WORKER PERSONAL DOSIMETRY GUIDELINES

Contents

UNIVERSITY OF WATERLOO

Introduction

Personal dosimetry, also called direct monitoring, is used to determine an individual's exposure to radiation. Personal dosimeters are used to measure external radiation exposures but are used to measure shallow and deep doses.

Definitions

External exposure
Radiation exposure that occurs with the source is outside of the body.

Internal exposure
Radiation exposure occurs when radiation is emitted by nuclear substances inside the body. Internal exposures are measured through bioassay or thyroid monitoring.

Shallow dose

The personal dose assessment for the external tissues such as the skin. The value is the dose equivalent at a tissue depth of 0.007 cm averaged over an area of 1 cm^2.

Deep dose

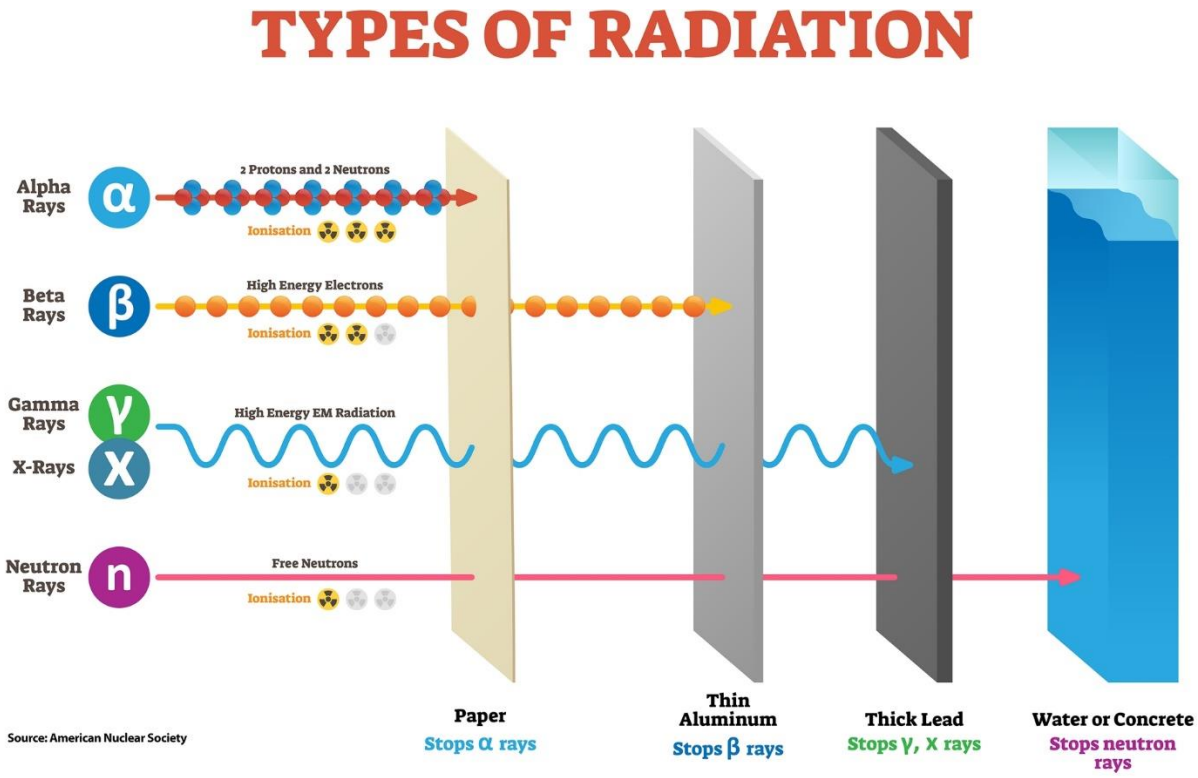
The personal dose assessment for the deep organs. The value assumes uniform whole-body exposure at a tissue depth of 1 cm.

Passive dosimeters
A small radiation detector typically worn on the person and is used to measure external exposure. A passive dosimeter produces a radiation-induced signal which is stored in the device to be later processed and analyzed.

Determining Dosimeter Use

Radiation

Radiation permits are evaluated for inclusion into the personal dosimetry program is primarily based on the type of radiation released, the energy of the radiation, and the shielding surrounding the source. This evaluation is conducted by the radiation safety officer (RSO) during the radiation permitting process.



Alpha radiation has a large mass and charge yet is unable to penetrate skin and does not present an external radiation hazard. As a result, solely alpha emitting radioactive nucleotides such as Polonium-210 (Po-210) are not part of the dosimetry program.

Beta radiation is a small negatively charged particle that can penetrate more deeply than alpha particles but can be easily stopped by a small amount of shielding such as plastic or glass. Beta radiation cannot penetrate the skin to reach the internal organs, but it can be a risk to skin and eyes. A common Beta emitter used at the University is Tritium (H-3). It is not part of the dosimetry program as the beta energy released is very low and not an external hazard. Only high energy beta hazards would be included.

Gamma radiation consists of photons originating from within the nucleus. Gamma radiation can travel very deeply and can sometimes require very dense shielding. At times, gamma radiation can penetrate body organs from external doses. Gamma radiation sources are often part of the personal dosimetry program depending on shielding. An example of a gamma source is Ba-133.

Neutron radiation is radiation in the form of neutrons and can penetrate tissues and organs from outside the body. All neutron radiation sources are part of the personal dosimetry program.

For radiation, personal dosimetry typically occurs for open source permits as sealed source permits include the necessary shielding to not require personal dosimetry.

X-rays

Personal dosimetry is used for x-rays to measure the gamma radiation as gamma radiation is very penetrating. Most x-ray sources at the University are very well shielded and therefore these users are not required to participate in the personal dosimetry program. X-ray users are added to the dosimetry program if they are:

- Designated as x-ray workers as per O.Reg 861/90
- Work with an unenclosed x-ray source (e.g., dental x-ray)
- Work with a home-built x-ray source or cabinet

Dosimetry for a home-built x-ray source may only be used for a trial period, for example, 1 year, or until consistent measurements are returned showing low leakage over time. This time period is determined by the XSO.

Use and Care of Personal Dosimeters

At the University, most personnel who use dosimetry use Whole Body Optically Stimulated Luminescence (OSL) dosimeters. Thermoluminescent Dosimetry (TLD) rings are also available for workers who have radiation exposure to their extremities.

Care and Storage:

- You can clean/wipe your dosimeter is necessary with an alcohol wipe or disinfectant.
- OSL dosimeters are not sensitive to heat and moisture if their blister pack is intact, yet the TLD ring badges are. Keep the TLD ring badges away from direct sunlight and moisture.
- Keep the dosimeters at work and stored away from the source and sunlight.

Use:

- The whole-body dosimeter is angle-dependent, make sure the dosimeter is facing outwards towards the radiation source. The minimal dose reading is 1 mrem (0.01 mSv).
- Place the dosimeter on your body as indicated on the dosimeter.
- Dosimeters should be worn outside of your lab coat or shielding.
- Only wear the radiation dosimetry assigned to you.
- Ring dosimeters should be worn on your dominant hand and have a minimum dose reading of 10 mrem (0.1 mSv). Ring labels should be worn with the white label facing towards the palm and under your gloves.

See Appendix A for more information on wearing a Landauer Badge.

Reporting

Worker dosimeters provide dose measurements based on the cycle agreed upon with the manufacture. The current cycle at the University is every two months. Dosimeters are collected from the participants, shipped to the manufacturer, analyzed by the manufacture, then the results are provided to the University. The University uses the following limits to determine how to respond to the results provided.

- For both radiation and x-ray workers, an action limit of 0.2 mSv/year is used to determine reporting requirements. The action limit is when workers are notified that during their wear period, they surpassed the limit. Any worker under the action limit will receive no notification of their readings. At anytime a worker may contact the Safety Office for the results of their monitoring.
- For both radiation and x-ray workers, an investigation limit of 0.5 mSv/year is used. If a worker dose exceeds this value, the radiation safety officer or x-ray safety officer will investigate and take any necessary corrective actions. This investigation will also be reported to the worker and the Radiation or X-ray Safety Committee.
- For radiation workers the yearly dose limit is 1 mSv. For x-ray workers, the yearly dose limit is 5 mSv. These dose limits are different because x-rays and radiation are regulated by different regulatory bodies. Workers that meet these limits will be no longer allowed to work with their source for the remainder of the year.
- For x-rays, if a worker receives a dose higher than the annual limit of 5 mSv in a period of 3 months or less. In addition to notifying the worker and investigating, the x-ray safety officer will also provide a report in writing to the director and the Joint Health and Safety Committee on the investigation and the corrective actions in line with Regulation 861.
- For radiation, if the radiation safety officer becomes aware that a dose to a particular organ or tissues above the effective dose limit or equivalent dose limit, there are also additional requirements listed in our license.

Resources

CNSC Introduction to Dosimetry

Record of Revisions

Date	Author/Editor	Change	Version
July 2022	Katelyn Versteeg	▪ Document release	Worker Personal Dosimetry Guidelines v.1.0 JUL2022

Appendix A: Wearing a Landauer Badge

Using Landauer Badges

How do I wear my badge?

It is very important for you to wear your badge so that your name is facing outward. There is a small oval on the front of the badge and this should be facing the source of radiation as much as possible to ensure the badge is providing the most accurate dose reading.

The front of the badge should always face outwards towards the source of radiation

The back of the badge should always be touching you.

For all body badges, you can see the location on your body where your badge should be worn by looking at the little white dot on the human figure on the badge. The white dot indicates where the badge should be worn. For fetal badges, you will see a little picture of a baby to indicate it is a fetal monitor.

For ring badges, the white plastic with your name etched into it should be facing the source of radiation at all times. The white plastic should be facing the outward on the underside of your finger. The ring opening should be worn on the upper-side of your finger.

Try to wear the ring on your dominant hand on your finger each time.

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