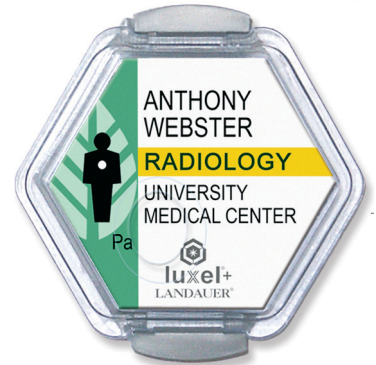


## Luxel®+ Dosimeter for X, Gamma, Beta, and Neutron Radiation

Luxel+ dosimetry service provides x, gamma, and beta radiation monitoring with optically stimulated luminescence (OSL) technology. OSL technology is the newest advancement in passive radiation protection dosimetry that improves on the best features of traditional film and TLD technologies. Neutron detection, processed with Track Etch® technology, is optional where the CR-39 is incorporated within the Luxel+ dosimeter's clear plastic pack. Luxel+ can be packaged for personnel monitoring, area monitoring, emergency response or other specialized services.

Luxel+ offers complete reanalysis to confirm the radiation dose measurement, imaging of unique filter patterns that provide diagnostic capabilities to identify static or dynamic states during radiation exposure, increased sensitivity and precision, a wide dynamic range of measurement, and excellent long-term stability. In addition to these technological advancements, Luxel+ can be customized to meet the administrative needs of a radiation monitoring program through graphic, color, and packaging design options.

Landauer's comprehensive full service provides automatic exchange out of dosimeters for each wear period, accredited dose of record processing and analysis, data management, reporting of exposure results, and customer service and technical support programs. In addition to Landauer's full range of diagnostic evaluation and reporting services, many ancillary services are available including direct computer access via the Internet to Landauer's database for exposure reports, shipment tracking and account maintenance transactions.



### Administrative Design Features

The look of Luxel+ can be specialized through the selection of various combinations of graphic formats and background options to help identify groups and wear dates. Optional features such as department (series) color-coding, company logos, and custom instructions that can further specialize dosimeters are available for an additional charge.

The name of the account and worker, and a dosimeter placement icon indicating correct placement of the dosimeter is shown on the front of the Luxel+ basic design. The account and participant numbers, wear date, dosimeter use location, serial number, and the dosimeter and component bar codes, all ensuring chain of custody, appear on the back of the dosimeter.

### Background and Graphic Format Options

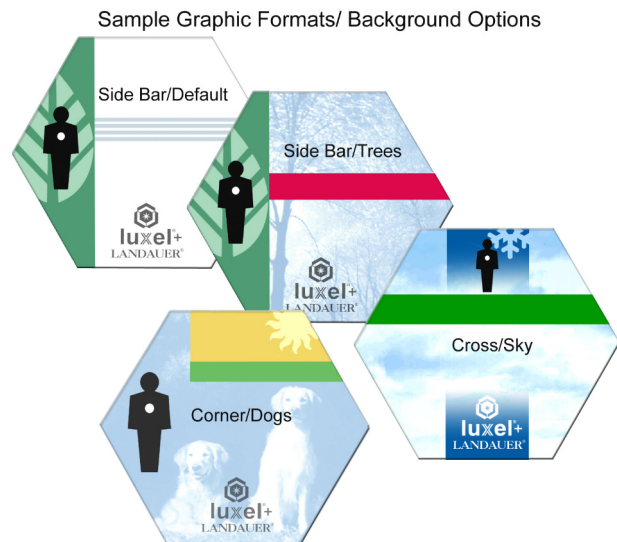
Choose between any combination of four background options and three graphic formats. Background options are no background (default), Dogs, Sky or Trees. Graphic formats are Side Bar (default), Corner or Cross. The graphic formats change in color with each exchange frequency and each season has its own unique icon to help distinguish wear dates.

### Department Groupings (Series)

Shipments are sent to a central location or can be divided into separate groups for shipping to one site or to multiple sites (series) at the same address or to different addresses. Series within accounts are segregated on dosimetry reports, the site name is printed on the face of the dosimeter, and a series code is printed on the back of the dosimeter. The site name on the face of the dosimeter is printed over a gray line graphic (default) or can be color coded for easy identification in a choice of six different colors.

### Dosimeter Placement Icons

Icons on the face of the dosimeter identify the correct placement of the dosimeter, and a written description is included on the back of the dosimeter for verification. Icons include all whole body and extremity use, area monitoring, and a special icon designed for fetal monitoring.



### Holder

A Finite Element Analysis (FEA) study was used to develop the most durable holder available. The dosimeter simply snaps into the holder.

The standard holder has an alligator clip for secure fastening to clothing. In areas where no metal material is allowed, a clip made from all plastic can replace the standard plastic and metal alligator clip. Area monitor holders have Velcro® tabs with adhesive backing for easy surface placement.

### Packaging

Luxel+ can be packaged for personnel monitoring, area monitoring, emergency response or other specialized services. Standard packaging ships each dosimeter individually wrapped in cellophane along with a card containing account and worker information that can be customized with a message to the entire account, a department (series), or a specific worker.

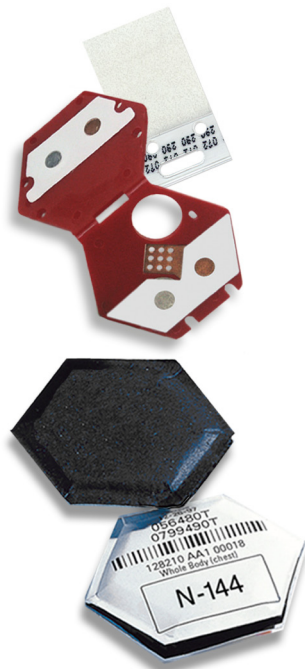
## Luxel®+ Dosimeter for X, Gamma, Beta, and Neutron Radiation

### Luxel+ and OSL Technology

Landauer grows the specially formulated aluminum oxide ( $\text{Al}_2\text{O}_3:\text{C}$ ) crystalline detector material. The  $\text{Al}_2\text{O}_3$  detector is then configured into a thin strip sandwiched within a multi-element filter pack. The filter pack is heat sealed within a laminated, light-tight paper wrapper creating an integrated, self-contained packet that is RF (radio-frequency) sealed inside a tamper-proof plastic blister pack to eliminate possible mishandling, light leakage, or lost detection elements.

Luxel+ may be used for up to one year. It is unaffected by heat, moisture, and pressure when the clear blister pack is uncompromised.

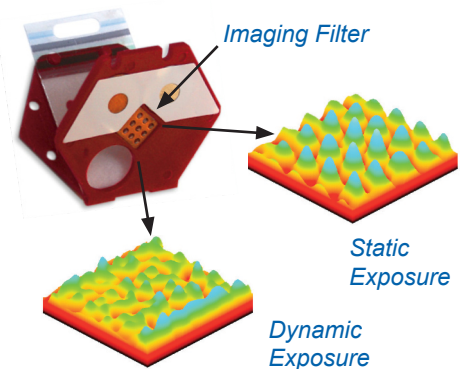
Radiation exposure is measured in Landauer's laboratory by stimulating the  $\text{Al}_2\text{O}_3$  material with selected frequencies of laser light causing it to luminesce in proportion to the radiation dose and the intensity of stimulation light. The luminescence measured is applied to a dose algorithm that relies on the response ratios between different filter positions within the dosimeter to discriminate between beta and photon (x and gamma) radiation fields to determine exposure results.



### Analysis

The  $\text{Al}_2\text{O}_3$  detector can be restimulated numerous times to confirm the accuracy of a radiation dose measurement. A full reanalysis is automatically performed for every measurement yielding a dose in excess of 500 mrem (5 mSv).

The filter pack imaging area renders unique filter patterns that provide qualitative information about conditions during exposure. Imaging to identify static, dynamic, or contamination conditions is automatically performed for low-energy photon measurements yielding a dose in excess of 500 mrem (5 mSv). Imaging capabilities are inconclusive at energies exceeding 150 keV.



Reanalysis or imaging at doses less than 500 mrem (5 mSv) can be requested. Imaging is not available for doses less than 50 mrem (500  $\mu\text{Sv}$ ).

A static exposure image indicates the dosimeter may not have been worn at the time of exposure. This is verified by the distinct grid patterns in the filter pack imaging area. A static exposure implies that an accidental exposure may have occurred with the dosimeter.

A dynamic exposure image indicates the dosimeter was moving at the time of exposure. This is verified by the blurred grid patterns in the filter pack imaging area. A dynamic exposure implies that the dosimeter was worn at the time of exposure, and the reported dose is valid.

### Technical Specifications

Radiations Measured	Photon (X and Gamma Ray)	Beta Particle	Neutron
Detector	$\text{Al}_2\text{O}_3$ (Aluminum Oxide)	$\text{Al}_2\text{O}_3$ (Aluminum Oxide)	Optional Neutrak® detector inside dosimeter (CR-39)
Analysis Method	Optically Stimulated Luminescence (OSL)	Optically Stimulated Luminescence (OSL)	Chemical etching followed by track counting (Track Etch®)
Energies Detected	5 keV to in excess of 40 MeV	150 keV to in excess of 10 MeV (Expressed as Average Energy)	Fast: 40 keV to 40 MeV Thermal/Intermediate: 0.25 eV to 40 keV
Dose Measurement Range	1 mrem to 1000 rem (10 $\mu\text{Sv}$ to 10 Sv)	10 mrem to 1000 rem (100 $\mu\text{Sv}$ to 10 Sv)	Fast: 20 mrem to 25 rem (200 $\mu\text{Sv}$ to 250 mSv) Thermal/Intermediate: 10 mrem to 5 rem (100 $\mu\text{Sv}$ to 50 mSv)
Accuracy	<b>Deep Dose</b> (Hp 10) $\pm 15\%$ at the 95% confidence interval for photons above 20 keV <b>Shallow Dose</b> (Hp 0.07) $\pm 15\%$ at the 95% confidence interval for photons above 20 keV and beta particles above 200 keV		
Accreditations, Approvals, Licenses	<b>NVLAP</b> (NVLAP Lab Code 100518-0) for Whole Body (ANSI HPS N13.11-2001) in the comprehensive subcategory "General" in all categories including VI when neutron component is added; and for extremity (ANSI HPS N13.32-1995). <b>HSE</b> (Health and Safety Executive) United Kingdom approved for Whole Body (OSL) and Whole Body Neutrons. <b>DOELAP</b> (Department of Energy Laboratory Accreditation Program). <b>CNSC</b> (Canadian Nuclear Safety Commission) Dosimetry Service License.		