

SAFETY PROTOCOL: ²⁴¹AM (BE) NEUTRON PROBE

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

Use of ²⁴¹Am (Be) neutron probes (gauge) 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 gauge users must be at least 18 years of age and have completed required radiation safety training. ***Never operate or handle a neutron gauge prior to the completion of radiation safety training.***

Physical Data

Am-241

Alpha = 5.49 MeV (85%), 5.44 MeV (13%)

Gamma = .060 MeV (36%)

Half-life = 458 yrs

Half value layer for lead shielding = 0.04 mm (0.002 inch)

In addition, the combination of Am-241 and Be produces neutrons of approximately 4.5 MeV at a rate of approximately 2200 neutrons/second per mCi of Am-241

Radiation Protection Procedures

Standard Operating Procedures

- Before removing the gauge from its place of storage, ensure that, where applicable, each gauge source is in the fully shielded position and that in gauges with a movable rod containing a sealed source, the source rod is locked (e.g., keyed lock, padlock, mechanical control) in the shielded position. Place the gauge in the transport case and lock the case.

- Sign out the gauge in a log book (that remains at the storage location) including the date(s) of use, name(s) of the authorized users who will be responsible for the gauge, and the temporary jobsite(s) where the gauge will be used. Log the gauge into the log book when it is returned to storage.
- Block and brace the gauge to prevent movement during transport and lock the gauge in or to the vehicle. Follow all applicable Department of Transportation (**DOT**) requirements when transporting the gauge (discussed later in this safety protocol).
- Use the gauge according to the manufacturer's instructions and recommendations.
- Do not touch the unshielded source rod with your fingers, hands, or any part of your body.
- Do not place hands, fingers, feet, or other body parts in the radiation field from an unshielded source.
- Unless absolutely necessary, do not look under the gauge when the source rod is being lowered into the ground. If you must look under the gauge to align the source rod with the hole, follow the manufacturer's procedures to minimize radiation exposure.
- Verify the integrity of the connection between the source and cable prior to use to ensure the source does not separate from the cable.
- After completing each measurement in which the source is unshielded, immediately return the source to the shielded position.
- Always maintain constant surveillance and immediate control of the gauge when it is not in storage. At job sites, do not walk away from the gauge when it is left on the ground. Take actions necessary to protect the gauge and yourself from danger of moving heavy equipment.
- Always keep unauthorized persons away from the gauge.
- Perform routine cleaning and maintenance according to the manufacturer's instructions and recommendations.
- When the gauge is not in use at a temporary jobsite, place the gauge in a secured storage location (e.g., locked in the trunk of a car or locked in a storage shed). Return the gauge to its proper locked storage location at the end of the work shift.
- If gauges are used for measurements with the unshielded source extended more than 3 feet beneath the surface, use piping, tubing, or other casing material to line the hole from the lowest depth to up to 12 inches above the surface. If the piping, tubing, or other casing material needs to be less than 12 inches above the surface (e.g., in order to avoid interference with farm equipment in the field), cover the hole liner or take other steps to ensure that the hole is free of debris and it is unlikely that debris will re-enter the cased hole. In addition, the deepest end of the casing must be closed to ensure the gauge source would be contained in the casing if it became disconnected from the control wire.
- After making changes affecting the gauge storage area (e.g., changing the location of gauges within the storage area, removing shielding, adding gauges, changing the occupancy of adjacent areas, moving the storage area to a new

location), reevaluate compliance with public dose limits and ensure proper security of gauges.

Emergency Procedures

If the source fails to return to the shielded position (e.g., as a result of being damaged, source becomes stuck below the surface) or if any other emergency or unusual situation arises (e.g., the gauge is struck by a moving vehicle, is dropped, is in a vehicle involved in an accident):

- Immediately secure the area and keep people at least 15 feet away from the gauge until the situation is assessed and radiation levels are known. However, perform first aid for injured individuals and remove them from the area only when medically safe to do so.
- If any heavy equipment is involved, detain the equipment and operator until it is determined there is no contamination present.
- Gauge users and other potentially contaminated individuals should not leave the scene until emergency assistance arrives.
- Notify the persons in the order listed below of the situation:

Name	Work	Cellular	Home
Joel Webb, RSO	402-472-2157	402-304-5333	402-465-9153
UNL Police	402-472-3555	NA	NA

- Follow the directions provided by the person contacted above.

Additional Emergency Procedures RSO and Authorized User

- As necessary, arrange for a radiation survey to be conducted as soon as possible by a knowledgeable person using appropriate radiation detection instrumentation. To accurately assess the radiation danger, it is essential that the person performing the survey be competent in the use of the survey meter.
- Arrange to have the source and access tube excavated as necessary to free the source. This should be done in such a way that the source integrity is not compromised. Source excavation may be done by directly withdrawing the access tube if possible, or by excavating the area near the tube and removing it. Dosimetry and radiation survey equipment shall be used in order to minimize the dose to the operators.
- If required by Title 180, Chapter 1 sections 004.51, 004.52, or 004.53, make reports to State officials.

Shielding Requirements

The gauge is self-shielded and under normal use, does not require additional shielding.

Surface Contamination Survey Schedule

Semi-annual leak tests of the neutron probe will be coordinated by the UNL Radiation Safety staff.

Bioassay Requirements

Bioassays are not required for users of neutron gauges.

Dosimetry

Neutron gauge users will be issued neutron dosimetry that must be worn when using the neutron probe. Extremity dosimetry is not required.

Waste Disposal

Surplus neutron probes shall be returned to the UNL Radiation Safety Office for proper disposal.

Survey Meters

A survey meter is not required for routine work with neutron probes.

Major DOT Regulations and Transportation Procedures

Per 180 NAC 13-005.01, the following requirements apply to “each licensee who transports licensed material outside of the site of usage, as specified in the Agency license, or where transport is on public highways.”

A “special form certification” must be maintained on file by the authorized user of the neutron gauge.

Gauges typically contain White I or Yellow II quantities of radioactive material. Therefore, a vehicle does not require a placard during transport of the neutron gauge.

A commercial driver’s license is not required to transport typical neutron gauges.

A neutron gauge must be blocked and braced during transport and cannot be transported in the passenger compartment of the vehicle.

Radiation safety and HAZMAT training are required for individuals involved in the use and transport of gauges. HAZMAT refresher training is required every three years.

Neutron gauges must be transported in a type “A” package. Type “A” testing results for the transport package must be maintained on file.

Markings and labels must be durable, legible, in English, and printed on or affixed to the package surface (e.g., a label, tag or sign).

Required markings include:

- Shipping name (ex.: radioactive material, special form, n.o.s., class 7)
- RQ (for gauges with an Am-241: Be source > 10 mCi); add to shipping name
- Identification number (ex.: UN3332)
- Package type (ex.: Type A)

Required labels include:

- Two DOT warning labels (ex: RADIOACTIVE YELLOW II) on opposite sides of the package
- Listing the package's contents and activity in SI and customary units
- The package's Transportation Index (the TI is the maximum dose rate in mrem/hr at one meter from the surface of the package).

Shipping papers are required whenever the gauge is transported off university property via public roads. Shipping papers consist of a bill of lading, operating procedures and emergency procedures.

A bill of lading, listing the below information, will be in the vehicle and immediately accessible to the driver during transport:

- Name of shipper.
- Description of shipment [proper shipping name, RQ (if applicable) identification number, hazard class, type of package, name and activity of each nuclide, category of labeling and Transport Index].
- Emergency response telephone number (manned by knowledgeable personnel or person with immediate access to knowledgeable personnel).
- Shipper's certification.
- Signature of shipper.

Attached is a "Bill of Lading" which can be used. Source type, source activity, and TI may differ from gauge to gauge. The "RQ" requirement applies only to sources containing americium.

Operating and emergency procedures will accompany the shipping papers. This safety protocol serves as the operating and emergency procedures. A copy of this protocol shall be included with the shipping papers.

If a gauge requires return to the manufacturer for repair or service, contact the RSO for assistance in preparing the gauge for shipment.

BILL OF LADING

Shipper: _____

RQ, Radioactive material, special form, n.o.s. 7, UN3332
TYPE "A" package, containing:

Cs-137, ____ GBq (____ mCi)

Am-241: Be, ____ GBq (____ mCi)

RADIOACTIVE YELLOW II Label, TI = _____

EMERGENCY CONTACT INFORMATION

Name	Work	Cellular	Home
Joel Webb, RSO	402-472-2157	402-304-5333	402-465-9153
UNL Police	402-472-3555	NA	NA

This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.

Shipper: _____ Date: _____
(Signature)