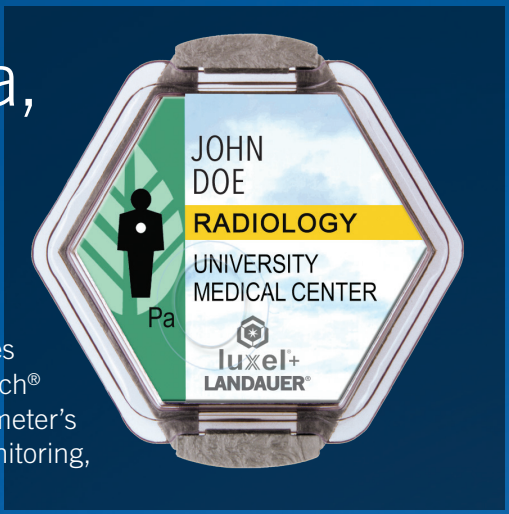
LANDAUER®

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 advanced 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.

The LANDAUER radiation dosimetry service includes a full range of diagnostic evaluation and reporting services accessed through your personalized myLDR portal.

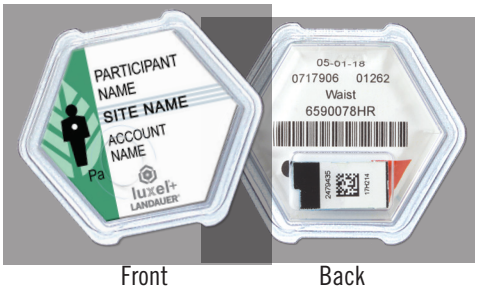
Luxel®+ OSL Technology and How it Works

LANDAUER grows the specially formulated aluminum oxide (Al_2O_3:C) crystalline detector material. The Al_2O_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 (radiofrequency) 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 the LANDAUER laboratory by stimulating the Al_2O_3 material with selected frequencies of laser light causing it to luminesce in proportion to the amount of radiation exposure. 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.

Dose equivalents arising from exposures to photons (X or gamma rays) will have a deep, lens of eye and shallow value reported. Depending on the energy of the X or gamma rays, these values may or may not be equal. Beta exposures are reported only as a shallow dose equivalent.



Front Back

Filter Pack

Al_2O_3 Detector

CR-39

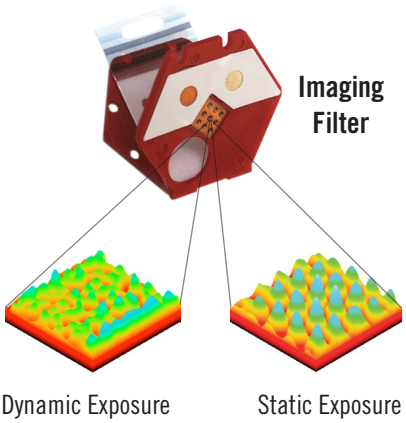
Analysis

The Al2O3 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 all beta and 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 µSv).

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.

Luxel®+ Technical Specifications

Radiations Measured	Photon (X and Gamma Ray)	Beta Particle	Neutron
Detector	Al_2O_3:C (Aluminum Oxide)	Al_2O_3:C (Aluminum Oxide)	Optional Neutrak® 144 detector inside dosimeter (CR-39)
Analysis Method	Optically Stimulated Luminescence (OSL)	Optically Stimulated Luminescence (OSL)	Chemical etching followed by track counting
Energies Detected	5 keV to in excess of 40 MeV	150 keV to in excess of 10 MeV	Fast: 40 keV to in excess of 35 MeV Thermal: under 0.5 eV
Dose Measurement Range	1 mrem to 1000 rem	10 mrem to 1000 rem	Fast: 20 mrem to 25 rem Thermal: 10 mrem to 5 rem
U.S. Accreditation	Accredited by NVLAP® (LAB CODE 100518-0) in subcategory general and in all categories including V1 when neutron component is added		
International Accreditation	Internationally accredited in many countries such as Canada, UK, Russia, Australia and many more		

Luxel®+ and Track Etch Technology

The optional Neutrak detector available for an additional charge is a CR-39 (allyl diglycol carbonate) based, solid-state nuclear track detector that measures exposure due to neutrons. It is not sensitive to X, beta or gamma radiation, and is sealed inside the Luxel®+ plastic blister pack to eliminate possible mishandling or lost detection elements. The CR-39 is laser engraved for permanent identification to assure chain-of-custody.

The fast neutron option uses a polyethylene radiator for fast neutrons that records recoil protons resulting from neutron interactions in the dosimeter. The thermal/ intermediate neutron option has a dosimeter design intended for fast, intermediate, and thermal neutrons. The left area of the chip uses a polyethylene radiator for fast neutrons while the right area uses a boron loaded Teflon® radiator fast, intermediate, and thermal neutrons that records alpha particles resulting from neutron interactions in the dosimeter.

During analysis in our laboratory, the CR-39 is etched for 15 hours in a chemical bath to enlarge exposure tracks. The fast neutron dose is measured by counting the tracks generated as a result of the proton recoil with the polyethylene radiator, while the thermal/ intermediate dose is measured by counting the alpha tracks generated with the boron radiator.

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 (subaccount) color-coding and company logos 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), Cross or Corner. If the corner graphic is selected, wear dates will appear on the front of the dosimiter instead of the back. The graphic formats change in color with each exchange frequency and each season has its own unique icon to help distinguish wear dates. Use the default color sequence, or select among six colors for a custom color sequence.

Department Groupings (Subaccount)

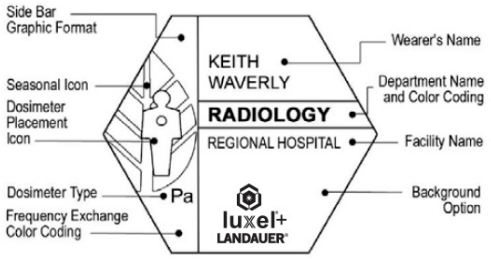
Department groupings within accounts are available for an additional charge. This service segregates departments on dosimetry reports, prints the department name on the face of the dosimeter, and a subaccount code on the back of the dosimeter. The department's name on the face of the dosimeter is printed 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.

Collar and waist dosimeters have color-coded icons for quick and easy placement when two dosimeters are required to be worn at the same time. One example is EDE 1, a special dose calculation where one dosimeter is worn at the waist level under a lead apron and one dosimeter is worn at the collar level outside the lead apron. Special dose calculations permit departure from the LANDAUER standard dose assessment protocol in order to provide a more accurate estimation of radiation dose under special circumstances as determined by the Radiation Safety Officer. Special dose calculations can be applied to an individual, a department (subaccount), or to an entire account.

Basic Luxel®+ Design



Graphic Format Options

Sidebar
(default)

Cross

Corner
(Wear dates appear on the front of the corner graphic)

Background Options

Blank
(default)

Dogs

Trees

Sky

Color Coding by Exchange Frequency

Snowflake

Flower Petals

Green Leaf

Hot Sun

Maple Leaf

Autumn Tree

Dosimeter Placement Icons

Whole Body

Collar

Waist

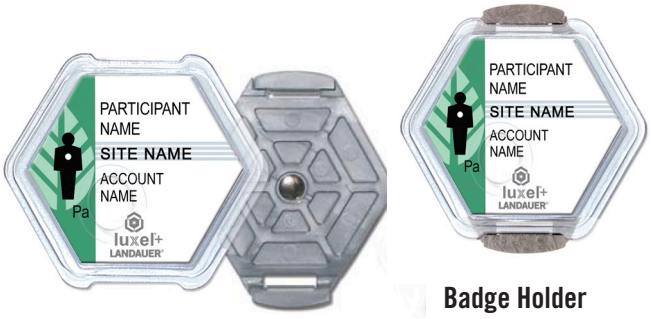
Fetal

Area

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.



Badge Holder

Packaging

Luxel®+ is packaged for personnel monitoring, area monitoring, emergency response or other specialized services. Standard packaging ships a set of up to 10 dosimeters in a plastic bag with messaging. Unused dosimeters returned to LANDAUER without the tab removed are automatically reported as unused (excluding control dosimeters).

Optionally, dosimeters can be sealed within a heavy-duty vinyl tamper resistant pouch that can have multiple slots to permit several methods of attachment for use with a snap-on strap and alligator clip or various length straps for extremity use. Emergency response packaging includes a customer designed informational card sealed within the vinyl pouch.

The polybag mailer is a 2-way bag that is environmentally friendly and compliant with postal regulations. Return all your used, unused and control dosimeters in this bag.

To keep the bag intact for returns, please carefully tear off only the very top portion—at the first perforation—and then apply the supplied LANDAUER return shipping label to the front to return. Use of LANDAUER furnished label carries a fee; otherwise you can apply appropriate postage to the package.

Tab Removal

Heavy-duty Pouch

Dosimeter Packaging

Shipping Envelope