

Radiation Dosimetry Badges: A Primer for Users and Managers

1.0 ASRT Continuing Education Credit

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Specific examples used in the tutorial refer to the Landauer Luxel® badge, but the general concepts apply to dosimeters from any company.

No Artificial Intelligence was used in the generation of this tutorial or the accompanying quiz

1. The Basics

Who is required to use a body dosimetry badge?

- a) Individuals *likely* to receive occupation dose higher than 500 mrem Deep Dose Equivalent (DDE), 1,500 mrem Lens Dose Equivalent (LDE), or 5,000 mrem Shallow Dose Equivalent (SDE) in a calendar year. These values work out to be 10% of annual Occupational Dose Limits (ODLs) for adults.
- b) Minors (below age 18) *likely* to receive more than 100 mrem DDE; 150 mrem LDE ; or 500 mrem SDE, in a calendar year.
- c) Declared pregnant women *likely* to receive more than 100 mrem DDE during the pregnancy.
- d) Individuals who *may* enter High Radiation Areas (*i.e.*, areas with dose rates > 100 mrem in 1 hour at 30 cm from the source) or Very High Radiation Areas (*i.e.*, areas capable of delivering >500 rad absorbed dose at 1 meter from the source). These apply to Radiation Therapists because they can be near an HDR therapy source. They do not include Diagnostic x-ray or CT rooms.
- e) Anyone who *operates* a medical fluoroscope (*i.e.*, steps on the pedal or operates the hand-switch) – [this is a specific Massachusetts requirement](#).
- f) Nuclear Medicine technologists and other individuals who *handle* radioactive materials. They may also need to wear ring badges. This is not by way of regulation, but a condition of the radioactive materials license.

How often should dosimetry badges be replaced ?

Wear periods can be monthly, bi-monthly, or quarterly. The frequency depends on facility workload. Nuclear Medicine badges are typically monthly, unless the workload is low. Fetal badges are also monthly. At most facilities, workers in Cardiac Cath Labs and other Interventional Fluoroscopy rooms also use monthly badges because they tend to get more occupational dose than other departments.

Who does not need to wear a personal dosimeter?

Individuals who are *occasionally* exposed to radiation, or are not likely to receive more than 10% of annual occupational dose limits, do not need badging. Examples:

- a) EKG / Stress test techs present near the treadmill during a nuclear medicine stress test.
- b) Ultrasound and Echo technologists performing a study on a patient who has undergone a nuclear medicine procedure.
- c) X-ray technologists who perform only CT, general radiography, dental radiography, mammography or bone densitometry (*i.e.*, do not perform, or assist in fluoroscopy or CT fluoroscopy): the vast majority receive well under the threshold for badging, making it unlikely that badging is needed. Operators of dental x-ray units (such as dental hygienists) have a specific regulatory exemption from badging.
- d) Bystanders such as nurses, anesthesiologists, PAs, scrub technicians and other personnel present in the room or area where fluoroscopy is performed.
- e) Pregnant women who have chosen not to declare their pregnancies (*i.e.*, non-declared pregnant women).
- f) Pathologists and laboratory technicians who handle human tissues or fluids that may contain residual radioactive materials from diagnostic or therapy patients.
- g) Facilities personnel who clean restrooms used by nuclear medicine patients, or occasionally handle wastes contaminated with radioactive materials.

If you fall into one of the above categories, you may be issued a badge, but this is only to determine whether you are likely to receive more than 10% of annual occupational dose limits. Once such a determination is made, it is reasonable to discontinue badging if the 10% limit is not exceeded; the reason for discontinuation is documented for regulatory review. In some cases such as cardiac cath labs and fluoroscopically guided interventional procedure rooms, monitoring of bystander personnel may be permanent.

What are the annual Occupational Dose Limits (ODLs) for adults?

Body Region	Annual Limit (mrem)	Trigger Level for badging*
Whole Body (<u>DDE</u> or Deep Dose Equivalent), which includes the head, neck, trunk, arms down to elbows and legs down to the knees.	5,000	500
<i>The DDE standard protects radiation workers from the stochastic (cancer-causing) risk of ionizing radiation.</i>		
Extremities (<u>SDE</u> or Shallow Dose Equivalent), which includes arms below the elbows and legs below the knees, the skin, and any individual organ of the body except the eye.	50,000	5,000
Lens of the eye (<u>LDE</u> or Lens Dose Equivalent).	15,000	1,500
<i>The SDE and LDE standards protect radiation workers from the deterministic (tissue-reaction) risk of ionizing radiation. The LDE standard is specific for radiation-induced cataracts.</i>		
Individual members of the public (excluding natural background and medical procedures)	100	N/A

* Nuclear Medicine technologists and other individuals who handle radioactive materials have to wear badges and rings even if their exposures are below these trigger levels. Similarly, operators of medical fluoroscopes in Massachusetts require badging irrespective of obtained dose.

Badge readings that indicate ALARA* status

Wear period	Approximate mrem that indicates the user is at or below ALARA		
	DDE	SDE	LDE
Monthly	40	400	125
Bi-monthly	80	800	250
Quarterly	125	1,250	375

*ALARA = As Low As Reasonably Achievable. Typically set at 10% of ODLs.

How does the Landauer Luxel[®] badge work?

Unlike the film badges (which Landauer discontinued at the end of 1999), this dosimeter used Optically Simulated Luminance (OSL) technology. A thin layer of aluminum oxide (Al_2O_3) receives the radiation that the badge is exposed to, parts of it having passed through filters. During analysis, the Al_2O_3 layer is stimulated with a laser, and emits visible light in proportion to the amount of radiation it was exposed to. The analysis can also indicate whether the exposure was static (stationary throughout the exposure, indicating accidental exposure) or dynamic (moving around during exposure, indicating that the user was probably exposed). The badge can be analyzed more than once.



How are DDE, SDE and LDE measured on the badge?

DDE: dose equivalent at a tissue depth of 1 cm

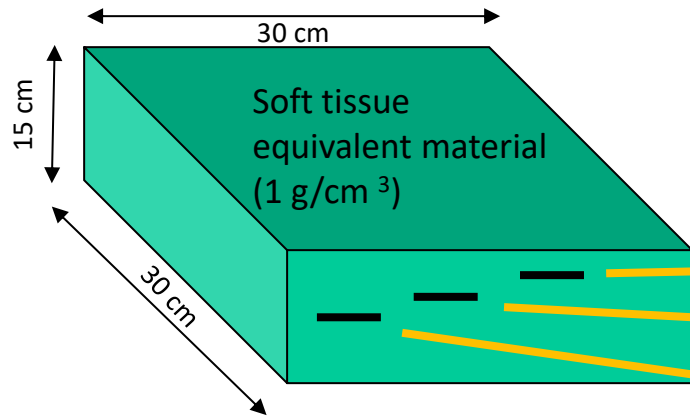
SDE: dose equivalent at a tissue depth of 0.007 cm (0.07 mm, or 70 microns) averaged over a 1 square cm area

LDE: dose equivalent at a tissue depth of 0.3 cm

These depths are stimulated by the filters present in the badge

Dynamic vs. Static exposures are determined by examining the dose distribution patterns behind the imaging filter, shaped like a grille. Distinct dots behind the grill indicate static exposure (the badge may have been left in an x-ray room for an extended period), while a smeared dose distribution would indicate that it was worn during the wear period, reflecting true dose to the user.

What is the rationale behind depth measurements as they relate to the three readings from a dosimetry badge ?



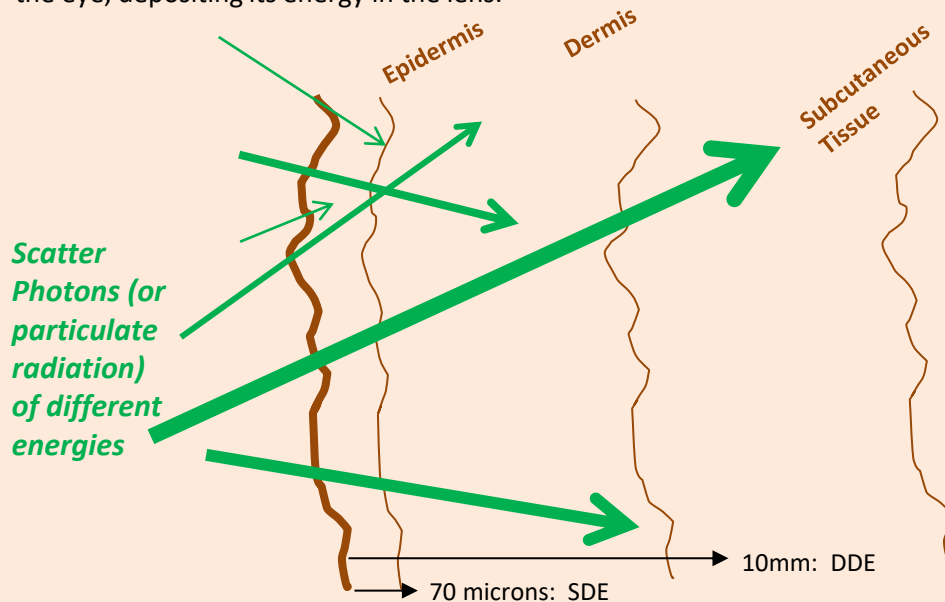
If a piece of material with density similar to soft tissue (plastic, 1 g/cm³), of dimensions 13 x 30 x 15 cm were to be exposed to ionizing radiation, dose at 10 mm, 3 mm and 0.07 mm in that material are considered equivalent to DDE, LDE and SDE in a human.

SDE = 0.07 mm (70 microns) depth

LDE = 3 mm depth

DDE = 10 mm (1 cm) depth

Schematic diagram of skin, showing the outer epidermal layer of cells, approximately 70 microns deep that are constantly replenished, the dermis, and subcutaneous tissue. Radiation workers are primarily exposed to scatter radiation, which travels in all directions. Most of these scatter photons encountered in diagnostic imaging (or low energy alphas and betas) are not energetic enough to deposit their energy beyond the outer layer of skin cells, and do not count towards occupational dose. Only photons (or higher energy particulates) that deposit their energy at greater depths contribute to dose. Similarly, dose deposited at a depth of 3 mm in the plastic material is equivalent to radiation traversing the cornea and anterior chamber of the eye, depositing its energy in the lens.



Incident radiation
(3 mm depth equivalent: LDE)

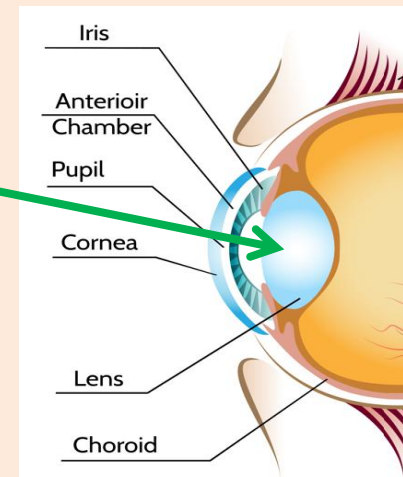


Image source
<https://www.magnific.com/free-photos-vectors/eye-diagram-sketch>

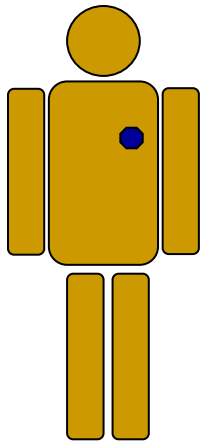
2. Types of dosimetry badges and how to use them

a) Whole Body (Chest) Badge



This is the most common badge, issued to more than 95% of users.

It displays a BLACK human-shaped icon on the front with a white dot indicating where the badge should typically be worn. The back of the badge contains the words 'Whole Body (Chest)'.

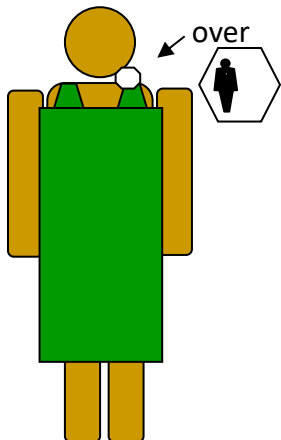


Commonly called a 'back body badge'.

Can be used with or without a lead protective garment.

Ideally worn at chest level when not wearing a lead apron. It is also OK to wear it anywhere between waist and collar, oriented towards source of radiation.

Move it to the COLLAR level when wearing a lead protective garment, OUTSIDE the lead apron or leaded thyroid shield.

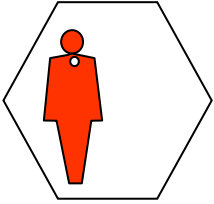


The badge measures exposures assuming worst case conditions (*i.e.*, you do not get credit for wearing leaded protective garments).

If badge readings indicate exposures above ALARA, and you require a credit for wearing a lead protective garment, you are switched to a collar badge.

b) Collar badge with EDE-2 Assigned Dose calculation

This is the 'intermediate level' badge



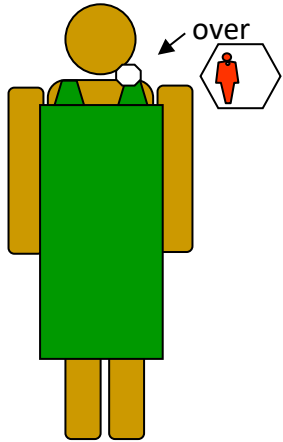
It displays a RED human-shaped icon on the front with a white dot indicating where the badge should typically be worn. The back of the badge contains the word 'Collar'.

Commonly called a 'red neck badge'.

It is suitable for whole-body badge users who routinely receive exposure readings above ALARA, and therefore need credit for wearing lead protective garments.

It is suitable only for users who get ALL their radiation exposure while wearing lead protective garments.

If you are occupationally exposed both while wearing lead garments (e.g., in fluoroscopy) and while not wearing lead garments (e.g., in Nuclear Medicine), and need credit for wearing lead protective garments because badge readings are above ALARA, you have to use two badges: a collar badge as well as a whole body badge.



The badge must be worn ONLY at collar level, OUTSIDE the lead apron or leaded thyroid shield.

Landauer must be instructed to perform an **EDE-2** (Effective Dose Equivalent) Calculation. This calculation results in Assigned Dose, which provides 70% credit for a lead protective garment.

This calculation only applies to DDE, not to SDE or LDE.

Assigned Dose = (Collar reading x 0.3)

*Example: If the measured dose was 180 mrem,
Assigned Dose = $180 \times 0.3 = 54 \text{ mrem}$
Dose went down **70%** by this calculation*

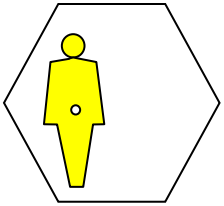
If properly set up with Landauer, the report will have a note stating 'ASSIGNED DOSE BASED ON EDE-2 CALCULATION'.

Difference between Whole Body badge worn at neck, and Collar badge?

You cannot do a EDE-2 Calculation on a whole body badge. The calculation is accurate and valid only if done on a designated collar badge.

c) Double Badge (Waist and Collar) System with EDE-1 Assigned Dose calculation

This is the 'advanced level' badge.



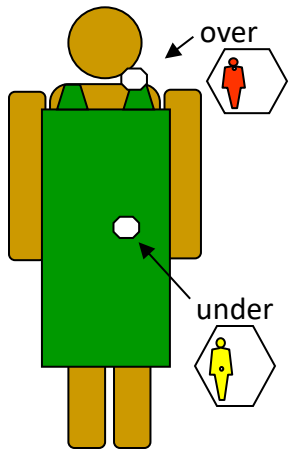
It displays a YELLOW human-shaped icon on the front with a white dot indicating where the badge should typically be worn. The back of the badge contains the word 'Waist'.

Commonly called a 'yellow belly badge'

This badge is only suitable for collar badge users (obviously, who receive all their exposure while wearing lead protective garments) with EDE-2, whose assigned doses are still above ALARA, and therefore need more accurate dosimetry measurements.

It must be worn only as a two-badge system, together with the collar badge. The collar badge must be worn at collar level, OUTSIDE the lead apron or leaded thyroid shield. The waist badge must be worn at the waist level, UNDER the lead protective garment.

Landauer must be instructed to perform an **EDE-1** (Effective Dose Equivalent) Calculation. This calculation results in Assigned Dose, which provides proper credit (typically >90%) for a lead protective garment. This calculation only applies to DDE, not SDE or LDE.



Assigned Dose = (Collar reading x 0.04) + (Waist reading x 1.5)

Example: If the measured dose was 180 mrem on the collar badge and 2 mrem on the waist badge,

Assigned dose = $(180 \times 0.04) + (2 \times 1.5) = 7.2 + 3 = 10.2 \approx 10 \text{ mrem}$

*Notice how the dose went down **94%** by this method. The exact % decrease depends on the collar and waist readings*

If properly set up with Landauer, the report will have a note stating 'ASSIGNED DOSE BASED ON EDE-1 CALCULATION'.

For two-badge users, LDE is reported for the badge placed closer to the eye (i.e., the collar badge). The reported eye dose is not corrected for the anatomical location of the eye, and therefore is an overestimate of true dose. In addition, there are no approved methods currently available to factor-in the protection from leaded eye protective devices.

Although the two-badge system with EDE-1 provides a more robust assessment of personal exposure than a collar badge with EDE-2, it has high potential risks for mistakes.

Both badges **MUST** be worn together, and they **MUST** be positioned properly (red: neck; yellow: belly) each time. If they are switched *even once* during the wear period, it invalidates the calculation, and makes the readings suspect.

Useful rule-of-thumb while assessing a 2-badge dosimetry report:

If the collar badge has a 3 digit DDE value, the waist badge should have a very low 1-2 digit value. This indicates proper wearing during the entire wear period.

Example: If the user wears badges properly:

*Suppose the measured dose was 180 mrem on the collar badge and 2 mrem on the waist badge,
Assigned dose = $(180 \times 0.04) + (2 \times 1.5) = 7.2 + 3 = 10.2 \approx \mathbf{10 \text{ mrem}}$*

If the badges in the above example were reversed for the entire wear period:

Collar badge reading = 2 mrem; waist badge reading = 180 mrem

Assigned dose = $(2 \times 0.04) + (180 \times 1.5) = 0.08 + 270 = 270.08 \approx \mathbf{270 \text{ mrem}}$

Notice how the assigned dose increased because of the user's carelessness

If the badge in the same example was reversed once during the wear period:

Suppose collar badge reading = 10 mrem; waist badge reading = 172 mrem

Assigned dose = $(10 \times 0.04) + (172 \times 1.5) = 0.4 + 258 = 258.4 \approx \mathbf{254 \text{ mrem}}$

If the badge in the same example was reversed a few times during the wear period:

Suppose collar badge reading = 50 mrem; waist badge reading = 132 mrem

Assigned dose = $(50 \times 0.04) + (132 \times 1.5) = 2 + 198 = \mathbf{200 \text{ mrem}}$

Notice how the dose was tainted even with a one-time switching of badges

This is the reason why it is preferable to use the less robust, but more reliable single collar badge with EDE-2 than the more robust, but unreliable two-badge system with EDE-1, especially for users who are known to be distracted and habitually mix up their badge wearing locations.

If the two badge system is worn properly, the waist badge reading should be minimum or very low, compared to the collar reading.

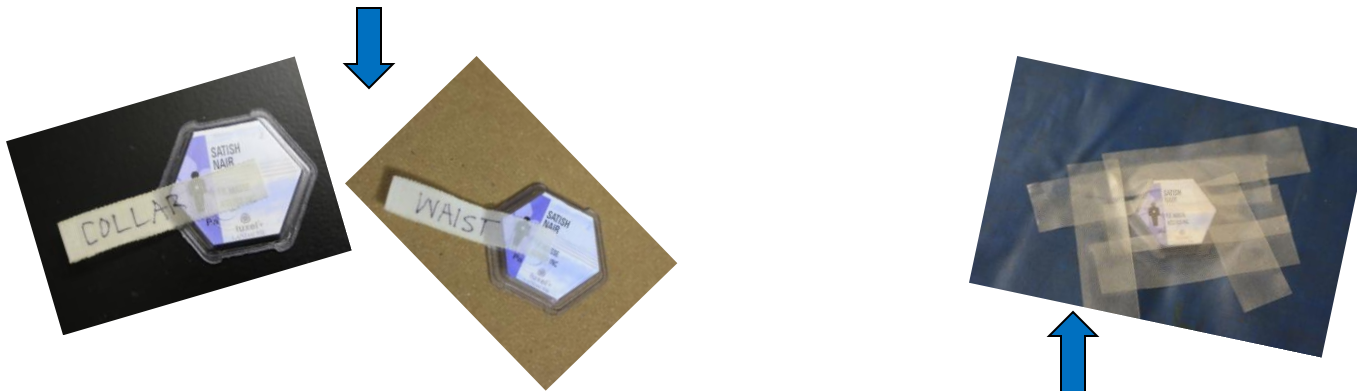
Proper placement of waist badge under a lead protective garment:

- (a) Clip the badge to the user's scrubs waistband or drawstring
- (b) Place the waist badge in the scrubs / pant pocket
- (c) Do not place the waist badge in the lead-jacket pocket, because the pocket is not leaded
- (d) Short users donning a lead skirt/jacket should not clip the waist badge to seam of the lead skirt, because it can frequently be exposed to radiation while the user is moving around

In every case, ensure that that both badges are unclipped at the end of the procedure, and returned to the badge board or other storage location

Suggested ways to increase compliance while using the two-badge system:

- (a) Assign specific personnel to observe two-badge users and ensure that they wear their badges properly before they are scrubbed in for the procedure.
- (b) Place additional, clearly worded labels on the badges.



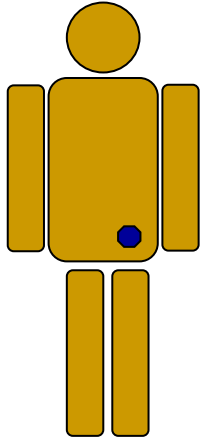
- (c) In some departments, the waist badge is taped to the underside of a lead apron or skirt. While this is an appealing method in theory, IT IS NOT A GOOD IDEA IN PRACTICE, because such badges tend to be forgotten and not returned on time for processing. Lead garments are constantly moved around in the hospital, and the badges taped to them frequently get lost.

d) Fetal Badge



This is typically a monthly badge, although bi-weekly badges can be obtained (an not necessary).

It displays a BLACK female-shaped icon on the front with the logo of a fetus. The back of the badge contains the words 'Fetal'.

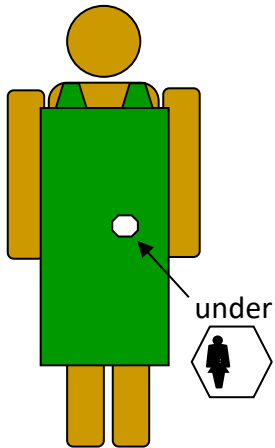


Can be used with or without a lead protective garment. If not wearing lead protective garments, wear the badge at the WAIST level.

If wearing lead protective garments, wear the badge UNDER the lead garment at the WAIST level.

Since the badging threshold is *the likelihood of receiving 100 mrem during pregnancy*, workers who may not be regularly badged (for instance, because they receive <10% of annual occupational dose limits) can qualify for a fetal badge.

The monthly fetal exposure should not exceed 50 mrem (this is not a regulation, but an NCRP recommendation). The regulatory limit for the unborn fetus of a declared pregnant woman is 500 mrem during gestation. In the vast majority of cases, exposures are negligible.

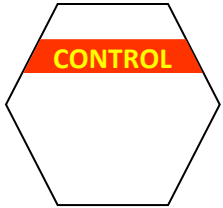


Remember to discontinue the badge at the end of the pregnancy, or if the user has withdrawn her pregnancy declaration.

What is a pregnancy declaration? A formal document in writing addressed to the Radiation Safety Officer (or manager, at facilities without an RSO), signed and dated by the declaring woman, providing the month and year of conception. The declaration is entirely voluntary. It can be withdrawn in writing at any time, for any (or no) reason, by the same woman. Women have the right to declare their pregnancy, or continue working as non-declared workers.

A fetal badge worn by an non-declared pregnant woman is considered an informal dosimeter. It has no legal standing. The badge report from this dosimeter is not admissible in a US court of law. That is a disadvantage of being a non-declared pregnant worker.

e) Control Badge



This badge is kept at badge board or other badge storage location.

Each badge board / storage location should have a control badge.

The storage location must be in a low background radiation area.

The purpose of the control badge is:

- to gather natural background radiation when while at the facility
- to gather cosmic radiation while the badges are in flight
- to gather radiation from airport mail scanners
- and to subtract all these from the user's badge readings.



TLD Ring
badge
control

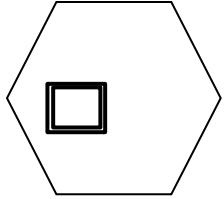
Each time badges are mailed, they **MUST** be accompanied by a control badge.
Sufficient numbers of control badges should therefore be ordered.

If no control badge is ordered, Landauer can be instructed to:

- use historical control badge readings , or
- subtract a set value for control, typically 6 mrem/month
- having a proper control badge is better than these two options.



f) Area Monitor Badge



Used for monitoring certain areas, mainly to verify that general public limits (100 mrem/year) are not violated.

This is NOT a control badge.

Best used as a monthly badge, for 6 months to 1 year, then discontinued.

It is a waste of \$\$ to attach it to C-arms, mini C-arms, and other x-ray machines. Readings from these badges do not mean anything – they may either indicate that that unit has been used, or that the badge is placed at a shadow-shielded location on the unit that it does not see any scatter radiation while in use, or that the unit has not been used.

Long term use on the area monitor is only meant for a few specific locations, like a cesium-137 irradiator room.

DO NOT use a Control Badge as an Area Monitor Badge:

The area monitor may accumulate a lot more radiation than a proper control, thereby leading to large underestimates of personal dosimetry readings

g) Ring Badge

The ring badge is not Luxel®; it contains a Thermo Luminescent Dosimeter (TLD).

It is required for Nuclear Medicine personnel. Other individuals who handle radioactive materials may also require ring badges, depending on license conditions.

Wear the ring with the TLD element facing the source of radiation (e.g., facing the palm while handling materials). Wear it under gloves to prevent contamination.

3. Understanding the Dosimetry Badge Report*

Dosimeter type:

Ja, Pa = Luxel badges
U = ring badge

Radiation quality:

P = Photon (x-ray, gamma)
B = Beta
PN = Photon and Neutron
NF = Neutron fast

Dose Equivalents for
the current wear
period (monthly, bi-
monthly or quarterly)

Data updated every
quarter (4 times / year)

Updated at each wear
period during the year

Lifetime dose, from the time the
service was started with Landauer.
Rule of thumb: Lifetime DDE in rem
(mrem/1000) should be less than the
user's age

Participant name,
date of birth and SSN
(newer versions do not
display SSN)

PARTICIPANT NUMBER	NAME			DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW			QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM)			YEAR TO DATE DOSE EQUIVALENT (MREM)			LIFETIME DOSE EQUIVALENT (MREM)			RECORDS FOR YEAR	INCEPTION DATE (MM/YY)	
	ID NUMBER	BIRTH DATE	SEX				DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE			
FOR MONITORING PERIOD:							06/01/00 - 06/30/00			QTR 2			2000								
000CC	CONTROL CONTROL CONTROL			J P U	CNTRL CNTRL CNTRL		M M M	M M M	M M M										6	6/80 6/80 6/80	
00191	ADDISON JOHN 336235619	08/31/1944	M	J	WHBODY P NF	PN P NF	90 60 30	90 60 30	90 60 30	90 60 30	90 60 30	100 70 30	100 70 30	100 70 30	200 170 30	200 170 30	200 170 30	6	6/80		
14839	JORGENSEN MIKE 471740095	10/04/1968	M	P	WHBODY NOTE		DOSIMETER PARTIALLY SHIELDED, NO EVALUATION POSSIBLE						160	160	160	470	470	470	860	860	860
16784	THOMAS LEE 384846378	11/22/1964	M	P P	COLLAR WAIST ASSIGN NOTE	P P ⑨	62 M 2	62 M 62	57 M 57		N/A N/A N/A		2	112	107	1072	3192	3327	6	2/86 2/86	
00901	WALKER JANE 587336640	06/09/1960	F	P	WAIST NOTE		ASSIGNED DOSE BASED ON EDE 1 CALCULATION						30	30	30	100	100	150	6	1/90	
50601	ZERR ROBERT 982446591	07/15/1945	M	P U	WHBODY NOTE UFINGR	⑩	ABSENT 40 CALCULATED	40	40	160	160	160	200	200	200	240	240	240	6	6/80	
									50			50			80		620			6/80	

- This sample report is from a Landauer brochure. All dosimeter providers supply the required information on their reports, although the formatting may be different. Dosimeter providers must be accredited by **NVLAP** (National Voluntary Laboratory Accreditation Program).

IMPORTANT: There is no requirement to post the report for public display, as long as users know where the reports are stored for review. If reports are posted for public display, order copies from Landauer without DOB and SSN, or obliterate this information for each user for each posting using a sharpie. You run the serious risk of identity theft if participants' DOB and SSN are displayed publicly; the individual who posts these compromising reports may be held criminally liable.

If not control present,
 "Calculated control dose = 6 mrem/month"
 "Historical control used"

Control badge readings

DDE: Deep Dose Equivalent
 (whole body dose)

LDE : Lens Dose Equivalent
 (eye dose)

SDE : Shallow Dose Equivalent
 (extremity dose)

PARTICIPANT NUMBER	NAME			DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW			QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM)			YEAR TO DATE DOSE EQUIVALENT (MREM)			LIFETIME DOSE EQUIVALENT (MREM)			RECORDS FOR YEAR	INCEPTION DATE (MM/YY)			
	ID NUMBER	BIRTH DATE	SEX				DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE					
FOR MONITORING PERIOD:							06/01/00 - 06/30/00			QTR 2				2000									
000CC	CONTROL CONTROL CONTROL			J P U	CNTRL CNTRL CNTRL		M M M	M M M	M M M										6	6/80 6/80 6/80			
00191	ADDISON JOHN 336235619	08/31/1944	M	J	WHBODY CNTRL	PN P NF	90 60 30	90 60 30	90 60 30	90 60 30	90 60 30	90 60 30	100 70 30	100 70 30	100 70 30	200 170 30	200 170 30	200 170 30	6	6/80			
14839	JORGENSON MIKE 471740095	10/04/1968	M	P	WHBODY NOTE		DOSIMETER PARTIALLY SHIELDED, NO EVALUATION POSSIBLE						160	160	160	470	470	470	860	860	860	6	1/90
16784	THOMAS LEE 384846378	11/22/1964	M	P P	COLLAR WAIST ASSIGN	P	62 M 2	62 M 62	57 M 57										6	2/86 2/86			
					NOTE	⑨	ASSIGNED DOSE BASED ON EDE 1 CALCULATION						N/A	N/A	N/A	2	112	107	1072	3192	3327		
00901	WALKER JANE 587336640	06/09/1960	F	P	WAIST NOTE		ABSENT									30	30	30	100	100	150	6	1/90
50601	ZERR ROBERT 982446591	07/15/1945	M	P U	WHBODY NOTE UFINGR		40 CALCULATED	40	40	160	160	160	200	200	200	240	240	240	6	6/80 6/80			
						⑩			50			50			80			620		6/80			

Sample report form Landauer brochure

NOTES:

ABSENT = badge not returned
 UNUSED = returned with tab intact

M = Minimum (1 mrem increments)
 SL = Selected Lower Limit (10 mrem), and 10 mrem increments
(intermediate readings are rounded up or down to the nearest 10)
 SL service has to be requested; M service is provided by default

'ASSIGN'
 Denotes Assigned (calculated)
 reading, not based on a
 direct measurement

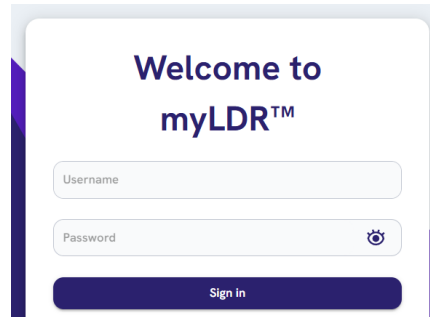
Basis of assigned reading (EDE-1 Calculation)
 "standard dose assessment was used" – if a calculation was attempted, but could not be done

A dosimetry report is a legal document, valid in a US court of law. Incorrect dosimetry records due to improper badge wearing or badge misuse, could have legal implications, and might affect the user adversely.

4. How to Download or Print Landauer Reports

1

Go to
myldr.Landauer.com



Welcome to
myLDR™

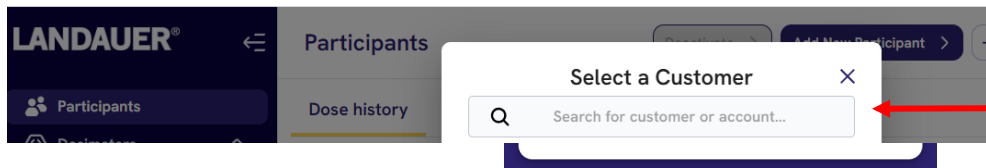
Username

Password

Sign in

2

Type your username and password, and click **Sign in**



LANDAUER®

Participants

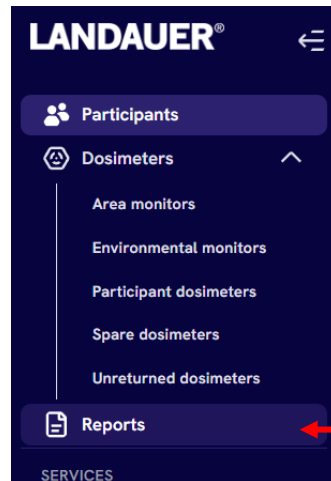
Dose history

Select a Customer

Search for customer or account...

3

Select your account



LANDAUER®

Participants

Dosimeters

Area monitors

Environmental monitors

Participant dosimeters

Spare dosimeters

Unreturned dosimeters

Reports

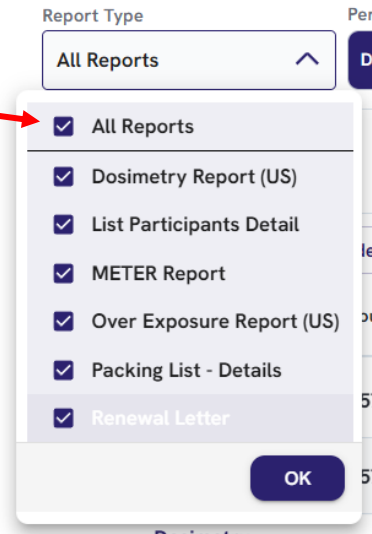
SERVICES

4

On the left pane,
click on **REPORTS**

Then click **All Reports** to uncheck blue boxes

5



Report Type

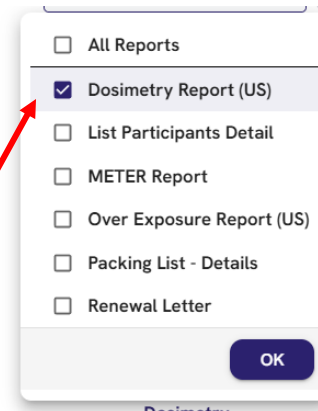
All Reports

- ☒ All Reports
- ☒ Dosimetry Report (US)
- ☒ List Participants Detail
- ☒ METER Report
- ☒ Over Exposure Report (US)
- ☒ Packing List - Details
- ☒ Renewal Letter

OK

6

Then click **Dosimetry Report (US)** from the drop-down list, and click **OK**



- ☐ All Reports
- ☒ Dosimetry Report (US)
- ☐ List Participants Detail
- ☐ METER Report
- ☐ Over Exposure Report (US)
- ☐ Packing List - Details
- ☐ Renewal Letter

OK

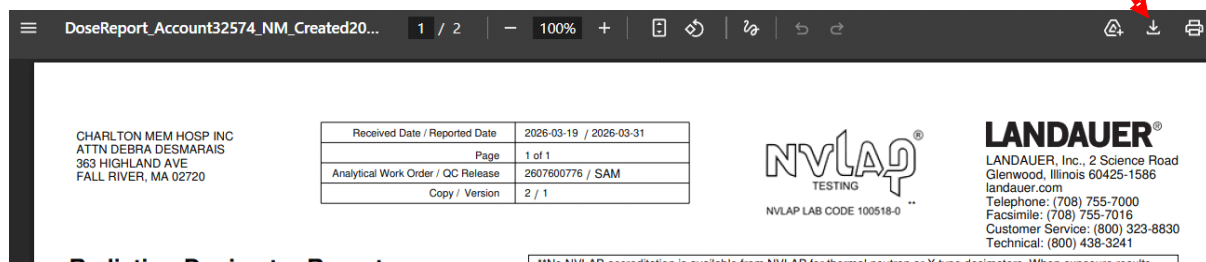
☐	Dosimetry Report (US)	32574	IR	03/31/2026	01/01/2026	02/28/2026	--
☐	Dosimetry Report (US)	32574	NM	03/31/2026	02/01/2026	02/28/2026	--

7 →

Select Subaccount from the drop down list (if you have multiple series).

8

Download and save report



More advanced search options are available (you can set a date range)

Search for Reports

Report Type: Dosimetry Report (US) ▼

Period Type: Date created Monitoring period

Period: 01/17/2026 - 04/17/2026 Last 30 days Last 60 days Last 90 days Year to Date Custom

You can also select multiple reports and export them as Excel or PDF files

You can filter by sub-account name

Filters: + Add filter

All Downloaded Not Downloaded

1 report selected Publish Export Download

Report	Account	Subaccount	Created ↓	Begin Date	End Date	CSV	Excel	PDF	Status in IDR
☒	Dosimetry Report (US)	32574	RAD ONCOLOGY	04/15/2026	01/01/2026	03/31/2026			Not Published

5. How to Manage a Dosimetry Program

Even though the Radiation Safety Officer has overall responsibility to oversee occupational doses at a facility, the ground work for distributing, collecting and mailing badges is done by other site personnel.

Assigning a **badge manager** is the first step in executing a successful dosimetry program. The badge manager can, in turn, delegate the collection and distribution of dosimeters to representatives in different departments, who have the best knowledge of current workers and whether or not they are exposed to ionizing radiation.

Eight responsibilities of the Badge Manager

a) Manages the dosimetry account with the service provider. Is the primary contact with the provider and has the administrative privileges to make alterations to the account.

b) Has current working knowledge of each series they are responsible for.

How many users are in each series that you manage?

Who are the key players?

Who are on collar badges, and who are on 2-badge systems?

Who are the habitual offenders? The late returners? The distracted wearers?

c) Adds and deletes users in a timely manner

How to change service from WB to Collar badge:

1. Discontinue Whole Body badge
2. Order collar badge
3. Request EDE-2 calculation

How to change service from Collar to 2-badge system

1. Add Waist badge
2. Request change from EDE-2 to EDE-1

These steps need to be done for each individual user, not for an entire group or series

- d) Breaks the 'remove' tab from each badge upon receipt
- e) Distributes badges at the beginning of wear period
- f) Collects badges at the end of the wear period
- g) Mails them promptly for processing, along with control badge(s)
 - Double-checks to ensure that no badges go back with their tabs intact
- h) Reviews badge reports upon receipt; makes reports available for user review
 - Flags unusual results, distracted wearers, and brings them to the attention of supervisor / RSO

Facilities accredited by The Joint Commission: Starting July 2015, dosimeter reports for CT, Nuclear Medicine and PET personnel must be reviewed at least quarterly by the Radiation Safety Officer, a Health Physicist, or a Diagnostic Medical Physicist

Four common badge issues

a) Badges reported 'unused'

This means the badge has been returned to Landauer without the 'remove' tab being broken

These badges are not read, under the assumption that they were not used

Reflects poorly on dosimetry program. If badges are being sent unused because the user no longer works there, promptly discontinue the badge

Raises a red flag during DPH and The Joint Commission inspections: What is the merit in maintaining badges that are regularly unused? **You are already paying for the service. There is no credit for returning a badge unused.**

Users must ensure that the badge is sent back with the tab broken **EVEN IF WAS NOT USED** during the wear period, such that it can be read, and a zero reading (M or SL) assigned

Break the Tab!



b) Badges reported 'absent'

This means the badge has not been returned for processing

The badge manager is responsible for collecting all badges and mailing them to Landauer in a timely fashion, typically *within a week* after the wear period.

Landauer charges an additional \$15.50 as of 2025 for each absent badge (even if returned late).

Users are responsible for storing badges on a badge board, not on leaving them on lead aprons; taking them home; leaving them in their offices

Bring habitual offenders to the attention of the Radiation Safety Committee, or the RSO via your supervisor

c) Incorrect Assigned EDE-1 Dose due to distracted users of the two-badge system

Continued monitoring of habitual offenders to ensure they wear their badges properly

Check for badge wearing during time-out, prior to a procedure

Label badges additionally as needed, if users cannot follow Landauer's color coding system (red neck, yellow belly)

d) EDE calculation service not properly ordered from Landauer

Anyone who has a single collar badge needs EDE-2

Anyone who is on a double-badge system needs EDE-1

You cannot have a chest badge with an "assigned" reading

6. Nine case studies: How to Decipher Problems in Dosimetry Practice

Pa	COLLAR	P	16	16	14
Pa	WAIST	P	1	1	M
	ASSIGNED		16	16	14

This user has a collar and a waist badge, therefore should have an assigned dose based on EDE-1. **Issue:** EDE-1 service not requested. Notice that the assigned dose is the same as the collar reading.
Solution: Order EDE-1 calculation for the user. With proper service, the Assigned Dose would be:
 $(16 \times 0.04) + (1 \times 1.5) = 0.64 + 1.5 = 2.114 \approx 2 \text{ mrem}$ instead of 16 mrem

Are there any issues with this reading? **No.**
 This user has a collar and a waist badge, and EDE-1 is being used. The 49 mrem collar reading vs. minimum waist indicates that the user has worn the two- badge system properly.
 The 2 mrem Assigned Dose is proper:
 $(49 \times 0.04) + (0 \times 1.5) = 1.96 + 0 = 1.96 \approx 2 \text{ mrem}$.
 Notice that the calculation only applies to DDE, not LDE or SDE.

Pa	COLLAR	P	49	49	49		
Pa	WAIST		M	M	M		
	ASSIGNED		2	49	49	2	71
	NOTE		Assigned dose based on EDE1				Calculation

COLLAR			SL	SL	SL		
WAIST	P	M	230	230	230		
ASSIGNED			350	SL	230	360	280
NOTE			Assigned dose based on EDE1				Calculation

This user has a collar and a waist badge, and EDE-1 is being used as expected. **Issue:** User has worn their badges reversed throughout the wear period. Notice how the assigned dose has increased from the measured 230 mrem to 350 mrem due to improper wearing.

How was the dose derived?
 $(0 \times 0.04) + (230 \times 1.5) = 0 + 345 = 345 \text{ mrem} \approx 350 \text{ mrem}$

Notice that this facility has SL service, so the 345 mrem has been rounded up to 350 mrem. Also, the LDE (2nd column) reported is SL, because the collar reading (being closer to the eye) is used.

Solution: Request Landauer to reverse the calculation. Re-educate user on proper wearing. Arrange for additional monitoring of user.

COLLAR	P	M	660	660	660						
NOTE			Imaging indicates a dynamic exposure. Dosimeter reprocessed second read agrees with reported dose.								
WAIST	P	M	90	90	90						
ASSIGNED			160	660	660	160	660	660	160	660	660
NOTE			Assigned dose based on EDE1 Calculation								
COLLAR			660	660	660						

Issue: This two-badge user who has mixed up their badges during the wear period, evidenced by the relatively high waist reading (90 mrem) when compared to the collar reading (660 mrem). Landauer has re-analyzed this badge, and found the collar reading to be a true exposure (a very high reading for this monthly wear period). This user is now stuck with an unreliable assigned dose of 160 mrem (indicating 4 times ALARA for the month), whereas their true exposure was probably much lower. Suppose the waist read a realistic 10 mrem, the assigned dose would have been: $(660 \times 0.04) + (10 \times 0.15) = 26.4 + 1.5 = 27.9 \approx 28 \text{ mrem}$, which is just below ALARA.

Solution: Re-educate user on proper wearing. Arrange for additional monitoring of user if necessary.

COLLAR	P	M	86	86	86						
WAIST	P		10	10	9						
ASSIGNED			86	86	86	261	288	279			
NOTE			Participant active in other account(s) or subaccount(s)								
COLLAR			86	86	86						

Issue: two-badge user who has probably mixed up their badges during the wear period, and in addition, does not have EDE-1 calculation. Under better badge management, the user's assigned reading would probably have been $(86 \times 0.04) + (0 \times 1.5) = 3.36 + 0 = 3.36 \approx 3 \text{ mrem}$, instead of the **86 mrem** (two times ALARA) that will appear on his/her record.

Solution: Request EDE-1 service from Landauer. Re-educate user on proper wearing.

Issue: EDE-2 service not ordered.

The proper assigned dose would have been $114 \times 0.3 = 34.2 \text{ mrem} \approx 34 \text{ mrem}$, instead of the incorrect 114 mrem, indicating close to 3 times ALARA for this monthly wear period.

Solution: Request EDE-2 service from Landauer.

COLLAR	P	M	114	114	108						
ASSIGNED			114	114	108	124	356				
NOTE			Standard Dose Assessment was used.								
COLLAR			114	114	108						

Pa	CHEST		M	M	M	
	ASSIGNED NOTE		M	M	M	M
			Standard Dose Assessment was used.			

Issue: Assigned Dose calculation was ordered and attempted, but not possible for a chest badge. 'Standard dose assessment' was performed.

Solution: Change chest badge to collar with EDE-2 service.

In this example, there is no problem. A chest badge with measured values, and a ring badge reporting extremity dose. The report indicates a Nuclear Medicine user.

Pa	CHEST	P	14	14	14
U	RFINGR				60
Pa	CHEST		M	M	M

Pa	COLLAR	P	M	133	133	132
Pa	WAIST NOTE ASSIGNED			ABSENT		
				133	133	132
						133

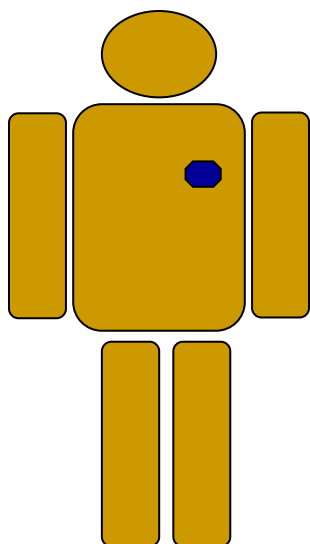
Issue: This user had their waist badge taped to the lead skirt, and therefore lost it. The badge is reported absent. With better practice, the assigned dose would have been $(133 \times 0.04) + (0 \times 1.5) = 5.32 + 0 = 5.32 \approx 5 \text{ mrem}$, instead of the 133 mrem value on the user's permanent report.

Solution: Find and return all badges for processing.

To reiterate: A dosimetry report is a legal document, valid in a US court of law. Incorrect dosimetry records due to improper badge wearing or badge misuse, could have legal implications, and might affect the user adversely. Exceeding occupational dose limits prohibits the user from working with ionizing radiation for the remainder of the year.

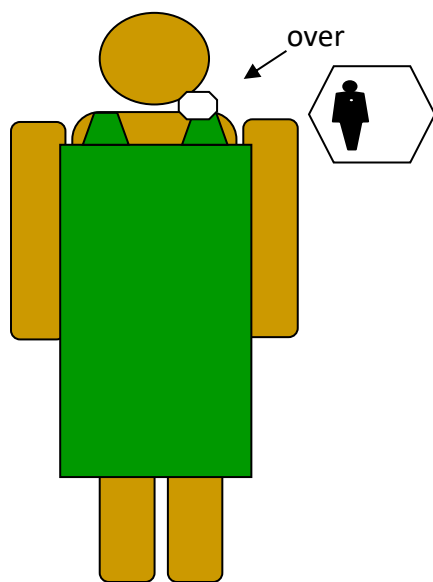
**7. The following pages contain
flyers suitable for posting next to badge boards
or badge storage locations**

Chest Badge Users



The Whole Body / Chest badge (black icon) is suitable for users who may or may not be wearing lead protective garments

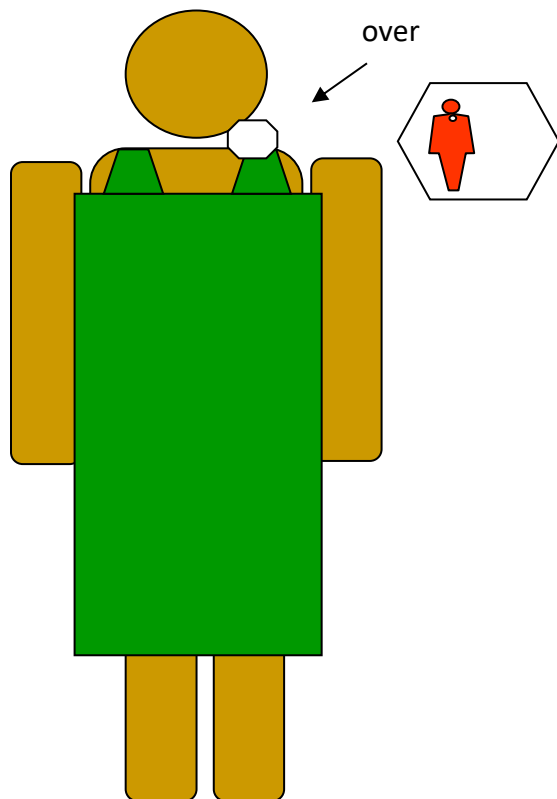
While not wearing lead protective garments, position the badge at the chest level



While wearing lead protective garments, position the badge **ONLY** at the neck level, **OUTSIDE** lead protective garments (apron, jacket or thyroid shield)

After use, do not leave your badge clipped to a lead garment. Return it to the badge board

Single Collar Badge Users



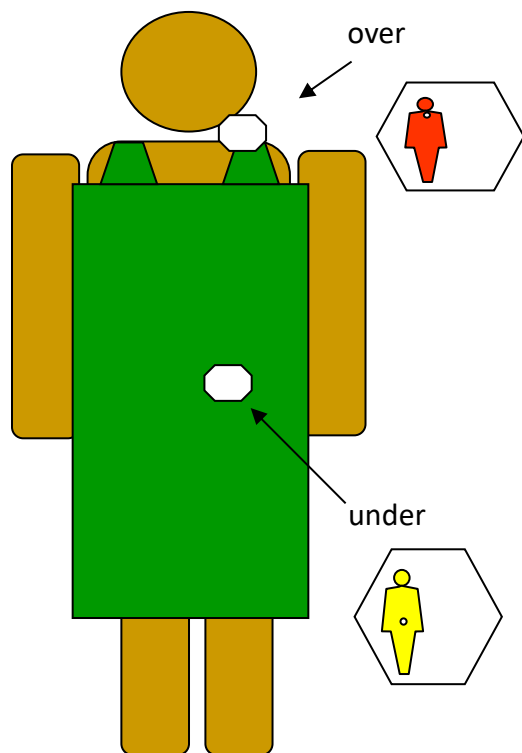
The single collar badge is suitable only for users who get all their occupational radiation exposure while wearing lead protective garments

If you have been issued a single collar badge (red icon), position it **ONLY** at the neck level, **OUTSIDE** lead protective garments (apron, jacket or thyroid shield)

After use, do not leave your badge clipped to a lead garment. Return it to the badge board

Two-Badge Users

The two-badge system is suitable only for users who get all their occupational radiation exposure while wearing lead protective garments



Position the Collar badge (red icon) **ONLY** at the neck level, **OUTSIDE** lead protective garments (apron, jacket or thyroid shield)

Position the Waist badge (yellow icon) at the waist level, **under** the lead protective garment

Mixing these badges will result in incorrectly high dosimetry readings

After use, do not leave your badge clipped to a lead garment. Return it to the badge board