fingers after handling a plated or deposited source. Plated or deposited sources will require an appropriate radiation detection instrument.

3. Do not touch an active surface of a plated or deposited source with your fingers.
4. Wash hands after handling plated or deposited sources.
5. Do not eat or drink in rooms where sealed sources are stored or used.
6. Leak tests (as required) and physical inventories are performed every 6 months. These activities are scheduled and performed by the Radiation Safety Office.
7. If required by the Radiation Safety Office, dosimeters shall be worn when working with sealed sources.
8. Sealed sources must be locked in a secured container or secured storage area when not in use.
9. Any room in which a sealed source is used must be locked when unattended.
10. Sealed sources are not to be removed from the authorized location of use or used in any other area/location without prior amendment of the associated license.
11. Sealed sources shall not be removed from designated shielding without prior approval from the Radiation Safety Office.
12. Contact the Radiation Safety Office (472-2157) immediately if you:
  - Find a sealed source missing.
  - Suspect that you have received a significant exposure to radiation.
  - Suspect that the radioactive source is leaking or damaged.
13. All sealed sources must be purchased through the Radiation Safety Office (including exempt quantity sources).

The properties of and precautions for commonly used sealed sources at UNL are provided in Table 1.

**Table 1. Properties and precautions for commonly used sealed sources at UNL.**

Sealed Source	Description
<p>Am-241  1.2 <math>\mu</math>Ci Alpha particle standard</p>	<ul style="list-style-type: none"> <li>• T1/2 = 432 years</li> <li>• Primary Emissions – Alpha particles @ 5.49 (85%) and 5.44 (13%) MeV; X-ray @ 0.060 MeV</li> <li>• Delicate plated source</li> <li>• Never touch the plated surface, as this can result in the removal of radioactive material; wear gloves when handling</li> <li>• No leak test requirement</li> <li>• Little exposure concern if used properly</li> </ul>
<p>Sr-90  1.0 <math>\mu</math>Ci Beta particle standard</p>	<ul style="list-style-type: none"> <li>• T1/2 = 28.5 years</li> <li>• Primary Emissions – Beta particles @ 0.546 (max) and 2.27 (max) MeV</li> <li>• Evaporated metallic salt</li> <li>• Extremely thin and delicate aluminized Mylar backing and cover (easily torn or damaged if directly handled); wear gloves when handling</li> <li>• No leak test requirement</li> <li>• Little exposure concern if used properly</li> </ul>
<p>Sr-90  39 to 72 mCi Calibration sources for thermoluminescence/ Optically Stimulated Luminescence Readers</p>	<ul style="list-style-type: none"> <li>• T1/2 = 28.5 years</li> <li>• Primary Emissions – Beta particles @ 0.546 (max) and 2.27 (max) MeV</li> <li>• Leak tests required; personal dosimetry required</li> <li>• Never remove sources from readers</li> </ul>
<p>Cs-137  87 <math>\mu</math>Ci Gamma-ray standard</p>	<ul style="list-style-type: none"> <li>• T1/2 = 30.2 years</li> <li>• Primary Emissions – Beta particle @ 0.514 (max) and 1.176 (max) MeV; Gamma ray @ at 0.662 MeV</li> <li>• RAM capsulated in plastic</li> <li>• Leak tests required</li> <li>• Dose rate at 1 meter = 0.33 rem/hr per Ci</li> <li>• Good ALARA practices (time, distance and shielding) should be implemented</li> </ul>
<p>Cs-137  49 mCi Gamma-ray source</p>	<ul style="list-style-type: none"> <li>• T1/2 = 30.2 years</li> <li>• Primary Emissions – Beta particle @ 0.514 (max) and 1.176 (max) MeV; Gamma ray @ at 0.662 MeV</li> <li>• Leak tests required; personal dosimetry required</li> <li>• Dose rate at 1 meter = 0.33 rem/hr per Ci</li> <li>• Good ALARA practices (time, distance and shielding) should be implemented</li> </ul>

**Table 1. Continued**

Sealed Source	Description
<p>Cs-137</p> <p>322 mCi Compton scattering sources</p>	<ul style="list-style-type: none"> <li>• T1/2 = 30.2 years;</li> <li>• Primary Emissions – Beta particle @ 0.514 (max) and 1.176 (max) MeV; Gamma ray @ at 0.662 MeV</li> <li>• Leak tests required; personal dosimetry required</li> <li>• Dose rate at 1 meter = 0.33 rem/hr per Ci</li> <li>• Never remove source from experimental shielding</li> </ul>
<p>Cs-137</p> <p>478 mCi Instrument calibration source</p>	<ul style="list-style-type: none"> <li>• T1/2 = 30.2 years</li> <li>• Primary Emissions – Beta particle @ 0.514 (max) and 1.176 (max) MeV; Gamma ray @ at 0.662 MeV</li> <li>• Leak tests required; personal dosimetry required</li> <li>• Dose rate at 1 meter = 0.33 rem/hr per Ci</li> <li>• Never remove source from shielding; ensure shutter is closed and locked when not in use.</li> </ul>
<p>Cf-252</p> <p>95 µCi Neutron standard</p>	<ul style="list-style-type: none"> <li>• T1/2 = 2.646 years</li> <li>• Primary Emissions – alpha particles (96.9%) and spontaneous fission products (3.1%)</li> <li>• Spontaneous fission produces fast neutrons (2000 n/s per µCi), fission fragments and progeny radiation</li> <li>• Leak tests required; personal dosimetry required</li> <li>• Dose rate at 1 meter = 3.2 rem/hr per Ci</li> <li>• Never remove source from shield</li> <li>• Materials exposed to neutrons may become radioactive through activation</li> </ul>
<p>H-3</p> <p>1.6 Ci Deuterium-Tritium neutron generator</p>	<ul style="list-style-type: none"> <li>• T1/2 = 12.28 years</li> <li>• Primary Emissions – Beta particles with a maximum energy of 19 keV</li> <li>• The radiation emitted from the decay of H-3 cannot escape the instrument</li> <li>• Instrument when operating can produce dangerous levels of neutron radiation</li> <li>• Leak tests required; personal dosimetry required when operating</li> </ul>