

**Tennessee Department of Transportation**  
**Division of Materials and Tests**  
**Standard Operating Procedure 7-2**  
**Nuclear Gauge Safety Plan**

**Purpose** - The purpose of this document is to establish guidelines on nuclear density gauge daily usage, gauge transportation, and outline an Emergency Response Plan for TDOT Radiation Safety Technicians. A TDOT Radiation Safety Technician is an individual who has successfully completed the TDOT Radiation Safety training and demonstrated a basic understanding of radiation safety and compliance, nuclear density gauge operation, testing procedures, and maintenance.

**Background**- Tennessee Radioactive Material License No. R-19017-K26 requires that TDOT technicians attend the appropriate training to operate and transport nuclear density gauges. The license also requires TDOT to have a radiation safety emergency response plan.

Each Regional Materials and Tests Office has a regional Radiation Safety Officer (RSO) as well as the Statewide RSO in Headquarters Materials and Tests. **Each gauge operator is responsible for knowing the current contact information of their Regional RSO. Each operator is also responsible for knowing how to transport and handle the nuclear density gauge according to Federal and State Laws and per SOP 7-2. Not following the below statements could result in TDOT and the operator receiving fines and loss of our Radioactive Materials License.**

**1 Storage Site:**

- 1.1 The gauge handle trigger shall be locked, and the gauge stored in its transportation case. Troxler/InstroTek gauge handle trigger shall be locked with a Master Lock P-581 or P-812. Humboldt gauge handle trigger shall be locked with the American Series 1100 only.
- 1.2 The transport case shall be locked with a LSDA Lock only.
- 1.3 **Keys to the transportation case and gauge shall not be stored with the gauge or in the storage building.**
- 1.4 The gauge and transport case shall be stored at least 15ft (5 m) from work areas, in a locked storage area in a dry location (indoors).
- 1.5 The storage area shall be marked with a radiation sign that reads "CAUTION RADIOACTIVE MATERIALS" (can be obtained from HQ RSO).
- 1.6 Do not store a nuclear gauge in a motor vehicle.
- 1.7 A log of all gauges stored at the site will be maintained at the storage site. All gauges must be signed in when stored and signed out by the operator when in use.
- 1.8 All storage sites will maintain a **SIGN IN/OUT LOG** with name of operator, signature of operator, date signed out/in, and time signed out/in contract number/ location of test site. This log will be maintained by storage site manager and will be readily available for inspection. Sign in/out log sheets will be provided by the HQ RSO as needed.
- 1.9 Storage site must be enclosed (four walls and a roof) and it must protect gauges from the elements.
- 1.10 Only nuclear gauges are allowed to be stored inside the storage site. No tools/equipment/debris of any kind is allowed to be placed inside the storage site. **(Unless approved by HQ RSO)**

## 2 Inspections:

- 2.1 Inspect the gauge before use to ensure proper operation of all safety features as follows:
  - 2.1.1 Push the source rod down into the backscatter position, and then raise it back to the SAFE (shielded) position. The source rod opening in the bottom of the gauge is equipped with a spring- loaded tungsten sliding block that shuts when the source rod is in the SAFE position. Turn the gauge over and verify that the sliding block is completely shut. **If any portion of the opening is uncovered, notify your Regional RSO or HQ RSO immediately. DO NOT REMOVE THE BOTTOM PLATE TO REPAIR.**
  - 2.1.2 **DO NOT TRANSPORT** the gauge unless the sliding block is completely closed. Increased radiation levels will violate transportation regulations and cause excessive personal radiation exposure.
  - 2.1.3 If a radiation survey instrument is available, verify that the radioactive gamma source is in place by measuring the exposure rate at the surface of the gauge. If the exposure rate is not in the approximately range of 10 - 20 mrem per hour contact the Regional RSO and discontinue use of the gauge until further notice.

## 2.2 Biannual Inspection

- 2.2.1 Gauges shall be leak tested every April and October. The Regional RSO shall conduct a 'swipe' test and submit the sample to the HQ RSO within 15 days after receiving their test packets. HQ RSO will login each test sample and submit all samples to the lab for testing. In conjunction with the 'swipe' test, the Regional RSO will conduct an inventory of all gauges assigned to their region. This means that the gauge must be physically located and accounted for. Inventory list will be completed by the Regional RSO with their signature (electronic signature is acceptable) and date of inspection, once completed forward a copy to HQ/TDOT RSO. The gauge tools and equipment will be inventoried at this time as well and all missing items reported to the HQ RSO.

## 3 Operator Certification and Monitoring:

- 3.1 All TDOT personnel that are required to operate a nuclear density gauge will need to possess a TDOT Hazmat Certificate.
- 3.2 TDOT Hazmat Certificate is only valid for **3** years. It is the responsibility of the individual to ensure their certification is valid.
- 3.3 All TDOT operators will be assigned a Bluetooth monitoring dosimeter badge for their duration as a nuclear density gauge operator. The operator must wear their assigned dosimeter badge while operating and/or transporting the nuclear gauge. Dosimeter badges may not be shared between individuals and may only be used by the person who is named on the dosimeter badge.
- 3.4 Any TDOT personnel that will be near a nuclear density gauge will need to be assigned a dosimeter badge. They will also need to possess a TDOT Hazmat Certificate.
- 3.5 It is the responsibility of the operator to keep up with their assigned dosimeter badge. In the event their dosimeter badge has become lost or damaged, it will be the operator's responsibility to notify their regional RSO immediately.
- 3.6 All badge personnel are to ensure your Bluetooth badge connects to the server every Monday to download readings. The following two options will be available to connect to the server.
  - 3.6.1 Install the Instadose Mobile App and connect via Bluetooth.

- 3.6.2 Connect via Intralinks Hotspot located inside the local office near the gauge storage site.
- 3.7 RSOs will notify any personnel with an abnormal weekly radiation exposure reading greater than 50 millirems. TDOT's annual whole body exposure dose limit is 5 rems.

#### 4 Transporting Nuclear Gauge to Project

- 4.1 Inspect the tungsten slide block to ensure it is properly closed (see section 2 Inspections above).
- 4.2 The gauge handle trigger shall be locked in the safe position with the specific lock covered in 1.1.
- 4.3 The nuclear gauge shall be placed inside the transportation case and the transportation case shall be locked with an **LSDA LOCK** only.
- 4.4 Operator will ensure the transportation case is packaged per the manufacturers closure instructions before transporting gauge. (See "TYPE A EVALUATION/CERTIFICATION" in gauge red shipping folder)
- 4.5 **All gauge tools** (drill rod, scraper plate and standard block) **must be** always stored in the transportation case.
- 4.6 Inspect transportation case to ensure the case is not damaged (holes, cracks, missing handles, broken or missing latches, etc.). If damaged, **DO NOT USE gauge and report damage to your regional RSO.**
- 4.7 Inspect transportation case to ensure all labels are undamaged, readable, and in their proper place. **DO NOT** transport gauge with missing or damaged labels. If labels are missing or damaged notify your Regional RSO.
  - There should be one red and white "USA DOT 7A TYPE A" label on top of the transportation case.
  - One red and white "USA DOT 7A TYPE A" label and one yellow and black "RADIOACTIVE II" label on the hinge side of the transportation case.
  - One yellow and black "RADIOACTIVE II" label on the latch side of the case.
  - Ensure the "TRANSPORT INDEX" number is readable and correct for the gauge.
    - Troxler = 0.3
    - Instrotek = 0.5
    - Humboldt = 0.2
- 4.8 Transport the nuclear gauge in the rearmost part of the bed of a truck inside either:
  - 4.8.1 Under a **locked** bed cover with the device secured in place with heavy chain to prevent the case from being easily removed and to prevent the case from moving more than ½ inch in any direct. Chain will be secured to the bed of the truck through both side handles and top handle, if present, to prevent the case from being opened and gauge being removed while secured, OR
  - 4.8.2 A mounted transportation box, specifically designed for the nuclear gauge case or one that has been approved by your RSO with two forms of locks. In either case, ensure the gauge will not move more than a ½ inch in any direction while being transported.
  - 4.8.3 The bed cover and/or mounted transportation box shall be **LOCKED** at all times while the gauge is being transported.
  - 4.8.4 TDOT is required to have a minimum of 2 forms of security barriers while transporting a gauge in our trucks.
  - 4.8.5 The transportation case lock IS NOT a form of security barrier.
  - 4.8.6 Transporting the gauge any other way will violate our transportation license agreement.

- 4.8.7 Gauges are not allowed to be permanently stored in a vehicle. The gauge must be returned and signed back to its permanent storage building once the project(s) testing it was signed out for is completed.
- 4.8.7.1 In the event the gauge will be used for multiple projects in a given day/week, it must be returned to its permanent storage building and signed in when the last test is completed for the work week.
- 4.8.7.2 At no time will any gauge be stored inside an employee/operator home of residence.
- 4.9 No one other than **DOSIMETER BADGE WEARER with HAZMAT TRAINING** is allowed in the vehicle while the nuclear gauge is in the vehicle.
- 4.10 While in transit, the following paperwork must be in the vehicle and readily accessible by the driver:
- Nuclear gauge shipping paper (Red & White BOL)
  - Proof of Operator's Hazmat Certification (Accessible electronic copy is acceptable)
- 4.11 The following will be maintained in the red folder assigned to the gauge and updated as required:
- TDOT Radiation Safety Plan (SOP 7-2)
  - IAEA Certificate
  - Current Leak Test (No more than 6 months old)
  - Manufacturers Closure Report
- 4.12 At any time the vehicle is parked while the gauge is stowed for transit, the shipping paper must be placed face up in the driver's seat or driver's side dashboard.

## 5 Operating Nuclear Gauge at the Project

- 5.1 See SOP 7-1 for instructions on how to calibrate and run tests.
- 5.2 Only remove the nuclear gauge from the transportation case when testing.
- 5.3 If the gauge is unsecured (i.e., not stored for transport per section 4 or stored per section 1), it shall be in the possession of the operator. The nuclear gauge must never be left unattended.
- 5.4 If it becomes necessary to move between locations inside the project, lock the handle into the SAFE position and place the nuclear gauge into the transport case and place in the rear of truck bed. At no time will the nuclear gauge be placed into the cab of the truck.
- 5.5 When the nuclear gauge is in operation/testing only the gauge operator will be near the gauge. All other personnel must be a minimum of 30' away from the gauge when testing. Only exception to this will be the RSO, the RSO may be with the operator while testing.
- 5.6 Once the operator has set the gauge and it is reading, the operator must be a minimum distance of 3' away from the gauge.

## 6 Emergency Response Plan: In the event of a Missing, Stolen, Vehicle Accident, or Damaged Nuclear Gauge adhere to the following procedure:

- 6.1 **In the event of a missing gauge:**
- 6.1.1 Call the Regional RSO and TDOT RSO.
  - 6.1.2 Regional RSO will start an investigation immediately.
  - 6.1.3 TDOT RSO will contact the regulatory agency.
- 6.2 **In the event of a stolen gauge:**
- 6.2.1 Call the police to file a report.
  - 6.2.2 Call the Regional RSO and TDOT RSO.
  - 6.2.3 Regional RSO will start an investigation immediately.

- 6.2.4 TDOT RSO will contact the regulatory agency.
- 6.3 **In the event of a non-injury vehicle accident while transporting a nuclear density gauge:**
  - 6.3.1 Call First Responders as needed and required per TDOT.
  - 6.3.2 Check gauge to ensure it is still secure and not damaged.
  - 6.3.3 Take pictures of gauge and transportation case.
  - 6.3.4 Call Regional RSO.
  - 6.3.5 Regional RSO will provide a written report to the TDOT RSO with pictures, gauge serial number, and any damaged that occurred to the gauge or case within 72 hrs. of accident.
- 6.4 **In the event the gauge operator is incapacitated in a major vehicle accident while transporting a nuclear density gauge: (After first responders are notified)**
  - 6.4.1 Operators' supervisor will secure and inspect the gauge.
  - 6.4.2 Supervisor will need to take pictures of the gauge and transportation case.
  - 6.4.3 Supervisor will notify Regional RSO and report any damage to the gauge or transportation case.
  - 6.4.4 Regional RSO will direct supervisor on what to do next and will go to the scene of the accident.
  - 6.4.5 Regional RSO will notify the TDOT RSO immediately of any major damage of the gauge or transportation case.
  - 6.4.6 Regional RSO will provide a detailed written report to the TDOT RSO with pictures, gauge serial number and any damage that occurred to the gauge or case within two weeks after the date of the accident.
- 6.5 **In the event of physical damage to the gauge at the worksite:**
  - 6.5.1 **Priority Response Actions To Be Taken By Gauge Operator:**
    - 6.5.1.1 Render aid as necessary for lifesaving, first aid, control of fire and other hazards. (Note: Radiation presents minimal risks to lives of persons during transportation accidents. Packages identified as "Type A" by markings on the shipping containers contain only non-life endangering amounts of radioactive materials.
    - 6.5.1.2 Visually inspect gauge for damage, including visual inspection of source rod.
    - 6.5.1.3 Determine if sources are or can be placed in their shielded positions.
    - 6.5.1.4 Locate sources if separated from the gauge. **DO NOT TOUCH OR MOVE RADIOACTIVE SOURCES.** Locate, mark, and secure but do not pick up with bare hands.
    - 6.5.1.5 Secure Area – Evacuate an area of at least a 15 ft. radius around the damaged gauge and/or radioactive sources. (Note: if a source cannot be located, evacuate and secure an area large enough to include any possible locations where the source might be located).
    - 6.5.1.6 Prevent entry by all unauthorized persons into the evacuated area.
    - 6.5.1.7 If a vehicle or construction equipment is involved in the incident, detain the equipment until it is determined that there is no contamination.
    - 6.5.1.8 As soon as possible notify your Regions RSO of the incident.
    - 6.5.1.9 Describe in detail the incident, condition of the gauge, and actions taken.
    - 6.5.1.10 Follow any additional instructions given by the RSO as soon as possible.
- 6.6 **Actions to Be Taken by the Region RSO**
  - 6.6.1 Give additional advice to gauge operator (if needed).
  - 6.6.2 Notify the police, fire, or other emergency agencies as needed or required.

- 6.6.3 Notify the TDOT RSO Rocky Kelley 615-924-6254.
- 6.6.4 **Travel to the accident site and perform the following:**
  - 6.6.4.1 Confirm the actions taken by the operator to be correct.
  - 6.6.4.2 Conduct a visual inspection of the gauge, shielding, and source rod to determine if radioactive sources are still in the gauge.
- 6.6.5 **If radioactive sources are found to be missing, or damage to the shielding is suspected:**
  - 6.6.5.1 Use survey meter to conduct a radiation survey of the gauge to assess the integrity of the source encapsulation and shielding. Compare the survey radiation levels to the gauge radiation profile. If the reading is greater than the listed values, you can suspect that the source shielding has been violated.
  - 6.6.5.2 If source(s) are not present in the gauge, perform the necessary surveys to locate and properly secure the source(s). (Note: DO NOT pick up radioactive sources with your hands. Use tongs or pliers to place the source in a properly shielded container. Container may be a source “pig”. The source may also be returned to the gauge shielding if uncompromised).
  - 6.6.5.3 Perform a leak test on the gauge and source rod.
  - 6.6.5.4 With gauge sources at least 30 feet away, check leak test filters with a survey meter and proceed as follows: If the wipe shows a reading greater than background reading, STOP all other actions. Leave any suspected contaminated material in the secured area and notify the appropriate regulatory agency. Increase the secured area and maintain security until proper authorities arrive.
  - 6.6.5.5 If no contamination is found, notify the HQ/TDOT RSO and request permission to transport the gauge. Once gauge has been approved for transporting, any involved vehicle or equipment may be released and the secure area re-opened.
  - 6.6.5.6 Document all actions taken, or not taken, and provide sketches and/or photos.
- 6.7 **Follow Up Actions Taken by TDOT Radiation Safety Officer:**
  - 6.7.1 TDOT RSO will notify the Tennessee Department of Environmental Conservation Division of Radiological Health (TDEC) at (615) 532-0364.
  - 6.7.2 The TDOT RSO will notify the following as needed or if required:
    - TEMA: 1 (800) 262-3300
    - Troxler 24-Hour Hazmat Emergency: (919) 549-9539
    - Humboldt 24-Hour Hazmat Emergency: 1 (800) 535-5053
    - Instro-Tek 24-Hour Hazmat Emergency: 1 (800) 535-5053 #83301
    - U.S. DOT: 1 (800) 424-8802
  - 6.7.3 Take photos of the damaged gauge prior to shipping for repairs or disposal.
  - 6.7.4 Place gauge in secure storage location until approved for shipment to manufacturer if needed.
  - 6.7.5 Notify the gauge manufacturer of gauge damage and accident.
  - 6.7.6 Send photos of the gauge along with leak test info to the manufacturer for clearance and shipping instructions.
  - 6.7.7 Document any actions and instructions given for records.
  - 6.7.8 Notify by telephone or mail/email ALL regulatory agencies as required of post-accident corrective actions and safety precautions taken.

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- 6.7.9 Ship the damaged gauge to manufacturer per instructions given. (Note: NEVER ship a damaged nuclear gauge until it has been leaked tested and the wipe cleared).
- 6.7.10 Review accident causes and measures taken.
- 6.7.11 Review guidelines to prevent similar future occurrences.