Types of Personnel Dosimeters

Four major types of monitoring devices in use today are the pocket dosimeter, the film badge, the thermoluminescent dosimeter (TLD), and the optically stimulated luminescent (OSL) dosimeter.

a) **Film Badge**

The film badge was once the most commonly used personnel monitoring device for x- and gamma radiation and charged particles, but in the United States it has been largely replaced by newer technologies. A film badge is composed of a piece of photographic film and a special film holder. The effect of radiation exposure is a darkening of the film, and the amount of darkening is proportional to the dose absorbed by the film. The film is placed inside a light tight packet which is placed in the film holder. The film holder contains various filters (e.g. lead, tin, aluminum, plastic). Radiation passing through the filters will produce a density distribution on the film from which the energy range and type of the radiation can be determined.

Photographic film has several disadvantages for its use as a personnel monitoring device:

1) Fogging may result from mechanical pressure, high temperatures or exposure to light before development.

2) Fading of the latent image can occur, which is dependent on the time interval between exposure and development.

3) Errors in the development process can affect the reading, and cannot usually be corrected.

4) Isotopes such as H-3, C-14 or S-35 have beta energies below the sensitivity of the film and cannot be detected

NOTE: Many people still commonly refer to personnel dosimeters of any type as "film badges," although most are actually TLD or OSL dosimeters.

Film Badge

b) **Thermoluminescent Dosimeters**

Thermoluminescent dosimeters, or "TLD's", are also used for monitoring beta, x-, and gamma radiations. Energy absorbed from the incident radiation excites and ionizes the molecules of the thermoluminescent material. Some of the energy is trapped[محاصر] by impurities[شوائب] or deformations in the material, and remains trapped until the material is heated to a high temperature. Once heated, the trapped energy is released as an emission of light. The amount of light emitted is proportional to the energy absorbed within the thermoluminescent material, which is proportional to the radiation dose absorbed. The emitted light is measured with a photomultiplier[مضاعف ضوئي] tube, the output of which is applied to a readout instrument.

The TLD is a better indicator[مؤشر] of radiation exposure than film because it is composed of elements of low atomic number (human tissue also contains elements of low atomic number). TLD's are less affected by environmental conditions such

as heat, light, and humidity than film, and are reusable. The TLD crystals are available in many sizes and shapes, such as rods, ribbons, pellets and single crystals.

TLD's also suffer from several disadvantages:

1) The TLD can only be read once, since reading it erases تمحو it. Thus, there is no permanent record of the dose, and errors in the measurement process may lose the reading.

2) Fading تلاشي of the stored signal can occur, which is dependent on the time interval between exposure and development.

3) The accuracy of the reading depends on the light sensitivity of the reader and heating rate of the TLD, but it can be difficult to maintain adequate reader constancy.

4) TLD's do not give as much information about the energy of the incident radiation as do film and OSL dosimeters.

Types of TLD Badges

c) **OSL Dosimeters**

Optically stimulated luminescent (OSL) dosimeters are currently the most common type of personnel dosimeter used in the United States, and are marketed by Landauer, Inc. under the proprietary name "Luxel dosimeter." The basic principle of operation is similar to that of the TLD, in that the energy absorbed from incident radiation becomes trapped in the material. However, green laser light, rather than heat, is used to stimulate release of the stored energy. The trapped energy is emitted as a blue light when it is released, so it can be collected and distinguished from the green incident light. As with the TLD, the amount of light emitted is proportional to the energy absorbed by the material, which is proportional to the radiation dose absorbed.

OSL dosimeters have several advantages over TLD's. They are more sensitive to a wider range of photon and beta particle energies, and provide more information about the energy of the incident radiation. This information is used to provide estimates of deep dose, dose to the lens of the eye, and shallow[المضمحلة] dose. The good resolution of the detector also allows analysis of whether the exposure was dynamic or static .Other major benefits of the OSL dosimeter are that it can be read multiple times without erasing all the information and that the read-out process is faster and more accurate than with TLD's. OSL dosimeters are also relatively unaffected by environmental conditions such as heat, light, and humidity.

Pocket dosimeters are small ion chambers that are read on-site and are used when readings are desired quickly or on a frequent basis. They can be of two types, direct reading or indirect reading.

Use of Personnel Dosimeters

Personnel monitoring devices must be worn by personnel as specified below and/or in such instances as deemed necessary by the Radiation Control Department.

a) Whole Body كامل الجسم Luxel/Film/TLD Badges

Whole body badges shall be worn when:

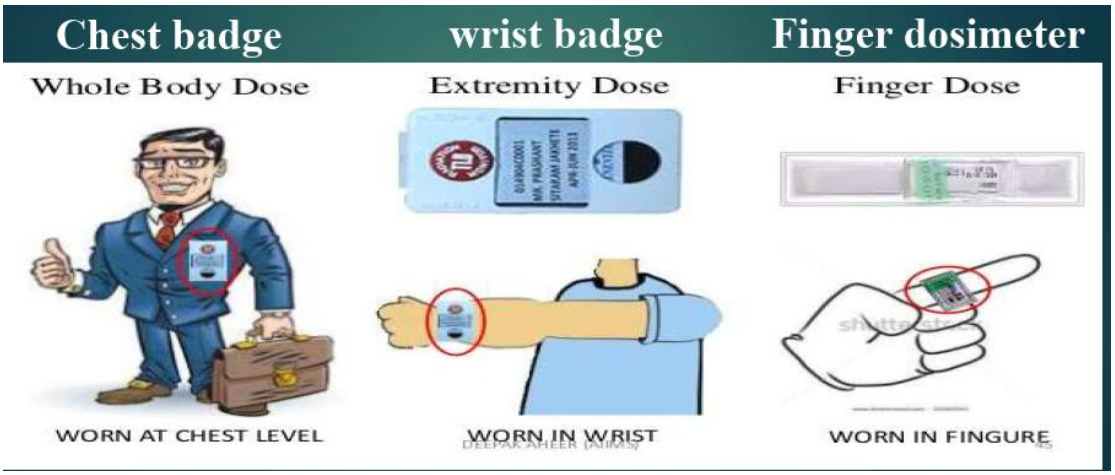
1) working with beta emitters where the energy is 300 keV or higher and the quantity greater than 1 millicurie (37 MBq) in any month.

2) working with any gamma emitters where the energy is 50 keV or higher and the quantity greater than 0.2 milliCuries (7.4 MBq) in any month.

3) working with neutron sources. Special neutron badges may be required in addition to other badges.

4) working with any apparatus capable of producing or emitting ionizing radiation as deemed necessary by the Radiation Control Department. For example, x-ray equipment, high power amplifying tubes, accelerators, etc.

5) specified by the Radiation Control Department, the Radiation Control Officer, and/or the Radiation Control Committee or the Human Use of Radionuclides and Radiation Committee .



b) Pocket Dosimeters

Pocket ion chambers may be required to be worn in addition to the film badge if other types of monitors are inadequate in the judgment of the Radiation Control Officer or the Radiation Control Committee. This shall apply where the investigator is working with high level radioactive materials or other ionizing radiations. When these devices are used, the Principal Investigator is responsible for maintaining daily pocket ion chamber records. Copies of these records shall be submitted monthly to the Radiation Control Office.