



OFFICE OF MATERIALS MANAGEMENT RADIATION SAFETY MANUAL 2023



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PREFACE

The Ohio Department of Transportation has been issued a license by the Ohio Department of Health for the procurement, possession and usage of radioactive materials. Continuation of this license requires that ODOT maintain an effective Radiation Safety Program. This Radiation Safety Manual has been prepared and established as the official guide in all matters related to radiation protection and control for the Ohio Department of Transportation (ODOT), in order to comply with State and Federal regulations.

The Ohio Department of Transportation has established a policy, which is intended to assure that employee and public exposure to ionizing radiation remains AS LOW AS REASONABLY ACHIEVABLE (ALARA). To accomplish this goal, ODOT has instituted strong administrative and physical control over radioactive material stored, transported, or used by the Department. This radiation safety manual follows set guidelines for training, transportation, protection and all other rules which apply to this area, as set by the Ohio Department of Health.

All questions concerning the information or guidelines contained within this manual should be directed to the State Radiation Safety Officer.

State Radiation Safety Officer
Nathan Paykoff

Revision date: 02/17/2023

RADIATION

SECTION 1.0 RADIATION

The atom consists of two parts: the nucleus and the electron cloud. The nucleus is located at the center of the atom and contains protons and neutrons. The electron cloud surrounds the nucleus. Atoms, which have the same number of protons but a different number of neutrons, are called isotopes.

Radioactivity occurs when atoms of a certain composition spontaneously transform and release energy and/or pieces of the atom. Each release is called a disintegration, or decay. This spontaneous emission by the nucleus is called radioactivity.

Many isotopes are unstable. Such unstable isotopes (both naturally occurring, like radium, and man-made, like cesium and americium) undergo changes in their nuclei. These changes yield energy in the form of radiation and produce a more stable neutron/proton ratio in the nucleus. In general, a neutron/proton ratio of less than 1½: 1 is stable. During this rearrangement the isotope gives off radiation and it is therefore called a radioisotope. There are four basic types of radiation that we must be concerned with: alpha, beta, gamma and neutrons. If these types of radiation had no effect on matter, we might regard radiation merely as interesting phenomena. But radiation does affect the material exposed to it.

When radiation passes through living things, it gives up energy to the tissue and cells. The energy deposits may cause damage to or destroy the cell. If too many cells are damaged or destroyed, radiation sickness or even death may occur. For this reason, radiation exposure of personnel handling radioactive materials must be held to safe limits.

SECTION 1.1 MEASURING RADIATION

Although there are several types of radiation measurements, the user of a nuclear gauging device needs to be familiar with only two. These are the rem (or millirem) and the curie. The rem is defined in terms of energy absorbed in tissue multiplied by a factor to allow for the effectiveness of the radiation involved. For example, neutrons are approximately 10 times as effective as gamma rays in producing biological effect. The rem, however, is a relatively large unit. In many instances, the term millirem (mrem) is used. There are 1000 millirem in a rem.

The following example gives an idea of how these units are used. A radiation dose of 500-1000 rem to a human being would most probably be fatal. The natural background radiation to which we are exposed amounts to about 100 mrems per year or 0.1 rems per year.

Most gauge operators receive less than 100 mrems per year of radiation from occupational exposure. The curie is not a measure of radiation dose. The curie defines the activity of a radioisotope in terms of its disintegration rate at which radiation is emitted. A millicurie is one thousandth (1/1000) of a curie.

SECTION 1.2 RADIATION PROTECTION STANDARDS

Nuclear gauges are like a power saw or welding torch that may be hazardous unless proper safety precautions are taken. Since the potential harm from radiation is not obvious, the exposure of personnel must be kept to a safe limit by following a few simple rules that assure working with or around nuclear gauges will pose no threat to a person's health and safety.

- 1) Any amount of radiation is assumed to be harmful and exposure to radioactive materials should take place only if some benefit is expected.
- 2) Standards for limiting a radiation dose to any individual should ensure that the probability of biological injury is extremely small.
- 3) Every reasonable effort should be made to keep exposure as far below recommended dose limits as possible. In the U.S., the Federal Radiation Council provides guidance for all federal agencies in the formation of radiation protection standards, considering the recommendations of advisory boards. In turn the Nuclear Regulatory Commission and individual state agencies assure the establishment and implementation of the standards for the activity under their control. For users of radioactive materials, radiation protection standards require that from all sources of occupational exposure:
 - a. The annual total whole-body dose should not exceed (5 rems) or 5000 mrem per year. The whole body includes the head, trunk, arm above the elbow, and legs above the knee.
 - b. The specified annual dose limit to the skin or any extremity (shallow dose equivalent) is (50 rems) or 50,000 mrem per year.
 - c. The specified annual dose limit to the eye (lens of the eye) is 15 rems or 15,000 mrem per year. In addition to these limits, federal and state regulations require that every reasonable effort be made to maintain radiation exposures "AS LOW AS REASONABLY ACHIEVABLE." This is commonly referred to as the ALARA principle.

In keeping with this principle, even though the permissible dose limit is (5000 mrem per year), the Ohio Department of Transportation shall investigate any radiation dose received by a gauge user in excess of 1250 mrem per quarter.

Radiation protection standards governing the use of radioactive materials are found in Ohio Administrative Code, section 3701:1 Radiation Control. Copies of pertinent sections of this document may be found wherever nuclear gauges are stored in the district. In addition, copies of the current License will be posted in the storage areas. Any employee who believes that a violation of the regulations or license conditions exists should notify the RSO.

SECTION 1.3 RADIOSOTOPES USED IN GAUGING DEVICES

The Ohio Department of Transportation uses three different types of nuclear gauging devices. They are described below along with their respective radioisotopes.

TROXLER MODEL 3241-C

This instrument is designed to measure the asphalt content of aggregate paving mixtures. It contains an americium-beryllium neutron source.

Fast neutrons emitted from the source pass through the material being tested and are slowed down (thermalized) in the process. The detection of the thermal neutrons provides an accurate indication of asphalt content. The radiation dose rate in mrem/hr. at various distances from the Model 3241-C is provided in Appendix A.

TROXLER MODEL 3400 (3440)

These instruments are designed to measure moisture and surface density of soil, soil stone aggregates, cements, asphalt surfacing, and asphalt treated bases. They contain cesium-137 and americium-241-beryllium source. The cesium-137 source is used for density measurements and is located at the tip of the source rod.

The americium-241 and beryllium source is used for moisture measurements and is in the center of the gauge base. The radiation dose profile for the Model 3440 is provided in appendix A.

Instrotek Xplorer2 (3500)

These instruments are designed to measure moisture and surface density of soil, soil stone aggregates, cements, asphalt surfacing, and asphalt treated bases. They contain cesium-137 and americium-241-beryllium source. The cesium-137 source is used for density measurements and is located at the tip of the source rod.

The americium-241 and beryllium source is used for moisture measurements and is in the center of the gauge base. The radiation dose profile for the Xplorer2 is provided in appendix A.

REGULATORY AUTHORITY

SECTION 2.0 OHIO DEPARTMENT OF HEALTH & NUCLEAR REGULATORY COMMISSION

The Ohio Department of Health, under agreement with the United States Nuclear Regulatory Commission has regulatory authority over all byproduct materials such as cesium-137 and americium-241.

Anyone possessing such materials in the state of Ohio must obtain a material license from the Ohio Department of Health. Additionally, all applicable provisions of the Ohio

Administrative Code chapter 3701:1-38 must be followed. Copies of chapter 3701:1-38, covering radiation safety practices and notices to employees, are posted next to the gauge storage area.

Should a safety or health complaint not be resolved after all channels within ODOT have been exhausted, the Ohio Department of Health may be contacted. Attempts to resolve the problem through ODOT must be documented.

TRAINING

SECTION 3.0 PURPOSE AND OBJECTIVE

The Ohio Department of Transportation, in accordance with our materials license, has instituted a comprehensive and ongoing training program designed to instruct gauge users and supervisors in the operation of nuclear gauging devices and the associated radiation safety precautions. This program is applicable to all the individuals who will operate or supervise the operation of nuclear gauging equipment.

The objective of the gauge-user training is to instruct the employee in such a way that they can use nuclear gauging equipment to measure the density of soils, soil stone aggregates, and other construction materials in the proper and safest way.

Once the course of instruction has been completed, gauge users are able to clean the shield cavity, transport the gauge in accordance with federal regulations, and take appropriate action in the event of an accident.

Authorized gauge users are expected to participate in a three-part comprehensive training program consisting of initial classroom training, on the job training, and refresher training as considered necessary by operational need.

SECTION 3.1 CLASSROOM, ON THE JOB and REFRESHER TRAINING **CLASSROOM (INITIAL TRAINING)**

The initial classroom training shall be conducted by the gauge manufacturer or an individual or agency, which is certified to offer this type of training by the ODH or NRC. (HT 303 Nuclear Safety)

The training will cover the following topics:

1. General gauge use)
2. Basic radiation theory and health physics
3. Radiation safety precautions
4. Exposure limits
5. Regulations (including NRC, ODH and ODOT)

6. Employee rights
7. Proper transportation and storage
8. Emergency procedures

A test will be given at the end of the instruction period to determine individual comprehension of the material. Those individuals not passing the test will be allowed to retake the class the next time it is given.

ON THE JOB

Upon completing the classroom training requirements, a new employee using a density gauge will be required to work with a gauge for a 40-hour period in the presence of an authorized gauge user. This on-the-job training will cover the following topics:

1. Safety practices
2. Transporting the gauge
3. Emergency procedures
4. Documentation
5. Practical use of the gauge (earth works)

If after the 40 hours of on-the-job training, the authorized user feels the individual can use the equipment properly and safely, he/she shall contact the State RSO in writing stating such. Additionally, a new employee using an asphalt content gauge shall complete the following training requirements: Completion of the initial Radiation Safety Training and Level 2 Asphalt certification. The District Engineer of Tests (DET) will send notice of completion of this training to the State Radiation Safety Officer.

REFRESHER

Refresher training (HT 304 Radiation Transportation Safety Update) will be given in accordance with the Code of Federal Regulations Title 49, Part 172, Subpart H and is considered necessary by operational need. Failure to attend a session will result in the authorization to use the gauge being revoked. An authorized user shall receive refresher training required by this subpart at least once every three years.

A record of current training (inclusive of the preceding three years) in accordance with this section shall be created and retained by each authorized user for as long as that employee is employed by the Department.

District Radiation Safety Officers shall have the following additional training within one year of designation as the District RSO:

1. Radiation safety officer training given by Troxler or equivalent (classroom training).
2. Training on procedures, accidents, and survey meter (Geiger counter) given by Department's State Radiation Safety Officer.

ADMINISTRATIVE CONTROLS

SECTION 4.0 ORGANIZATION AND STRUCTURE

A specific organizational structure has been established within ODOT to ensure implementation and compliance with all radiation safety policies, regulations, and guidelines. This structure represents the lines of control through which radiation safety policy, questions, and concerns should flow. Additionally, this structure indicates the chain of responsibility regarding radiation safety and compliance with applicable rules and regulations.

SECTION 4.1 RADIATION SAFETY OFFICER

The Director of the Ohio Department of Transportation has empowered the State Radiation Safety Officer (RSO), through the Office of Materials Management, with the authority to regulate the possession, use, transportation, storage, receipt and transfer of radioactive materials licensed to this Department. The RSO is responsible for the enforcement of all Federal, State and ODOT regulations regarding radioactive material. The RSO drafts all correspondence to the Ohio Department of Health. The RSO is also responsible for investigating all radiation safety complaints and any over exposures.

SECTION 4.2 OFFICE OF MATERIALS MANAGEMENT

The Office of Materials Management maintains control of all nuclear gauging devices owned by the Department. All nuclear density gauges are maintained on the inventory of the Office of Materials Management. All nuclear asphalt content gauges used in the district are kept on the district's inventory. The Office of Materials Management Nuclear Shop or the device manufacturer performs the maintenance on all nuclear gauges.

The Office of Materials Management is responsible for determining ODOT's need regarding nuclear gauging devices. All purchases of radioactive materials must be approved by the RSO.

SECTION 4.3 DISTRICT TESTING AND CONSTRUCTION DEPARTMENT

The District Test Lab is primarily responsible for the Asphalt Content Gauges (AC) used at the District location. The DET or DCA is responsible for the safety of Test Lab employees and employees of ODOT who are considered the general public. The District Engineer of Tests is also responsible to ensure that all aspects of this program are followed regarding the safe handling procedure of the AC gauge.

The District Construction Department is responsible for the use of all nuclear density gauges in the District. The District will name a District Radiation Safety Officer, or District RSO to be the primary person responsible for Nuclear Radiation Safety and coordination for the district. The District RSO will be the DCA or his/ her designee. If the District Construction Administrator chooses a designee, the designee must meet the following requirements:

1. Must be a management employee.
2. Must work in the Construction Department.
3. Must have transportation in case of emergency.
4. Complete Radiation Safety Officer training and training on procedures, accidents and survey meter.
5. Must have knowledge of all aspects of ODOT's Radiation Safety Program.

The District Construction Administrator, or designee, is responsible for ensuring the safety of employees using the gauge as well as for the employees of ODOT who are considered to be members of the general public. The District Construction Administrator, or designee, is also responsible for the proper use, transportation and storage of the gauges. Even though the DCA may appoint a designee, he/she is ultimately responsible for all applicable sections of this program.

SECTION 4.4 AUTHORIZED USERS

Individuals successfully completing the training requirements as specified by this program and any requirements of the material use license, shall be designated "authorized user" by the State Radiation Safety Officer.

Only "authorized users" may operate, possess, transport, or otherwise handle radioactive sources licensed to this Department.

The authorized user is responsible for the safety of him/herself, other employees, and the general public regarding licensed radioactive material when on the way to or at a construction site.

The authorized user is directly responsible for ensuring that radioactive materials are transported and used within the confines of Federal regulations, Ohio Administrative code chapter 3701:1-50 and ODOT's Radiation Safety Program.

RADIATION SAFETY/ GENERAL

SECTION 5.0 DISTRICT STORAGE

All District facilities shall have a permanent storage facility for storage of nuclear density gauges not in use. The storage facility must meet the following guidelines:

1. The storage area must be a distance of at least 15 feet from any permanent work area.
2. The area must have a locked door with accessibility being limited to nuclear density gauges users or their counter parts, the State RSO or the appointed District RSO.
3. The area must have electrical outlets as well as a heater for use during the winter months. The gauges must not be kept at temperatures below freezing.
4. No one may enter the storage area without a dosimeter badge. At District storage, the gauge shall be stored inside its transport case with the source rod in the locked and

shielded position. The transport case will be lock as well as the source rod. Access to the gauge shall be limited to the authorized user.

5. The storage area must be posted with a “Caution Radioactive Material” sign.
6. The storage area must have the following items posted:
 - a. Notice to employees (Ohio Department of Health)
 - b. Copies of Ohio Administrative code chapter 3701:1-38, 40 and 50
 - c. Emergency Contact Card (Telephone numbers to call in case of emergency)
 - d. A copy of ODOT’s Radiation Safety Program Manual
 - e. A copy of ODOT’s Material License
 - f. Radioactive Warning Sign

Annually, the State RSO will inspect the district storage areas for radiation hazards.

SECTION 5.1 TEMPORARY WORK SITE STORAGE

Nuclear gauge equipment may be stored at the job site if it is stored inside a storage box, which must be secured by being chained or bolted to the floor or wall. The box must conform to ODOT specifications for field office storage boxes. The box can be metal or wood with access to an electrical outlet (refer to 619.02 in the specifications Manual). See Appendix B for an example of an acceptable storage box. The storage box shall be 15 feet from the nearest employees work area. The storage box shall be locked.

The storage area must have the following items posted:

1. Notice to employees (Ohio Department of Health)
2. Radioactive Warning Sign
3. Copies of Ohio Administrative code chapter 3701:1-38/ 40 and 50
4. Emergency Contact Card (Telephone numbers to call in case of emergency)
5. A copy of ODOT’s Radiation Safety Program Manual
6. A copy of ODOT’s Material License

At temporary storage, the gauge shall be stored inside its transport case with the source rod in the locked and shielded position. The transport case will be locked.

Access to the gauge shall be limited to the authorized user. If a storage box is not in place at the project, a gauge may not be stored at the site. Overnight storage of a nuclear gauge in a vehicle is prohibited. A Nuclear Density Gauge may be temporarily stored at any one location for a maximum of 180 days. The State RSO inspects Temporary Storage areas for conformance.

SECTION 5.2 SEALED SOURCE LEAK TEST

Sealed source leak tests shall be done in a way as to ensure each gauge is checked at intervals not to exceed six (6) months.

The Radiation Safety Officer shall collect samples on wetted 9mm filter paper. The sample will be analyzed using the gas flow proportional meter that is owned by the Office of Materials Management. The results of the leak test shall be recorded in micro curies. If the sample indicates 0.005 micro curies of removable contamination is present, the gauging device will be sent back to the gauge manufacturer for repairs.

In addition to the semi-annual testing, gauges shall be leak tested upon initial receipt, before final disposal, and in the event of emergency action taken. The Radiation Safety Officer shall keep records of leak tests.

The **Emergency Management Agency (EMA)**, or Office of Materials Management (OMM), shall calibrate the gas flow proportional meter annually. The Radiation Safety Officer shall keep records of calibration.

SECTION 5.3 SEMI-ANNUAL INVENTORY

The State RSO shall conduct an inventory of all radioactive material licensed to the Ohio Department of Transportation. This inventory shall be done at the same time of the sealed source leak test. The leak test and inventory shall be documented and include the Authorized users name, the gauge serial number, the location of the gauge, and the date of the inventory.

SECTION 5.4 SURVEY METER CALIBRATIONS

The Department has Ludlum Model 3 survey meters (Geiger Counters). Each District, as well as the Office of Materials Management, has one of these meters. Each meter is equipped with a pancake probe and is capable of reading counts per minute (CPM) as well as millirems per hour (mR/hr).

Emergency Management Agency (EMA) shall calibrate these meters at least annually.

SECTION 5.5 RECEIPT AND DISPOSAL OF GAUGES

The State RSO will perform a sealed leak source leak test within 24 hours of receipt of the gauge or gauges. If the leak test shows contamination, then the gauge manufacturer will be notified, and the gauge will be returned through an approved method. If no contamination is detected, the gauge will be put into storage and await distribution for District use. The leak test must be performed, and results recorded before the gauges can be entered into ODOT's inventory. The Radiation Safety Officer shall keep a copy of all order receipts.

If disposal of a gauge becomes necessary, it shall be returned to the gauge manufacturer, or otherwise transferred to a state licensed user. An acknowledgment from the gauge manufacturer is required once they have received the gauge. The gauge must then be removed from ODOT's inventory. The Radiation Safety Officer shall keep all records for gauge disposal.

SECTION 5.6 AREA SURVEYS

An area survey of the nuclear shop will be performed annually. The State RSO will perform the survey. The results will be determined with the use of the gas flow proportional meter. The location of the area swipes will be done as determined by the State RSO.

SECTION 5.7 RECORDS: PERSONAL MONITORING, & PRENATAL CARE

Authorized users' files, area surveys, sealed source leak tests, personal monitoring records, gauge receipts, all registration acknowledgments, and ODOT's materials use license and any other pertinent paper or records shall be kept by the State RSO.

The Nuclear Shop, located at 1600 West Broad Street, Columbus, Ohio will keep records.

Personal Monitoring:

Authorized users shall use personal monitoring whenever they are transporting or using radioactive materials. Personal monitoring shall be a Luxel detector badge issued by Landauer Inc. Luxel badge holders shall only use the badges assigned to him/her. The Radiation Safety Officer shall keep all exposure records. The badge holder may request to see his/her exposure record at any time. The request must be in writing and requested from the State RSO.

All badge holders shall receive a written exposure report annually. The exposure reports will be sent to the District RSO during the first quarter of the following year. The State RSO shall be issued ring badges for use when working on gauges. The ring badges shall be worn at all times during gauge repair.

Prenatal Radiation Exposure and Monitoring

ODOT will instruct individuals working with licensed radioactive materials on the health effects of radiation exposure to an embryo/fetus of a declared pregnant woman. A declared pregnant woman is a woman who has voluntarily informed ODOT, in writing, of her pregnancy and the estimated date of conception.

The written declaration should be submitted to the Radiation Safety Officer and such declaration will remain in effect until the declared pregnant woman withdraws the declaration in writing or is no longer pregnant.

Ohio Administrative code 3701:1-38-12(h) states that occupational exposure of a declared pregnant woman should not exceed 500 millirems for the length of the pregnancy. ODOT will begin fetal monitoring of the declared pregnant woman upon receipt of the declaration of pregnancy. Any required or requested changes to the declared pregnant woman's job duties during pregnancy shall be discussed with, and approved by, the declared pregnant woman's supervisor and the Radiation Safety Officer.

5.8 DOSIMETER BADGE RESPONSIBILITIES

If an authorized gauge user loses his/her badge, the use of the gauge is prohibited until a new badge is obtained. A written explanation shall be sent to the State RSO stating how the badge was lost. A temporary badge will then be issued to the user for use during that quarter. If a badge is lost at any time during the quarter, an average exposure dose that the badge holder received during the previous four quarters will be assessed for that quarter for the lost badge.

This dose will be added to the dose received on the temporary badge. Each district handles the distribution, return and payment for the badges. The badges are sent to the District RSO, who collects badges used during the previous quarter and distribute badges for the present quarter. The District RSO is also responsible to ensure that the badges of authorized users that are on vacation, disability, sick leave, etc. be available for exchange. Once the badges have been exchanged, they are to be returned to Landuaer.

Procedures for dosimeter badges:

1. Quarterly readings

- a. All Dosimeter badge readings will be reviewed by the RSO. Readings above normal for the quarter (as stated in radiation safety manual) will be investigated by the RSO.
- b. If it is determined the exposure was due to a malfunction of the gauge the gauge will be taken out of service.
- c. The employee will be sent for medical testing and the Ohio Department of Health will be informed.

2. Distribution of annual dosimeter readings

- a. All annual dosimeter reports will be sent to the districts to the District RSO.
- b. A cover letter will be attached. The cover letter will contain the following information.
 - i. A list of names of all badge holders in that district.
 - ii. Information about distribution of the reports to the employee.
- c. The District RSO will keep a copy of report on file and distribute a copy to each employee. The employee will sign for their copy.
- d. The District RSO will send a copy of the signed list to State RSO and keep a copy on file at the district.
- e. The RSO will review each list to verify that each employee has received their report.

SECTION 5.9 NUCLEAR REPAIR SHOP

Access to the nuclear repair shop shall be limited to the Office of Materials Management, State Radiation Safety Officer. This area is a restricted area and shall be posted as outlined for District storage as indicated in Section 5.1. Additionally, a sign indicating the area is a restricted area

shall be present. The repair shop shall be locked when unattended even for short periods of time. All nuclear gauge users are authorized to enter the repair shop if they are wearing a Luxel badge and have specific purpose for being there. Actual repair work shall consist of minor electrical work, cleaning of the gauges (including the source rod), sealed source leak tests, density gauge calibration, and other repair work not involving the source rod or its encapsulation. The State RSO shall have training from the gauge manufacturer specific for gauge repair. Ring badges must be worn whenever working on a gauge. All gauges must be stored in the gauge holding area or storage room when gauges are not being worked on.

SECTION 6.0 TRANSPORTATION

Vehicles used to transport nuclear gauging equipment shall be equipped with a transport box mounted in such a way as to prevent lateral and horizontal movement of the transport case and gauge.

Gauges shall be locked in their transport cases with the source rod in the locked and shielded position. The cases shall then be placed inside the transport box. The transport box shall be locked. Only authorized users may be inside the vehicle when a gauge is being transported and a film badge must be worn. A bill of lading, emergency response information, and a yellow emergency response card (with response personnel and phone numbers) shall be kept inside the driver's side door. A roll of yellow caution tape for isolation of the gauge in the event of an accident must be carried in the vehicle.

All vehicles used to transport gauges shall be equipped with two-way radio or some other type of communications. The nuclear asphalt content gauges will not be transported without the written consent of the State RSO.

Process for tracking transportation of the gauge:

Notification of transport of the gauge shall be completed by email or phone to the State RSO and the District RSO. Notification will include the following:

1. The operator's name
2. The gauge inventory number
3. The routes that will be traveled to the project number or storage location

SECTION 6.1 HANDLING PRECAUTIONS

The responsibility for safe use of nuclear gauging equipment at the job site falls to the "authorized user." The authorized user has both the responsibility and the authority to keep unauthorized persons away from the operating area of the gauge. The operating area shall consist of an area approximately 15 feet (5 meters) from the gauge. The ODH considers all employees not authorized to use radioactive material members of the general public. Members of the general public shall not be unnecessarily exposed to radiation. No work involving

dismantling the gauge or maintenance involving removal of the source rod or the source holder should be done.

If any problem should arise involving the “authorized user” maintaining a safe working environment regarding radioactive material, he/she should contact the District RSO or the State RSO for assistance.

Process of tracking transfer of gauges:

1. All gauges are assigned to districts by gauge inventory number.
2. Gauges are assigned to district gauge operator by inventory number.
3. A transfer sheet is filled out by receiving operator (available on OMM webpage).
4. A copy of this transfer sheet is sent to the State RSO and the original is kept on file at the district.
5. Each time a gauge is transferred from one employee to another, is brought to district or brought to the nuclear shop for repairs, a transfer sheet is be completed.

SECTION 6.2 EMERGENCY PROCEDURES

In the event of an accident or incident involving material licensed to ODOT, quick and correct action is of prime importance. Each District shall be equipped with a survey meter for emergency response purposes and the District RSO shall respond to an emergency involving nuclear gauging equipment. In the event of an accident or incident with nuclear gauging equipment, the following steps should be taken:

1. Check the gauging equipment for damage.
2. If the gauge is damaged, isolate the area using a barrier of yellow caution tape.
3. The District RSO should be contacted and informed of the situation.
4. The District RSO shall notify the State RSO.
5. The State RSO shall instruct the District RSO on what further action must be taken.

In the event the District RSO cannot reach the State RSO, the District RSO should follow the outlined plan for containing the gauging equipment until the State RSO can be reached. The gauge user must stay with the gauge until it can be moved to a safe location.

In the event a nuclear gauging device is stolen or lost, the following steps shall be taken:

1. The authorized user shall contact the District RSO immediately upon determining that the gauge is missing.
2. The District RSO shall contact the State RSO.
3. The State RSO shall instruct the District RSO on what further action needs to be taken.

In the event no one can be reached, the authorized user should contact the Ohio State Highway Patrol and inform the officer of the situation. The authorized user should continue to attempt to contact the State RSO and the District RSO.

REVIEW

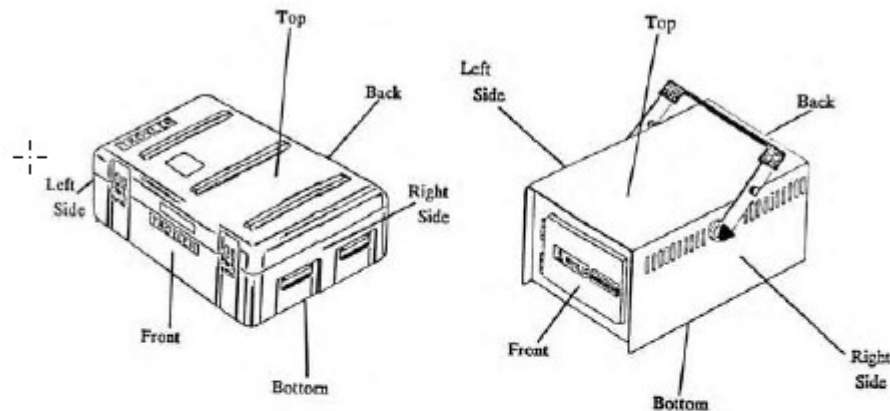
SECTION 7.0 ANNUAL REVIEWS

This program shall be reviewed annually by the State Radiation Safety Officer to incorporate any changes in regulations, technology or equipment.

All updates shall be sent to all authorized users, all District RSO's all District Safety Offices, and will be made available to anyone needing instruction on ODOT's policy regarding nuclear gauging devices or the material license.

Appendix A: Distance Dosage Tables

3241-C (100 mCi) RADIATION PROFILE



RADIATION PROFILE FOR 3241-C GAUGE (100 mCi)

LOCATION	SURFACE			10 cm.			30 cm.			1 Meter		
	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total
FRONT	1.5	3.5	5.0				0.2	0.8	1.0	*	0.1	0.1
BACK	0.5	1.9	2.4				0.1	0.6	0.7	*	*	*
LF. SIDE	0.7	4.0	4.7				*	1.1	1.1	*	*	*
RT. SIDE	1.5	4.0	5.5				0.2	1.4	1.6	*	0.1	0.1
TOP	3.0	8.0	11.0				0.2	1.4	1.6	*	0.1	0.1
BOTTOM	2.0	4.0	6.0				0.15	1.4	1.55	*	0.1	0.1

RADIATION PROFILE FOR 3241-C IN PLASTIC CASE (100 mCi)

LOCATION	SURFACE			10 cm.			30 cm.			1 Meter		
	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total
FRONT	0.3	1.4	1.7				0.1	0.4	0.5	*	0.1	0.1
BACK	0.3	1.2	1.5				0.1	0.4	0.5	*	0.1	0.1
LF. SIDE	*	0.3	0.3				*	0.1	0.1	*	*	*
RT. SIDE	0.3	1.2	1.5				*	0.4	0.4	*	0.1	0.1
TOP	0.9	1.6	2.5				0.1	0.6	0.7	*	0.1	0.1
BOTTOM	0.2	1.1	1.3				*	0.3	0.3	*	0.1	0.1

1. All readings in mrem/h.
2. "*" indicates reading less than or equal to 0.1 mrem/h.
3. Measurements made with Nuclear Research Corp., Model NP-2 Survey Meter, Calibrated March 1989.
4. Dose Rates for 100 mCi americium-241:beryllium source

Figure 14
3241-C (100 mCi) Radiation Profile

3440 RADIATION PROFILE

Table C-1 shows the radiation profile for the 3440 gauge. The table lists the radiation dose equivalent rates (in mrem/hour) for each side of the gauge and transport case shown in Figure C-2.

Table C-1. Radiation Dose Equivalent Rates in Millirems per Hours

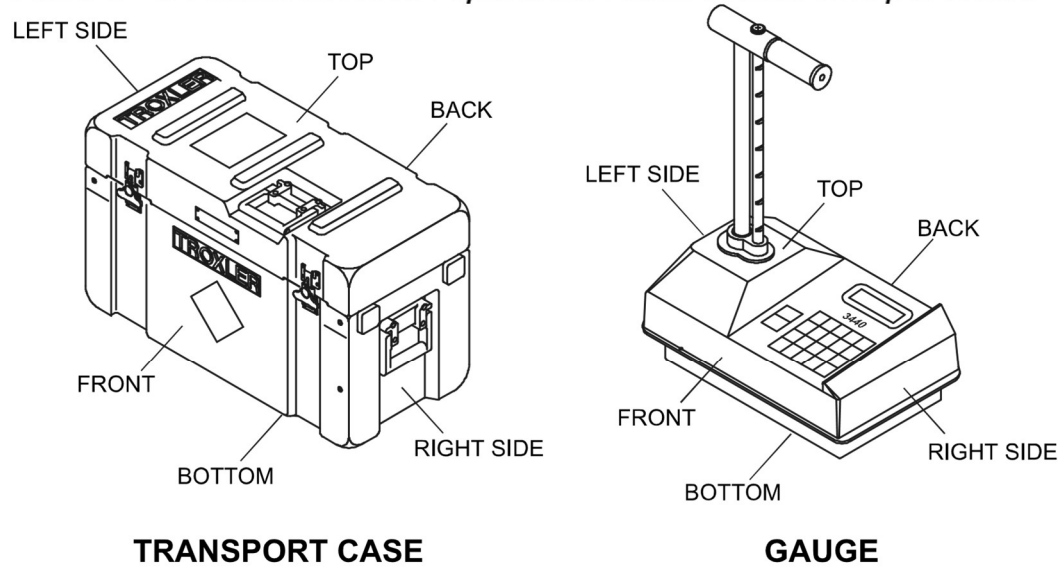


Figure C-2. 3440 Gauge and Transport Case

Appendix C-4



	SURFACE			10 CENTIMETERS			30 CENTIMETERS			1 METER		
	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total	Gamma	Neutron	Total
GAUGE												
Front	19.0	1.5	20.5	5.0	0.5	5.5	1.2	0.2	1.4	0.3	0.1	0.4
Back	18.0	0.8	18.8	6.0	0.4	6.4	1.5	0.2	1.7	0.2	0.1	0.3
Left Side	13.0	0.4	13.4	3.0	0.2	3.2	0.8	0.1	0.9	0.1	0.1	0.2
Right Side	12.0	0.6	12.6	6.0	0.3	6.3	3.0	0.2	3.2	0.5	0.15	0.65
Top	19.0	0.9	19.9	3.5	0.6	4.1	0.6	0.4	1.0	0.15	0.1	0.25
Bottom	18.0	1.9	19.9	4.0	1.2	5.2	0.7	0.4	1.1	*	0.1	0.1
TRANSPORT CASE WITH GAUGE												
Front	8.0	0.3	8.3	3.0	0.25	3.25	1.1	0.15	1.25	0.3	*	0.3
Back	7.0	0.3	7.3	3.0	0.2	3.2	1.0	0.1	1.1	0.2	*	0.2
Left Side	0.4	0.1	0.5	0.3	*	0.3	0.2	*	0.2	0.2	*	0.2
Right Side	6.0	1.4	7.4	2.0	0.7	2.7	0.6	0.25	0.85	0.2	0.1	0.3
Top	13.0	0.2	13.2	3.0	0.15	3.15	0.9	*	0.9	0.3	*	0.3
Bottom	8.0	0.3	8.3	4.0	0.1	4.1	2.5	0.1	2.6	0.6	*	0.6

NOTES:

1. Dose rates measured by the State of North Carolina Department of Environment, Health, and Natural Resources, Division of Radiation Protection.
2. All values in mrem/hr.
3. Indicates a reading of less than 0.1 mrem/hr.
4. Dose equivalent rates for 0.3 GBq (8 mCi) Cs-137 gamma source and 1.48 GBq (40 mCi) Am-241:Be neutron source
5. Surface indicates surface of gauge or surface of transport case.
6. Gamma measurements made with *Ludlum Model 14C Survey Meter*, calibrated September 1987.
7. Neutron measurements made with *Nuclear Research Corporation Model NP-2 Survey Meter*, calibrated March 1988.

Appendix 5: Model Xplorer 2 Elite Radiation Profile



Fig A3.3 Open Case Radiation Profile

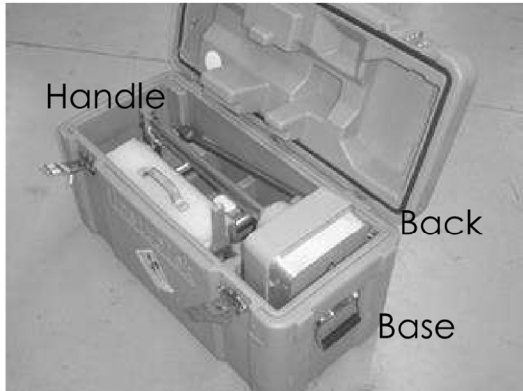


Fig A3.1 Closed Case Radiation Profile

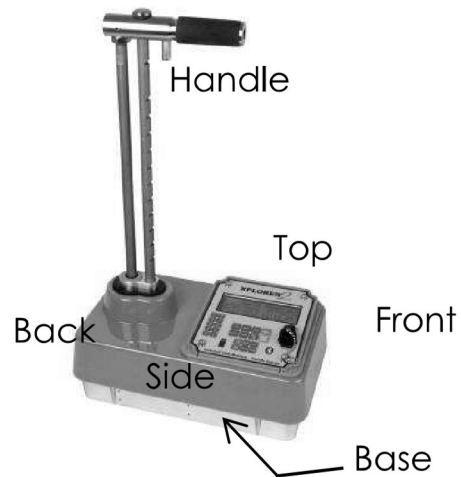


Fig A3.2 Gauge Radiation Profile

Readings in mREM/HR

		Gauge						Transport Case					
		Front	Back	Sides	Top	Bottom	Handle	Handle End	Base End	Top	Bottom	Hinge Side	Latch Side
Surface	Gamma	7.0	12.0	12.0	6.0	12.0	0.1	0.1	8.0	7.0	8.0	5.0	6.0
	Neutron	0.5	0.5	0.6	2.0	7.0	0.1	0.1	3.0	1.0	0.6	0.8	1.0
	Total	7.5	12.5	12.6	8.0	19.0	0.2	0.2	11.0	8.0	8.6	5.8	7.0
10 cm	Gamma	5.0	4.0	6.0	2.5	2.5	0.1	0.05	6.0	4.0	5.0	3.0	4.0
	Neutron	0.3	0.2	1.0	1.0	3.0	0.1	0.05	2.0	0.5	0.5	0.3	0.8
	Total	5.3	4.2	7.0	3.5	5.5	0.15	0.1	8.0	4.5	5.5	3.3	4.8
30 cm	Gamma	3.0	1.5	2.0	0.8	1.2	0.1	0.05	0.6	1.6	3.0	1.6	2.0
	Neutron	0.1	0.1	0.4	0.8	1.0	0.1	0.05	0.8	0.2	0.3	0.1	0.4
	Total	3.1	1.6	2.4	1.6	2.2	0.15	0.1	1.4	1.8	3.3	1.7	2.4
100 cm	Gamma	0.3	0.2	0.2	0.1	0.2	0.05	0.05	0.3	0.2	0.4	0.4	0.05
	Neutron	0.05	0.05	0.2	0.1	0.1	0.1	0.0	0.1	0.05	0.0	0.1	0.1
	Total	0.35	0.25	0.4	0.2	0.3	0.15	0.05	0.4	0.25	0.4	0.5	0.15

Notes:

1- Gamma Measurements made with a Victoreen Model 492 Ionization chamber, S/N 3695.

2- Neutron Measurements made with a Ludlum Model 12-4 neutron meter, S/N 237866, calibrated.

3- Dose rates are for 10 (+/- 10%) mCi Cs-137 gamma source and 40 (+/- 10%) mCi Am241:Be neutron source.

Appendix B: Storage Box Specification

