2025

KARNATAKA RADIOLOGY EDUCATION PROGRAM

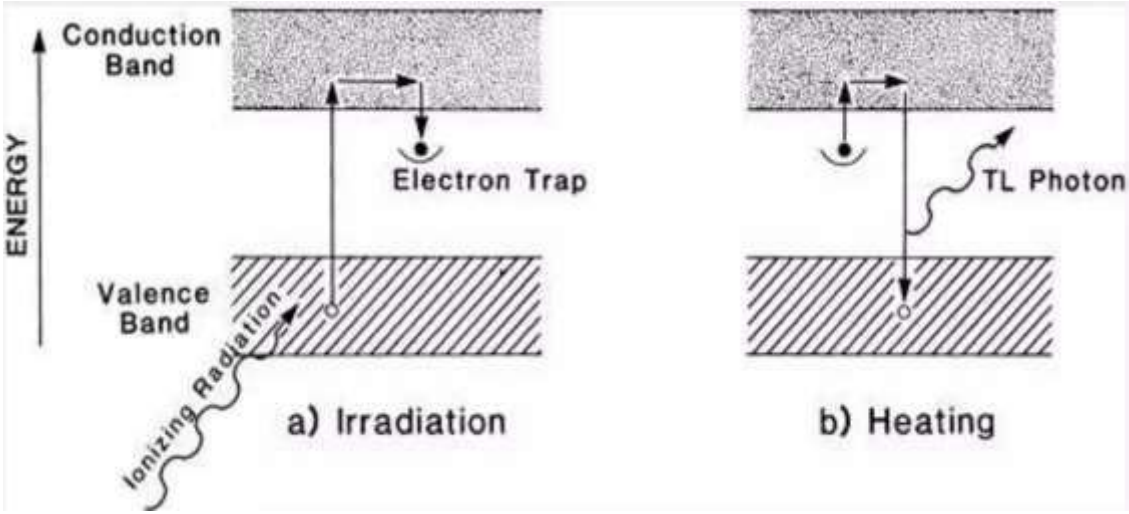
THERMOLUMINESCENT DOSIMETER

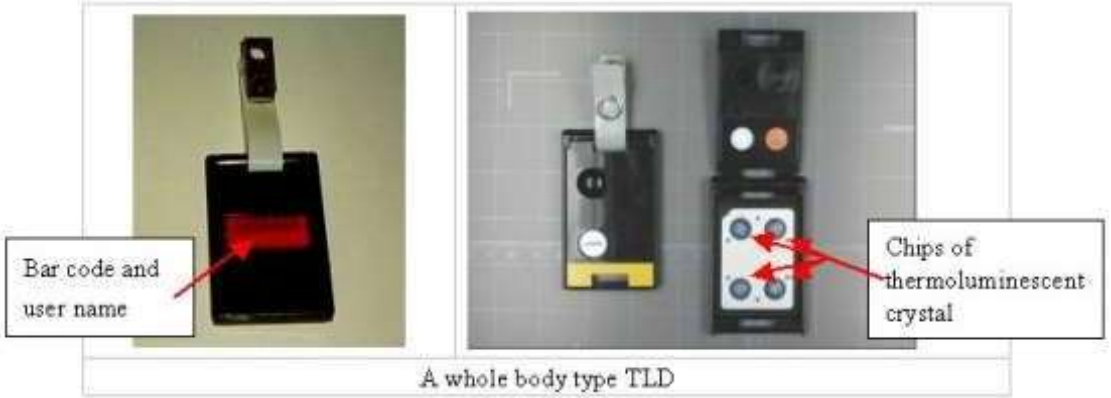
Thermoluminescent Dosimeters (TLDs) play a crucial role in **monitoring radiation exposure** for both patients and healthcare workers. Since ionizing radiation is used in various diagnostic and therapeutic procedures (such as X-rays, CT scans, and radiation therapy), accurate measurement of radiation exposure is essential to ensure safety and compliance with regulatory standards of AERB and BARC in India.

How TLDs Work?

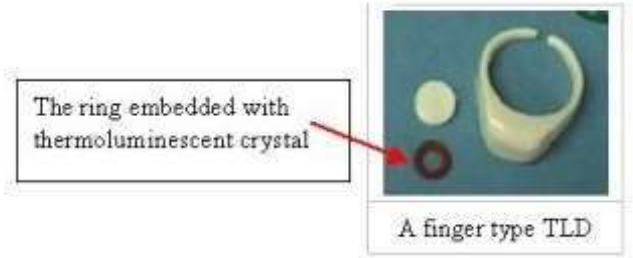
- A thermoluscent dosimeter is a small chip of activated lithium fluoride that is exposed to radiation.
- The chip is then heated, and emits light in proportion to the amount of radiation it received (the term "thermoluminescence" indicates heating to liberate luminescence).
- The intensity of the emitted light is proportional to the amount of radiation the material has absorbed, allowing for the measurement of the dose of radiation received.
- Measures radiation ranges from 10mR to 10000 mR +/- 10%.

Thermoluminescence Process- Energy level diagram:





A whole body type TLD



A finger type TLD

Components:

- **A)Parts of a TLD badge:**

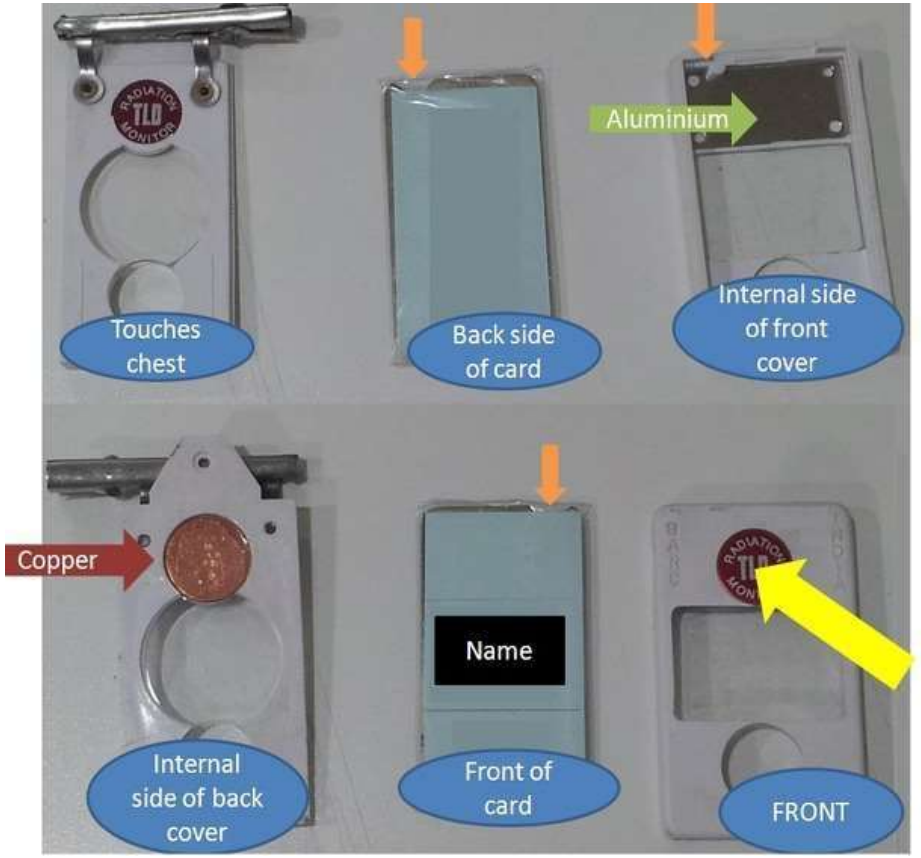
➢ Plastic holder.

➢ Nickel-coated aluminum card with TLD discs.

- The discs are made of a thermoluminescent material, commonly calciumsulphate doped with dysprosium ($CaSO_4$:Dy) or lithium fluoride (LiF)
- Nearly tissue equivalent, although not at all x-ray energies.
- The discs are 0.8 mm thick and have a 1.35 cm diameter.

➢ Three filters against each disc:

- Top: Aluminum and copper.
- Middle: Perspex.
- Lower: Open.



A)Parts of a TLD Badge:

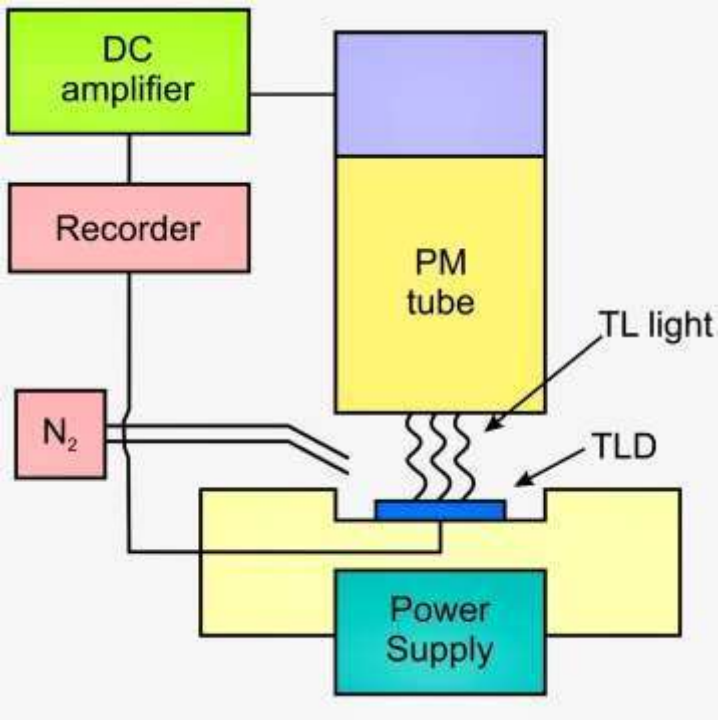
B)TLD Reader-

➢ **Heating**: The TLD is heated to release the trapped energy in the form of light (thermoluminescence).

➢ **Light Detection**: The emitted light is measured by a **photomultiplier** tube or a similar light detector, and the intensity of this light is proportional to the radiation dose.

Features of TLDs:

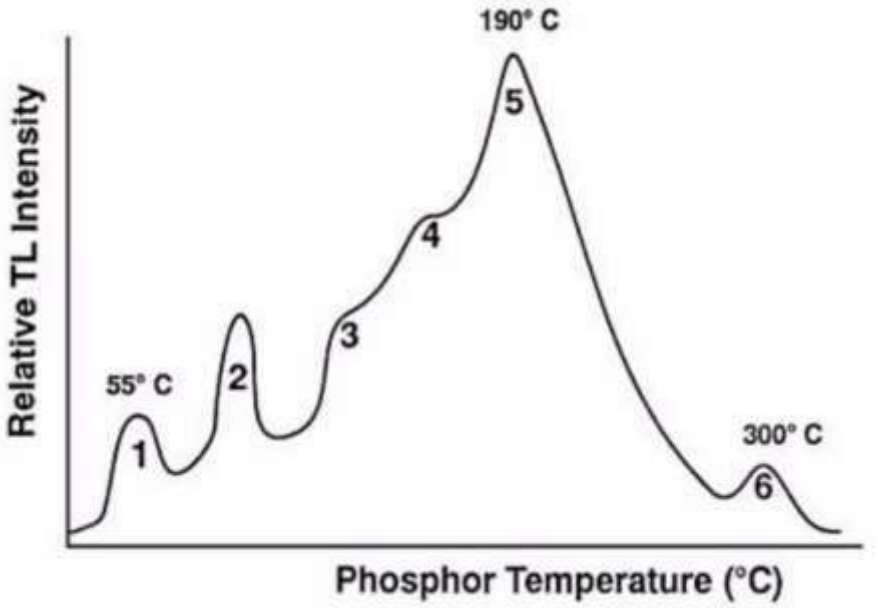
- **Reusability**: After the dose is read, TLDs can often be reused, making them cost-effective for repeated measurements.
- **High Sensitivity**: TLDs are sensitive to low doses of radiation and can detect both high and low levels of radiation.
- **Accuracy**: They offer high precision in dosimetry, often with a low margin of error.
- **Energy Dependence**: TLDs can be affected by the type and energy of the radiation, but this can be compensated for by using specific calibration techniques.



B)TLD reader-

Glow curves-

- It is the plot of thermoluminescence against temperature.
- As the temperature of TL material exposed to radiation is increased the probability of releasing e- increases.
- Optimum Temperature for TLD readout is 170-230°C
- Area under this curve is directly proportional to the amount of radiation that was absorbed in the chip.
- The individual glow peaks are numbered and correspond to different trap depths.



POSITIONING OF THE BADGE –

- One badge should be worn at chest level to record whole body equivalentdose.
- Should be worn below the lead apron if used.
- If selectively high doses are expected to hands and head- additional wristand head badges may be used.

Applications:

In **medical radiology**, Thermoluminescent Dosimeters (TLDs) are essential tools for:

- Ensuring **patient safety** by accurately measuring radiation doses during diagnostic imaging and therapy.
- **Monitoring the occupational exposure** of healthcare workers to ionizing radiation.
- Supporting **quality control** of radiology equipment to maintain proper calibration and dosage levels.
- Providing **regulatory compliance** with radiation protection standards.

Advantages of TLDs:

- **Small and Portable**: TLDs are compact and easy to carry, which makes them suitable for both personal dosimetry and environmental monitoring.
- **Durability**: They are relatively robust and can withstand a range of environmental conditions.
- **High Accuracy**: TLDs are capable of providing accurate dose.

Personnel TLD is to be properly stored when not working with radiation

Never store/ leave TLD badges inside X-ray Room/Radiation Area.

- *Store control TLD badge in radiation free area all the time.*

- *Store personnel TLD badge in radiation free area when not in use, along with control TLD badge.(e.g., office room)*

Limitations of TLDs:

- **Limited Immediate Feedback**: Unlike electronic dosimeters, which provide real-time data, TLDs need to be read after exposure, which means there is a delay in receiving the dose information.
- **Calibration Sensitivity**: TLDs require precise calibration to ensure accurate measurements, as their response can vary depending on factors like temperature or the type of radiation.

In **summary**, thermoluminescent dosimeters are valuable tools for precise and reliable radiation dose measurement in many applications, offering both sensitivity and durability.

Change your TLD cards every monitoring period (eg. Quarterly) and return used TLD cards to Laboratory for dose assessment.

If TLD fell/left in X-Ray room, and got accidentally exposed, report immediately to the lab and send it for processing.

Dose limits of Occupational Exposure (AERB Directive)

Effective Dose 20 mSv in a year averaged over a period of 5 years.

Annual equivalent dose in the

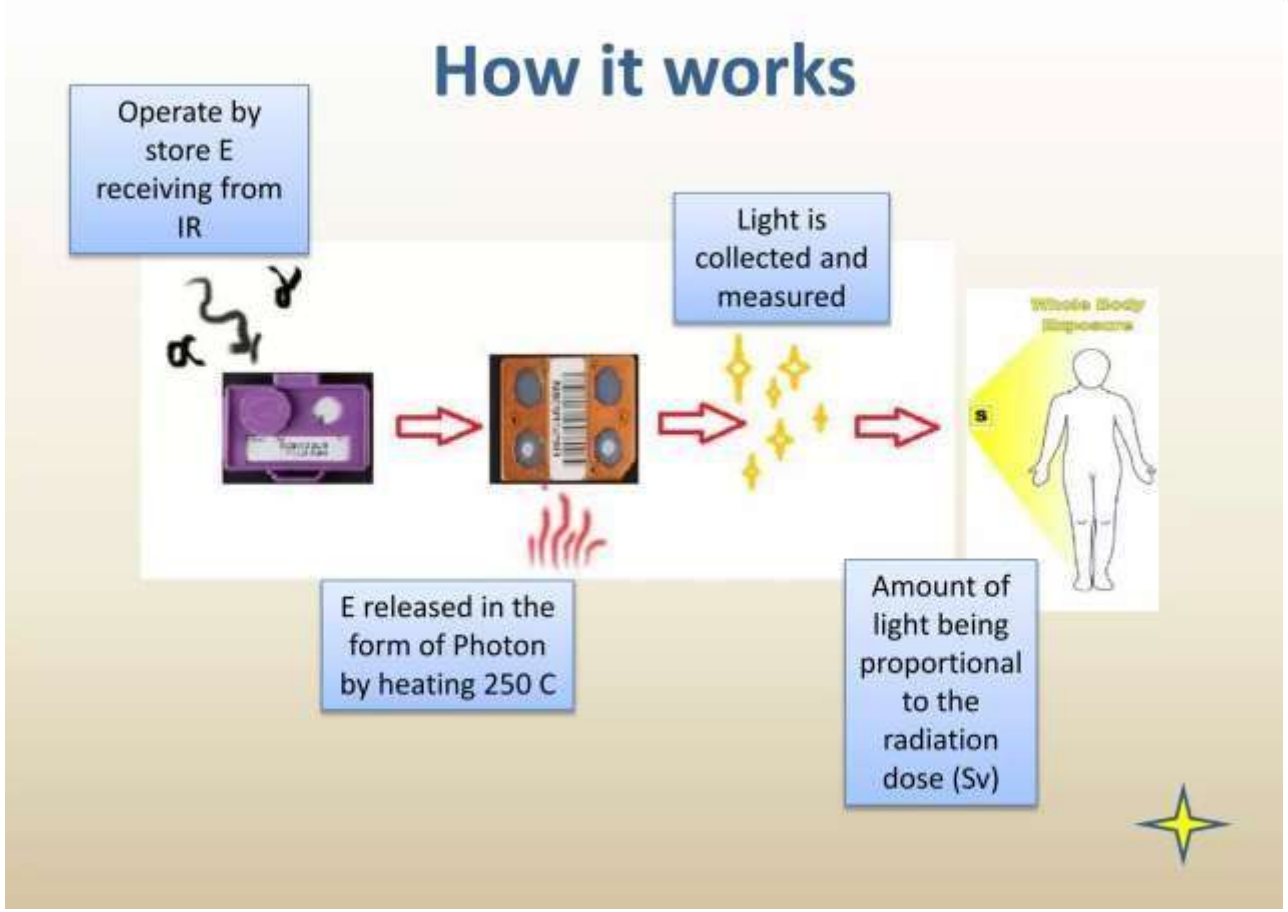
Lens of the eye	150 mSv
Skin	500 mSv
Hands & Feet	500 mSv

Radiation Warning Placard to be pasted outside Medical X-ray Installation

Despite some limitations, TLDs continue to be widely used due to their **accuracy, reusability, and versatility** in measuring both low and high radiation doses across various medical applications.

Flow Chart of TLD Dosimetry:

Radiation Warning Placard to be pasted outside Medical X-ray Installation



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