

2. Radiation Safety

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2.1. General

Radioactive material use at DOT&PF is bound by the limits and requirements established in the DOT&PF's NRC Radioactive Materials License. This license imposes limits on the quantities, types, and forms of radioactive materials that can be possessed and outlines specific requirements for DOT&PF's Radiation Protection Program. All aspects of the purchasing, use, and disposal of radioactive materials must comply with the terms of the DOT&PF's Radioactive Materials License and State of Alaska laws and regulations.

This section of the manual outlines the requirements and procedures for DOT&PF's purchase and use of radioactive materials.

2.2. Audit Program

To comply with the requirements of 10 CFR 20.1101, 10 CFR 20.2102 and the NRC Radioactive Materials License, each of the regional programs, and the statewide program must be audited annually. In addition, the RRSO conducts unannounced audits of gauge users in the field to verify compliance with the Radiation Protection Program.

The SRSO audits the Radiation Protection Program for each region annually and must complete the audit no later than December 31 of each year. Conduct the

audit in accordance with NUREG 1556 Vol. 1 "Portable Gauge Audit Checklist" (Appendix D). The RRSO must address any deficiencies, and forward a record of all corrective actions taken to the SRSO within 60 days of the completion of the audit.

The State Materials Engineer or their designee must audit the SRSO program no later than June 30 of each year. The SRSO must address any deficiencies, and forward a record of all corrective actions to the State Materials Engineer within 60 days of the completion of the audit.

RST members may make unannounced random audits of gauge users in the field. Make a record of the audit detailing items or procedures inspected, any deficiencies noted and corrective actions taken, and include it in the gauge operator's permanent record. Forward copies to the SRSO for inclusion in the licensee's files.

Keep all records of audits for a minimum of three years from the date of the audit. Records include the date of the audit, audit findings, corrective actions, and follow-up.

2.3. Gauge Receipt and Accountability (Including Registration with Dept. of Health)

The DOT&PF Radioactive Material License requires an active inventory of all of its radioactive sources. To ensure compliance with this requirement, notify the SRSO prior to the purchase, receipt, or disposal of any radioactive material. The SRSO must review all requests for purchase or disposal of radioactive materials to ensure that the possession limits of source types are within the scope of the license. The SRSO must also review all requests for disposal to ensure that disposals are made by properly licensed parties. Anticipate all purchases of nuclear gauges in advance so that a review and amending of the license, if required, can be completed prior to purchasing.

The SRSO must approve in writing nuclear gauge requisition or disposal requests prior to purchase or disposal. The approval will identify the make, model, source, and quantity.

Assess the storage facility to verify that the additional source(s) will not exceed the regulatory ALARA

requirements, notably the 100 mrem/yr and 2 mrem/hr requirement for the general public.

When the new gauge is received, set up a gauge file with the shipping documents, certificate of competent authority, current leak test results, initial calibration records, sealed sources and devices certificate, and emergency procedures. Add the gauge to the regional inventory and forward a record of the receipt to the SRSO within seven days.

Notify the State of Alaska Department of Health and Social Services of the new gauge(s) by submitting a completed Registration Form – Radioactive Materials (Appendix G) within seven days of the acquisition.

Retain all records pertaining to the gauge for three years after its final disposition.

The RRSO must inventory all sealed sources at least every six months. Inventory records must include the nuclear isotope and quantity, manufacturer's name, model number, serial number of both the gauge and the source, location of the gauge, and the date of the inventory. Forward a copy of the physical inventory to the SRSO within seven days of completion.

2.4. Occupational Dose

All DOT&PF personnel who have been trained and who have been approved to work with the nuclear gauges will receive either a film badge or a thermoluminescent dosimeter, which they are required to wear when working with a nuclear gauge. This will allow the SRSO and the RRSO to verify that the exposures are within the regulatory limits and that our program is functioning according to the principles of ALARA.

The data collected by personal dosimeters are for department use only. None of our employees are likely to have received annual radiation doses in excess of 10 percent of the regulatory required limit and therefore use of personal dosimeters is required by regulation. A memo is on file with the SRSO describing the method used to verify the use of personal dosimeters.

All DOT&PF personnel who participate in the nuclear gauge program must receive radiation safety training. This will include but is not limited to those who use nuclear gauges and transport them, and those who prepare gauge documents for shipment.

Prior to allowing an authorized nuclear gauge user to begin work, the RRSO must request exposure

information from prior employment. In complying with this request, the RRSO may accept a written signed statement from the employee stating the occupational dose he or she received during that year, a signed statement from the employee's former employer stating the nature and amount of the occupational dose the individual received during the current year, a completed NRC Form 4 or equivalent, or copies of the individual's dose reports. The RRSO may receive documents by fax, letter, or electronic media. In the absence of this information, the RRSO will assume the gauge user has received 1250 mrem/quarter toward the allowable exposure of 5000 mrem/year for the year in which the gauge user is hired.

If a dosimeter is lost or stolen, report it to the RRSO within 48 hours. The RRSO will report the loss to the SRSO quarterly and assign a temporary dosimeter until a replacement is received.

The authorized user performs a personal exposure investigation under the direction of the RRSO. The estimated dose is reported to the dosimeter provider so that the YTD dose can be updated.

The personal exposure investigation establishes an estimated dose by multiplying the estimated hours the gauge was in close proximity (30 cm) to the gauge user times the dose rate at (30 cm). Calculate the time with the following assumptions: Assign five minutes for each density test taken and 10 minutes for each loading/unloading into storage.

If the individual performed other functions, i.e. leak testing, cleaning gauges, etc., estimate and add these functions to the estimated dose.

A National Voluntary Laboratory Accreditation Program (NVLAP) approved processor will supply and process dosimeters.

When the holder of a dosimeter is not working with or around the nuclear gauges, the worker must store the dosimeter in way that exposes it only to background radiation, out of direct sunlight, and away from heat or nuclear sources not being used by the wearer during occupational activities, i.e. x-rays, and sources not related to licensee work.

The doses received by authorized users wearing a dosimeter will be monitored so the total annual dose does not exceed 5000 mrem.

The RRSO must review quarterly dosimeter reports within 48 hours of receipt. When the measured quarterly dose is more than 150 mrem/quarter, the RRSO must notify the SRSO immediately and begin an investigation. The investigation reviews when and where the dosimeter has been worn, where it is stored, and any possible sources of exposure. The RRSO will notify the SRSO within seven days of receipt.

The SRSO will issue each authorized nuclear gauge user an annual report noting the total dose received during the previous year. The SRSO will deliver the report no later than March 31 of the year following the exposure year.

2.5. Public Dose

Monitor transportation, use and storage so that the general public is not exposed to more than 100 mrem/year and 2 mrem in any one hour at 30 cm. Demonstrate the exposure levels at storage sites according to Section 2.14.

Maintain constant surveillance over gauges that are not in storage and secure stored gauges from unauthorized removal or use to ensure the public dose is not exceeded.

2.6. Embryo/Fetus Dose

Authorized users are encouraged to notify supervision when pregnant, however, declaration of pregnancy is voluntary and implies a willingness to abide by lower dose limits for the protection of the embryo/fetus and accept temporary changes in work schedules, location, or assignments.

All declarations of pregnancy shall be made in writing to the individual's supervisor, the RSO, or the personnel department and shall include the estimated date of conception. A sample form for declaring pregnancy is contained in Appendix 3.5. A doctor's statement is not required. A woman may withdraw a declaration of pregnancy at any time by providing written notice.

Upon declaration of pregnancy, an evaluation shall be performed to determine the potential for the employee to exceed the regulatory exposure limit during the nine-month gestation period. If the potential for exposure in excess of the dose limits exists, the employee may be transferred to a different job assignment.

Declared pregnant women with the potential to exceed 50 mrem during the course of pregnancy shall be assigned a TLD badge.

Dose to an embryo/fetus of a declared pregnant woman shall not exceed 500 mrem during the entire pregnancy.

If the dose to an embryo/fetus is found to have exceeded 450 mrem by the time the woman declares the pregnancy, additional dose to the embryo/fetus shall not exceed 50 mrem during the remainder of the pregnancy.

If a woman does not declare pregnancy, she will be subject to the normal occupational exposure limits.

2.7. Operating and Emergency Procedures

2.7.1. Operating Procedure

- All gauge operators shall wear a dosimeter when working with and around the nuclear gauges. Nuclear gauge operators may wear only the dosimeter that is issued to them.
- Before removing a gauge from storage, verify that the source is in the locked position and that the gauge is properly secured in the locked transport case.
- Sign the gauge out on the gauge's utilization/transportation log and indicate date, individual removing the gauge from storage, and the location where the gauge is to be used.
- Block or brace the gauge so that the gauge cannot move during transport, and lock the gauge to the vehicle using two independent, tangible barriers. Follow all current applicable U.S. Department of Transportation (USDOT) requirements when transporting the gauge. This includes but is not limited to sealing the gauge case with a seal that is evidence that the case has not been opened (zip ties are acceptable).
- Do not touch the unshielded source with fingers, hands, or any part of the body.
- Do not place fingers, hands, feet, or any part of the body in the radiation field from an unshielded source.
- Follow the manufacturer's instruction for lowering the source into the hole for testing.
- After completing the final measurement, immediately return the source to the shielded position.

- Maintain constant surveillance and immediate control of the gauge when the gauge is unsecured. At the job site, do not walk away from the gauge and leave it on the ground. Protect yourself and the gauge from danger of moving heavy equipment.
- Keep unauthorized persons at least three feet away from the gauge. Exceptions can be made for individuals viewing data after a test. Keep these exceptions as brief as possible.
- Perform cleaning and routine maintenance according to the manufacturer's instructions.
- When the gauge is not in use (and under the constant surveillance of the radiation worker) on a temporary job site, keep the gauge secured by locking it in an RRSO-approved storage site.
- Return the gauge to its proper, secured storage area at the end of each work shift.
- Log the gauge in the gauge's utilization/transportation log when it is returned to storage.
- After making changes to the gauge storage area (such as changing locations in the storage area, adding gauges, changing occupancy of adjacent areas, and moving the storage area to a new location), reevaluate compliance with public daily dose limits and ensure proper security of the gauges. Proper security includes maintaining two independent, tangible barriers. If changes are initiated by the authorized user, they must notify the RRSO prior to making any changes in the storage of a nuclear gauge.

unshielded (e.g. the gauge locking mechanism on the handle becomes damaged)

- 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)

If any of these conditions exist, the following actions must be taken:

- Immediately secure the area (i.e. cordon off with rope, etc.) 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 any injured people and remove them from the immediate area only when it is medically safe.
- Notify the RRSO and the SRSO. The NRC must be notified of the incident within 24 hours. If the gauge was part of an event such as a fire or explosion, the NRC must be notified within four hours.
- Inspect the gauge to determine the extent of the damage to the source(s), source housing, and shielding. **Do not attempt to remove the gauge until a technician authorized in using a survey meter has completed a radiation survey and determined the source is shielded or the exposed rod is contained in a lead shielding pig.**
- If any heavy equipment is involved, immediately detain the equipment and the operator until it is determined there is no contamination present.
- Gauge users and other potentially contaminated individuals should not leave the scene until released by the RRSO, the SRSO, or the State of Alaska Department of Health and Social Services representative.

2.7.2. Emergency Procedures

Damaged Gauge or Source Rod

A gauge or source rod is considered damaged if any of the following conditions exist:

- If the source fails to return to the shielded position (e.g. as a result of being damaged, source becomes stuck below the surface)
- Gauge internals are exposed from damage, or if the source could inadvertently become

Name	Work Number	Home Number	Cell Phone Number
Jeanne Dirks—Central Region RSO	(907) 269-0469		(907) 244-7231
Carl Heim—Northern Region RSO	(907) 460-2894		
Pat Harmon—Southeast Region RSO	(907) 465-1797		

If unable to contact the RRSO, contact the following:

Name	Work Number	Home Number	Cell Phone Number
Greg Christensen—Statewide RSO	(907) 269-6248	(907) 357-7055	(907) 529-0598
Troxler – Gauge Manufacturer	(919) 549-9539		
NRC—24 hour hot line	(301) 816-5100	N/A	N/A
Clyde Pearce—Chief, Radiological Health Program— State of Alaska Dept. of Health	(907) 334-2100		

Theft or Loss of a Gauge

- Immediately notify the RRSO. The RRSO should then contact the SRSO and the police. The SRSO will contact the NRC, the Department of Health and Social Services and Troxler.
- For lost gauges, where practical, initiate a search after making notifications.

Fire

- Immediately call the Fire Department.
- Take appropriate action to protect personnel. **Remember, this is your first priority!**
- Notify the RRSO as soon as possible. Notification to the NRC must be made immediately or not to exceed four hours after the incident.
- Stand by to advise firefighters of the nature, location, and potential hazard of the radioactive materials. **Do not leave the scene.** Supply firefighters with all necessary information regarding facility layout, gauge storage area, number of gauges, etc. Be sure to include any other potential hazards present such as chemicals, explosives, guard dogs, locked doors, etc.

**Figure 2-1
Melting Points**

Gauge Technical Information	
Temperatures from most industrial fires will normally range from 500 °F near floor level up to 1800° F near ceiling height. These temperatures are high enough to melt the Lexan plastic gauge cover and the lead shielding around the source rod. The aluminum housing around the gauge bottom and containing the Am-241/Be source would only melt in the most severe fire. The double stainless steel capsules in which the Cs-137 and Am-241/Be sources are sealed would not reach their melting point.	
Melting Points of Nuclear Gauge Construction Materials	
Stainless steel	2550° F
Aluminum	1005° F
Lead	620 ° F
Lexan and Poly	257° F

Responsibilities of the RRSO and SRSO

- Arrange for a radiation survey as soon as possible by an authorized person using a survey meter. This could be the RRSO, the SRSO, or a consultant. To accurately assess the radiation danger, it is essential that the person performing the survey be competent in the use of the survey meter.
- The SRSO will notify authorities as required including:
 - Notify the Department of Health and Social Services through the emergency number listed above of any potential radiation hazards.
 - NRC notification is required when gauges containing licensed material are stolen, lost, or involved in accidents that involve exposures in excess of 10 CFR 20.2203 limits
 - When it becomes apparent that attempts to recover a source stuck below the surface will be unsuccessful
 - If the gauge is involved in a fire or explosion; or if the source rod cannot be returned to its shielded position

The 10 CFR 20.2203 limits and time requirements are:

- Report immediately if the total effective dose exceeds 25 rems, the lens dose exceeds 75 rems, or the shallow dose to the skin or extremities exceeds 250 rads.
- Report within 24 hours if a person's total effective dose exceeds 5 rems or the lens dose exceeds 15 rems or the shallow dose to the skin or extremities exceeds 50 rems.
- Use the phone numbers listed above to report to the NRC.

2.8. Leak Tests and Inventory

Only personnel who have been instructed in performing leak tests shall conduct them. Perform leak tests at the frequency required by the specific Sealed Source and Device Registry. Perform positive visual match inventories at least every six months. The leak testing must be done in accordance with service provider's procedures. The leak test kits will

be supplied and processed by a processor who is NRC approved.

- Perform leak tests at the direction of the RRSO and send them to the NRC-approved processor.
- The SRSO will audit the RRSO to ensure that all gauges were leak tested within the time limit required.
- If the RRSO does not perform the leak testing or inventory within the intervals specified, the SRSO will secure the gauge(s) from use and report a violation to the RST. The gauges will not be released for use until the SRSO has finalized their investigation and all issues have been resolved.
- The RRSO will forward to the SRSO a copy of the Leak Test Certificate within seven days of receipt from the service provider.
- The RRSO must conduct a physical inventory of all sealed sources at least every six months. Inventory records must include the nuclear isotope(s) and quantity, model number, serial number of both the gauge and the source, and the date of the inventory. Forward a copy of the physical inventory to the SRSO within seven days of completion.

2.9. Maintenance

Licensee personnel will clean, lubricate, and perform routine maintenance according to instructions of the gauge manufacturer and the NRC license. All routine maintenance must follow ALARA principles. Authorized licensee personnel, gauge manufacturers, or licensed service providers will do non-routine maintenance.

2.10. Transportation

Transport of nuclear gauges must be according to the requirements of USDOT and International Air Transport Association (IATA).

- Source rods must be in the locked position and secured with a padlock on the trigger mechanism.
- Gauges must be locked and secured in the vehicle, and the transport container sealed.
- Transport containers must be secured from movement and locked to the vehicle in such a

manner as to have two independent security measures that must be defeated before the gauge can be removed from the vehicle.

- Gauge placement in the vehicle must be secured as far from the driver and passengers as possible, observing distance requirements dictated by the Transportation Index (TI).
- The transportation case must have all signage required by USDOT and/or IATA, depending the transportation method, and it must be legible (See Appendix A).
- The RRSO will maintain all shipping records and keep them for a minimum of three years from the date of shipping.

2.11. License Termination

Dispose of licensed materials in accordance with NRC regulations.

- Notify the NRC within 60 days when the gauges have not been used for 24 months, or a decision is made to permanently cease licensed activities.
- Certify the disposition of the licensed materials by submitting NRC Form 314 according to NRC instructions.
- Before a license is terminated, send the records important to decommissioning, including survey maps and facility drawings, to the appropriate NRC regional office.

2.12. Survey Instruments

2.12.1. Calibration

Monitoring equipment must be routinely calibrated against standard radiation fields to determine the equipment's detection efficiency. The meter manufacturer or an NRC-approved service provider will calibrate survey instruments annually. Place a calibration sticker on each instrument indicating:

- Calibration date
- Next calibration due date
- Serial Number of meter

Calibrate new survey meters prior to use.

Calibration Documentation

Maintain documentation of all radiation instrumentation calibrations for a minimum of five years and include:

- The owner/user of the equipment
- A description of the equipment (i.e. manufacturer, model, serial number)
- A description of the calibration source(s)
- The calculated and actual exposure rate at each calibration point
- Battery check reading (if applicable)
- The angle between the radiation flux field and the detector (parallel or perpendicular for external detectors and the angle for internal detectors)
- Calibration results, correction factors, and/or efficiencies as applicable.
- The name of the person who performed the calibration and the date the calibration was performed
- Statement demonstrating the meter was calibrated against a standard(s) that is traceable to National Institute of Standards and Technology (NIST).

2.13. Surveys

Radioactive materials may be stored only in areas that have been approved by the RRSO. The RRSO must be kept informed of all changes in storage areas and will provide assistance in the selection of these areas as requested to ensure compliance with ALARA and NRC regulations.

A new survey is required when one of the following changes occur:

- The number of gauges increases beyond the number used in the survey
- The gauge storage is relocated or the geometry of the storage changes
- A new gauge storage area is established
- There is a change in the occupancy of the area

Personnel trained and competent in the use of the survey meter will perform surveys. Turn on the survey meter and perform checks on the battery and high voltage output. Check the survey meter for response by passing it into a known radiations field such as that surrounding a nuclear gauge.

Surveys must be done within 24 hours of storing a gauge at the selected location to verify compliance. The survey will include a map showing the storage area and surrounding structures, as well as the geometry of the gauges if multiple gauges will be stored.

If the storage is in a remote location and a visit by the RRSO within 24 hours is not practical, the number, type, and geometry may be reconstructed by the RRSO in a location of their convenience. They will forward the results of the survey including the geometry and distances of measurement to the storage location for posting.

Forward a copy of the survey to the SRSO within five days of completing the survey and verifying regulatory compliance. Include both unrestricted and restricted measurements. Post survey maps and results at the storage location.

If surveys indicate radiation levels in excess of 100 mrem/year or 2 mrem/hour, the SRSO will investigate to determine if members of the public have been exposed to radiation levels in excess of public dose limits.

2.14. Demonstration of Compliance

Demonstration of compliance of exposure limits for members of the public is required. This may be achieved by showing that the member of the public most likely to receive the highest dose is within the regulatory limit. List assumptions made regarding the distance to the individual, time the individual is present, and the time the gauge is in storage when the individual is present.

2.15. Signage and Postings

Storage site signage must conform to NRC regulations. Post the storage container or housing with an approved “Caution—Radiation Area” sign bearing the radiation symbol if at 30 cm the radiation levels exceed 5 mrem/hr. Post a “Caution—Radioactive Materials” sign in the immediate area or on the door of the storage cabinet or closet. Label and mark transport cases to comply with USDOT and IATA requirements. See Appendix A.

Post all information required by 10 CFR 19.11. Post in a sufficient number of places so that radiation workers can see them as they go about licensed activities. Required postings include NRC Form 3, the NRC license with attachments, this manual, and any violations and responses from the licensee.

Also listed in 10 CFR 19.11 are a number of documents that may not be practical to post due to size, including 10 CFR 19 and 10 CFR 20, and it is acceptable to post a sign indicating where they are kept.

2.16. Enforcement Policy for Radiation Safety Infractions

The enforcement policy for radiation safety infractions is designed to inform DOT&PF personnel of the sanctions that may be imposed for various radiation safety infractions, cited either during regular inspections or during periodic spot checking. The policy will assist the Radiation Safety Team in assigning enforcement actions to the infractions. The policy is based on Nuclear Regulatory Commission guidance.

The list of infractions that can result in sanctions includes but is not limited to

- Loss or improper use of personal dosimeter
- Improper storage practices
- Improper transportation practices
- Lack of control and constant surveillance during use of the gauge.
- Violations of ALARA

The progression of actions taken for the above infractions will be (progression may be escalated for infractions of danger to health, safety or security):

- Coaching
- Coaching with remedial actions/training
- Coaching with mandatory/supervised actions
- Removal/Suspension of Authorized User status

A record of actions taken for infractions will be completed as follows:

- Coaching – memo to file
- Coaching with remedial actions/training – record of training including time, date, and participants
- Coaching with mandatory /supervised actions – record of all actions taken signed by both the RRSO and the authorized user
- Removal/Suspension of Authorized User status – Record of the removal of access to licensed materials. Copy of the record will be forwarded the SRSO and the RRSO of all regions.

This enforcement policy applies only to access and use of licensed materials by department employees and is separate from any disciplinary actions that may result from personnel actions taken by other supervisory personnel.