# SEMI-AUTOMATIC TLD BADGE READER
# TYPE : TL1010A

## Technical Data


Auto TLD Badge Reader TL1010 is a personal monitoring system, designed to read the TLD card (TL dosimeters) worn by radiation workers.

This Badge Reader system is designed using state of art electronics, electro mechanical system, embedded code and software to load and read the TLD cards for TL glow curve / dose. System facilitates entry of ID number for the person and his dose record and glow curve can be stored in the system. TL dosimeter is heated by hot gas ($N_2$) jet to 280 $^{o}$C & TL output is recorded using PMT whose integral of the current output is proportional to the dose.

It is a Thermoluminescent dosimeter based personnel monitoring system. Thermoluminescent dosimeters make use of the property of certain materials which absorb energy when exposed to X , Gamma or Beta radiation. On heating, the absorbed energy is released in the form of visible light. A plot of light intensity emitted against temperature is known as a glow curve. For a given heating rate, the temperature at which the maximum light emission occurs, is called the glow-peak temperature and it is characteristic, of the individual TL material (also called phosphor).

The quantity of the visible light emitted (TL output) is found to be proportional to the energy absorbed by the TL material. The estimation of radiation exposure may be based either on the height of the glow curve (differential method) or the area under the glow curve (integral method).
The TLD personnel monitoring system essentially consists of two major parts: TLD badge and the TLD badge reader.
The TLD Badge Reader comprises of a plastic cassette containing three Teflon TLD discs (13.3mm and 0.8mm thick) that are mechanically clipped on to circular holes (12.0mm) punched in an aluminium card (52 x 30 x 1mm).

The TLD Badge Reader is designed to measure X, Gamma and Beta radiation dose. The metal filter combination (1mm Al + 0.9mm Cu) is provided to reduce the photon energy dependence of the TL discs. The TL badge reader is calibrated such that the TL output of the disc under the metallic filter reads directly the gamma radiation dose.

# SPECIFICATIONS

**Dosimeter :** Three-element BARC $CaSO_4$ (Dy) PTFE disc dosimeter badge

**Light Measurement System :**
Photo-multiplier tube (EMI 9125A - bialkali) Light measuring system (LMS)

**Dark current :** Dark current is 1 Sv ($CaSO_4$) equivalent with software-based sampling & subtraction

**Heating Method :** Hot gas ($N_2$) heating

**Heating Cycle :** The temperature is raised to 280°C in 8 sec and clamped at 280°C

**Dose Range :**
50uSv - 5Sv (Gamma) and
100uSv – 5Sv (Beta)

**Dose Threshold :** <50uSv

**Readout time :** 100 sec. per badge

**Residual Signal :** <10% of reading

**Facilities Available :** Entry of badge ID numbers, calibration factor, etc. Storage of dose and glow curve data of badges in floppy/hard disk. Motorised driver assembly for automatic feeding of 50 dosimeter cards loaded in a magazine.

**Software :** IBM PC compatible menu driven 'C' based software opening in DOS mode for transfer of data to user defined file, storage and display of glow curves, computations of dose & generation of dose reports.

**Temperature Monitoring :** Chromel Alumel thermocouple in hot gas stream. External temperature monitoring output at the back panel.

**Range Selection :** Automatic from 9.999mSv to 5.000Sv

**Calibration :** Coarse adjustment by varying the EHT through a potentiometer in the EHT circuit; fine through software.

**Safeguards :**
Heater/Gas flow failure: The heater and gas flow are checked for failure in every dosimeter readout cycle. In the event of failure of heater or gas flow the readout is terminated and a message indicating heater / gas flow failure is flashed on the PC monitor.

**TLD CARD MAGAZINE SIDE VIEW**

Mechanical Failure : Any mechanical failure during readout cycle is sensed using a timeout watchdog programme and the cycle is terminated with an option for the user to restart the cycle. EHT or the input circuit (I-F converter) is sensed and reading cycle is terminated in case of failure.

**Nominal Power Supply :**
Power supply : 230V, 50Hz :
Power requirements : 500 VA (max including PC)

**PC Requirements :** IBM Pentium II or upward compatible, with FDD & HDD drives, VGA monitor, Serial & parallel ports with Windows 98 operating system.

**Applications :** Personnel Monitoring of radiation workers in Nuclear power stations, Isotope laboratories, Industrial radiography installations, diagnostic & therapeutic radiology centres, etc.

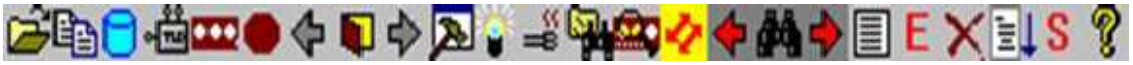
**TLD CARD MAGAZINE FRONT VIEW**

**Additional Accessories / Items Required**
(i) Three element (BARC Developed) $CaSO_4$ (Dy) PTFE disc dosimeter badges
(ii) Cassette holder
(iii) Annealing oven
(iv) Nitrogen cylinder / Generator with regulator
(v) TLD card magazine

** Note : Manufactured by NUCLEONIX SYSTEMS based on Technology* from Bhabha Atomic Research Center, *Mumbai.*

# SOFTWARE FEATURES

The software is a GUI interactive software. These options are 'ICONS' in tool bar and drop down menus in menu bar. These are the software features as given below.



1. Opens the Glow Curve file
2. Dumps Dose Report to ASCII format
3. Creates New Personnel file
4. Show/hides reader status
5. Starts Actual Readout cycle
6. Stops Readout
7. Move Magazine Backward
8. Eject Magazine
9. Move Magazine Forward
10. Reader Settings
11. Light Source Checking
12. Temperature profile Check
13. Probe Reader Check
14. Starts Test Readout Cycle
15. Magazine Movement Testing
16. Previous Glow Curve
17. Search for a Glow Curve
18. Next Glow Curve
19. List all Glow Records
20. Edit Glow curve Records
21. Delete record
22. Evaluate Dose
23. Statistical Analysis
24. Help

On opening this software normally 1, 3-6, 8-15 and 24 icons are enabled. The remaining icons are disabled. These disabled icons are enabled on opening the glow curve file.

**TLD CARD**

# Technical Data

Three CaSO4: Dy Teflon TLD discs are mechanically clipped on an Alluminium plate. An asymmetric “V” cut is provided in the card to ensure its loading in the plastic cassette as well in heater drawer / magazine of TLD reader in only one orientation. Alluminium card should be uniformly Nikel plated or buffed, having plating thickness of about 10 micron.

**DIMENSIONS OF TLD CARD:**

Dimensions of A1 card: 52.5 mm X 30.0 mm X 1.0 mm
Dimensions of hole on A1 Plate : 12.0 mm dia
Dimensions of TLD Disc : 13.3 mm dia

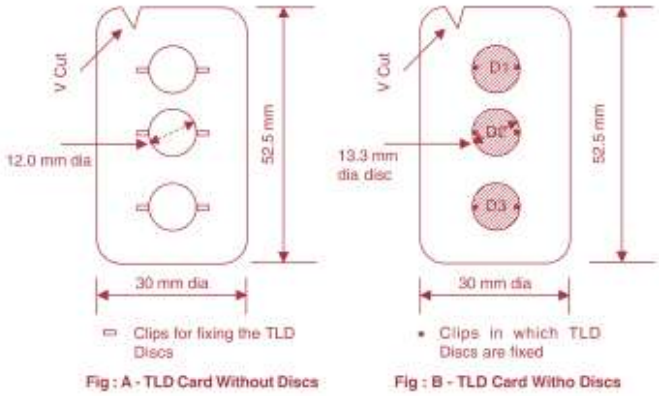



Fig : A - TLD Card Without Discs

Fig : B - TLD Card Witho Discs

Characteristics of CaSO4 : Dy Teflon TLD disc

| | | |
|---|---|---|
| Ratio of CaSO4 : Dy and Teflon | : | 1: 3 |
| Effective Atomic Number (Z) | : | 15.1 |
| Density of the TLD Disc | : | 2.52 g/cm3 |
| Softening Point of Teflon | : | $330^{o}$ C |
| Main Glow Peak Temperature | : | $230^{o}$ C |
| Sensitivity of TLD Disc | : | About 30-40 times more than LiF TLD-100 |
| Fading | : | 2-3% in six months |
| Climactic Effect | : | Negligible |
| Effect of Sunlight | : | Negligible when covered by paper wrapper & polythene pouch and loaded in the badge |
| Useful Linear Dose Range | : | 0.10 mSV to 20 SV (linearity within + 10%) |
| Reusability | : | 20 cycles |
| Beta Response | : | 60% of 60Co gammas for Nat.U (effective energy 0.8Mev) |
| Thermal Neutron Response | : | 60Co gamma ray equivalent to 2.4 mGy per 1010 n/cm2 |
| Fast Neutron Response | : | Negligible |

# TLD CASSETTE

## Technical Data

- Three well-defined regions in the plastic cassette / holder corresponding to three TLD discs of the TLD card.

  i. Disc D1- sandwiched between a pair of filter combination of 1.0mm thick Cu (Copper filter nearer to the disc).
  ii. Disc D2- sandwitched between a pair of 1.6mm thick (180mg/cm2) plastic filters and
  iii. Disc D3- under a circular open window.

- The asymmetric "V" cut of the card permits its loading in the plastic cassette in only one orientation and ensures proper positioning of three disc.

- For identification purposes, photograph of the user could also be permanently fixed on the central transparent region of the badge.

- There are two types of TLD badges/ cassettes in use namely,

  1. Chest Badge for whole body monitoring and
  2. Wrist Badge for extremity dosimetry

  Though the dosimeter and design of both TLD badges are same, they have different attachment (clip/strap) for wearing purpose depending on their use.

**TLD CASSETTE DIMENSIONS**

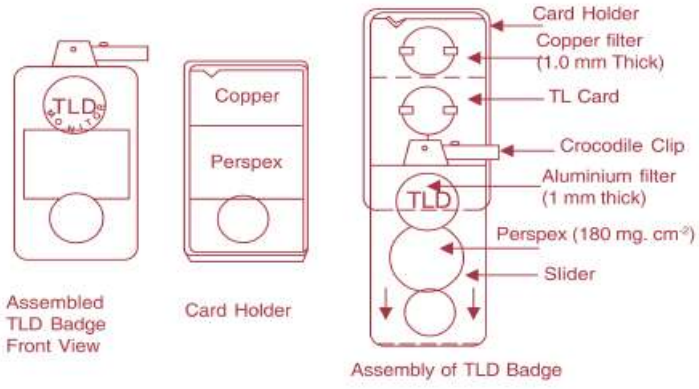
In this design of the TLD cassette, dimension of some of the filters was altered and crocodile clip was replaced by a smaller size clip. The cassette was made of ABS plastic (white) and filters were embedded into the plastic body.

**Dimensions :**
**Main Body :**

| | | |
|---|---|---|
| Cu filter (rectangular) | : | 32 mm x 16 mm x 1mm |
| A1 filter (circular) | : | 13.6 mm x thickness – 0.6 mm |
| Plastic filter (rectangular) | : | 30.5 mm x 21 mm x 1.6 mm |
| Open window | : | Dia – 14.5 mm |

**Slider part :**

| | | |
|---|---|---|
| Cu filter (rectangular) | : | Dia – 15.6 mm, x thickness – 1 mm |
| A1 filter (circular) | : | Dia – 12.6 mm, x thickness – 0.6 mm |
| Plastic filter (rectangular) | : | Dia – 25 mm, x thickness – 1.5 mm |
| Open window | : | Dia – 13.5 mm |



## SPECIFICATIONS OF HOT AIR ANNEALING OVEN

| | | |
|---|---|---|
| Working Chamber Size | : | 12” x 12” x 12” (APPROX) |
| Working Temperature | : | From ambient to 350$^{0}$C / 400$^{0}$C |
| Temperature Accuracy | : | + / - 1$^{0}$C |
| Temperature Indication & Control | : | By Automatic Electronic Digital Display Controller cum Indicator with Thermocouple. |
| Time Setting | : | By an Electronic Digital Timer of 0-1 minutes with associate logic circuit for setting the period of annealing and automatically putting off the heater and even after the set period. |
| Air Circulation System | : | For maximum uniformity of temperature inside the working chamber, air circulating system is provided by means of a meter driven fan. |
| Heaters | : | Heaters are made out of best quality Nichrome Wire insulated with refractory runners and enclosed in stainless steel sheet and fitted to the sides of the Oven. |
| Construction of Oven Body | : | The Oven body will be of triple walled construction with inner and middle wall made out of S.S. 304 material and outer wall made out of C.R.C.A. sheets duly painted or power coated. |
| Door | : | An insulated hinged side swinging type double walled door (inner S.S. 304 and outer H.S.) with asbestos gasket, ball catch lock and handle provided for easy and effortless closing & opening of door. |
| Insulation | : | High grade ceramic fibre blanket insulation is provided on all the six sides of the Oven. |
| Power Rating | : | 2.5 K.W. |
| Input Supply | : | Single Phase AC, 230 Volts |
| Trays/Shelves | : | 2 Nos. Stainless Steel trays provided. |