University of Nebraska Lincoln

Safe Operating Procedure

(Revised 8/19)

SAFETY PROTOCOL: SEALED SOURCES

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 (DHHS, 180 NAC 1). Certain sealed sources (e.g., electron capture detectors) are generally licensed with the State of Nebraska (see the EHS SOP, ***Electron Capture Detectors and Other Generally Licensed Radioactive Material Containing Devices***). Safety protocols for the use of ^{241}Am (Be) sealed sources in neutron gauges is provided in the EHS SOP, ***Safety Protocol: ^{241}AM (Be) Neutron Probe***.

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 **Application for Radioactive Material Use** 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.

Certain sealed sources with radioactivity content in exempt quantities (e.g., survey instrument check sources) may be used without approval from the UNL RSC. When using exempt quantity sealed sources, instruction provided herein must be followed.

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 or device without prior approval from the Radiation Safety Office.

12. Contact the Radiation Safety Office at (402) 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).

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

Sealed Source	Description
Am-241	• T1/2 = 432 years • Primary Emissions – Alpha particles @ 5.49 (85%) and 5.44 (13%) MeV; X-ray @ 0.060 MeV • For plated sources, never touch the surface, as this can result in the removal of radioactive material; wear gloves when handling plated sources • Leak testing required for sources greater than 10 μCi; Dosimetry may be required.
Sr-90	• T1/2 = 28.5 years • Primary Emissions – Beta particles @ 0.546 (max) and 2.27 (max) MeV • Leak tests required for sources greater than 100 μCI; personal dosimetry required • Skin dose rate at 30 cm = 0.73 mrem/hr per μCi • Never remove sources from OSL readers • Good ALARA practices (time, distance and shielding) should be implemented
Cs-137	• T1/2 = 30.2 years • Primary Emissions – Beta particle @ 0.514 (max) and 1.176 (max) MeV; Gamma ray @ at 0.662 MeV • RAM capsulated in plastic • Leak tests required for sources greater than 100 μCi; personal dosimetry required • Dose rate at 1 meter = 0.33 rem/hr per Ci • Good ALARA practices (time, distance and shielding) should be implemented
Cf-252	• T1/2 = 2.646 years • Primary Emissions – alpha particles (96.9%) and spontaneous fission products (3.1%) • Spontaneous fission produces fast neutrons (2000 n/s per μCi), fission fragments and progeny radiation • Leak tests required; personal dosimetry required • Dose rate at 1 meter = 3.2 rem/hr per Ci • Never remove source from shield • Materials exposed to neutrons may become radioactive through activation
Ho-166m	• T1/2 = 1230 years • Decay by β- (100%) • Primary Emissions – Gamma @ 0.184 MeV (72.6%), 0.810 MeV (56.9%) and others • Leak tests required; personal dosimetry required • Dose rate at 1 meter = 9.05 rem/hr per Ci • Good ALARA practices (time, distance and shielding) should be implemented