FactSheet

Personnel Monitoring Devices - Radiation

Personnel monitoring devices are worn by USC faculty and staff that use radioactive materials (RAM) and radiation-producing machines to record radiation exposure. Dosimetry devices DO NOT shield or protect the users against the harmful effects of radiation.

Who must enroll in the USC dosimetry program?

USC personnel likely to receive a radiation dose in excess of ten percent (10%) of the annual limits for occupational workers (see Table 1) must wear a personal monitoring device. The Radiation Safety Committee (RSC) mandates personal monitoring devices for the following:

- Open beam X-ray producing devices (except dental x-ray machines)
- PET Imaging Center
- Cyclotron and associated hot lab
- Radionuclides that emit: (a) beta particles > 600 keV in quantities exceeding 5 mCi of activity and (b) gamma rays in quantities exceeding 1 mCi of activity
- Entry into a posted high radiation area
- Nursing staff who care for radiation therapy patients
- Use of non-shielded radiation-producing machines

The Radiation Safety Officer (RSO) will make the final determination whether personal monitoring is required. The RSO may remove the requirement if dosimetry records indicate only minimal exposure over a period of at least one year.

Table 1. Limits of Radiation Exposure

Body Part	REM Limit	Time Period
Whole Body	5	Year
Lens of the Eye	15	Year
Hands and Feet	50	Year
Skin of the Whole Body	50	Year
Embryo/Fetus*	0.5	Gestation Period

*Declared pregnant worker

What monitoring devices are used at USC?

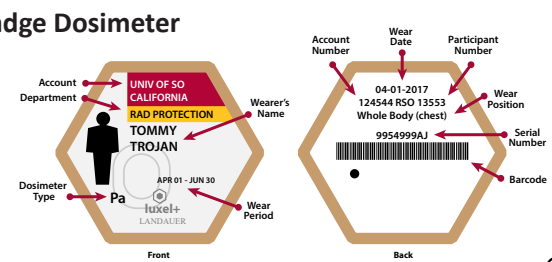
Personal dosimeters routinely used at USC are whole body (PA) badge dosimeters and extremity finger ring dosimeters (S1) These dosimeters are exchanged every month or every quarter as assigned.

What I need to know

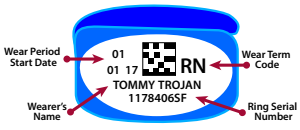
- Always wear a dosimenter when you are working with or near ionizing radiation to ensure accurate readings of your external radiation dose.
- Store dosimeters in a cool, dry place and away from radiation sources. DO NOT take home.
- Return the dosimeter at due date to obtain accurate exposure readings.
- Pregnant workers may declare their pregnancy per Radiation Safety Committee policy.
- PA dosimeters are OSL type; S1 dosimeters are TLD type.
- OSLs are commonly referred to as film badges.
- OSLs are more robust and produce more accurate dosimetry results than TLDs due to the OSL being less vulnerable to the external environment.
- Report lost/damaged dosimeters to Radiation Safety radsafety@usc.edu immediately.

All dosimeters are processed commercially and the exposure reports are sent to Radiation Safety for review. Individuals may receive copies of their exposure history by contacting Radiation Safety radsafety@usc.edu. Any exposure that exceeds the maximum permissible limit or is much higher than average is discussed with the individual and the individual's supervisor.

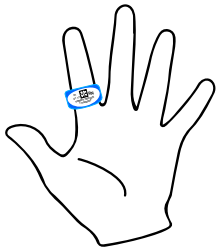
Badge Dosimeter



Ring Dosimeter



Ensure that ring label faces radiation source



How do they work?

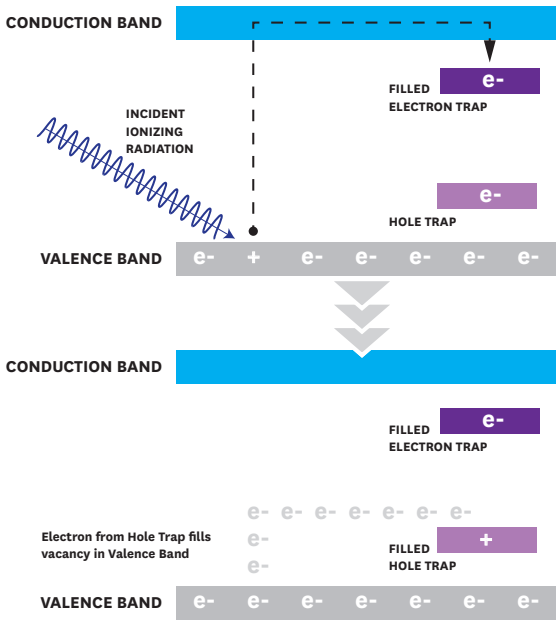
Radiation dosimeters are a key part of the radiation safety program at USC for assessing exposure of personnel to ionizing radiation. Landauer is the main supplier of dosimeters to USC which distributes either thermoluminescence dosimeters (TLDs) or optically-stimulating luminescence dosimeters (OSLs). Chest badges at USC are typically OSL badges and ring dosimeters are typically TLD badges.

Thermoluminescence Dosimeter (TLD)

The TLD is a phosphor with special filters to attenuate and distinguish between various energies of radiation that impinge upon it. The phosphor (lithium fluoride (LiF) or calcium fluoride (CaF) crystals) has electrons present at unexcited states initially in the valence band of the atom.

When the electrons are excited by incident radiation, they are promoted to the conduction band and move into positively charged electron traps (see Figure 1). Electrons are held there until they are released down to the ground state.

Figure 1.



TLDs are read by heating the dosimeter up to a certain temperature that causes the electrons to be released (see Figure 2). The electrons are collected by a photomultiplier tube that amplifies the signal to give the overall exposure value on the badge and the data is recorded by the reading system. The dosimeter could then be reused again. **NOTE:** This process causes the information from the dosimeter to be permanently lost, so the exposure data must be recorded.

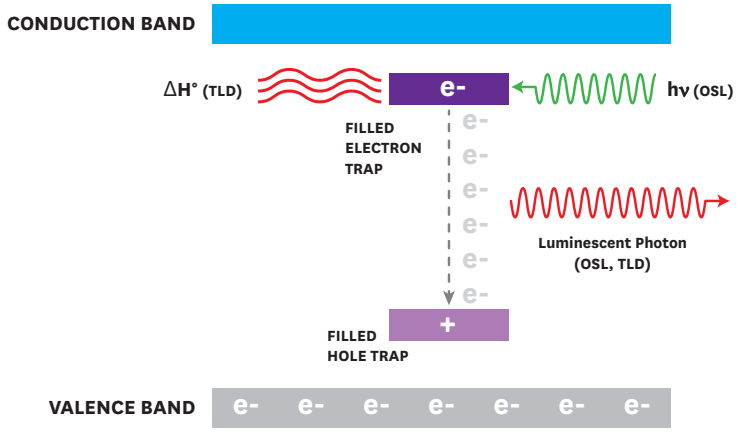
To ensure the TLD works properly, always wear it when in the presence of ionizing radiation and store the it in a cool, dry place to prevent the early release of the electrons. An early release may cause the dosimeter to underreport the true reading.

Optically-Stimulated Luminescence (OSL) Dosimeters

OSL dosimeters contain a system of filters that attenuate incoming radiation. OSL badges are also referred to as "film badges" and are more commonly used on campus. The basic mechanism of electron excitation and trapping is the same for OSLs (see Figure 1) except that trapped electrons are released via optical stimulation.

In optical stimulation, a low energy laser targets a small area of the aluminum dioxide and triggers the release of electrons from their traps (see Figure 2). The dose reading is acquired as a result. OSL dosimeters only have a small area targeted with each reading, so the dosimetry information can be preserved between readings. OSL dosimeters are less vulnerable to heat than TLDs but still should not be exposed to excessive heat to ensure the material doesn't break down.

Figure 2.



References

National Radiation Council OSL Dosimeters

NDT Resource Center Thermoluminescent Dosimeter

USC Radiation Safety Manual

NRC Title 10 CFR Part 20 Section 20.1502