Gammacell Irradiator Safety Guide

77 Massachusetts Avenue, Cambridge , MA 02139

(617)-452-3477 | environment@mit.edu | ehs.mit.edu

MIT EHS
ENVIRONMENT · HEALTH · SAFETY

Delegation of Authority

MIT has a standing institute **Committee on Radiation Protection** to oversee all uses of radiation at the Institute and its associated off campus locations. They give the RPP authority to stop any experiment or process involving radiation that is deemed unsafe.

When to call RPP

- Security Issues
- Survey meter not working/out of calibration
- Iris Scanner problems
- Irradiator not working
- Need Special training

Irradiator Access

Requirements for unescorted access to the irradiator: Safety training, hands-on training for the unit you will be working with, federal criminal background check, personal reference check.

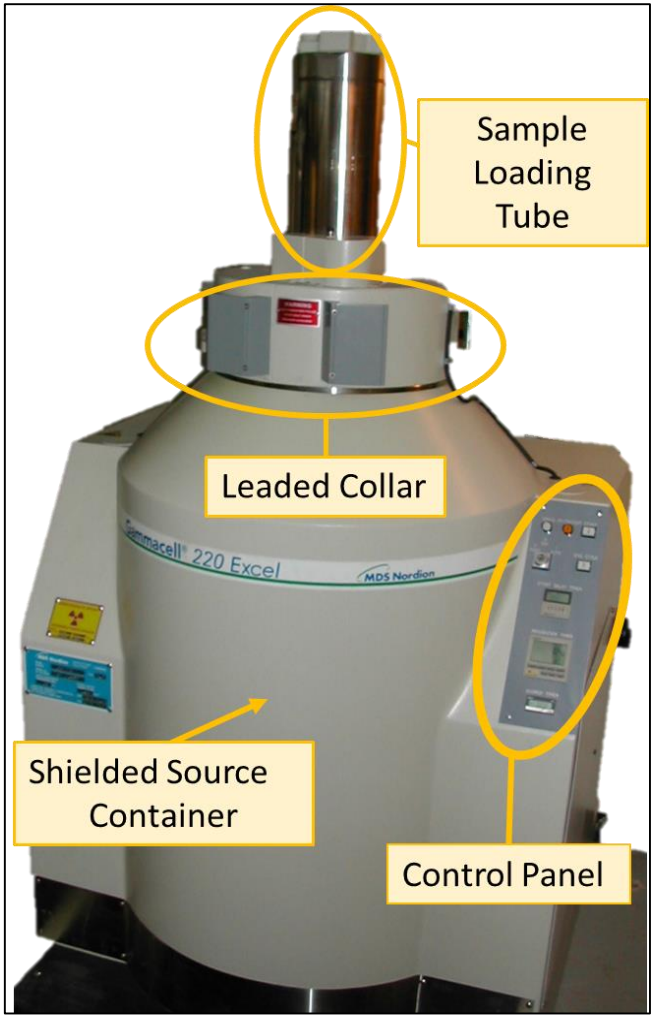
Requirements for entering the room: MIT ID access card and dosimeter

DO NOT…

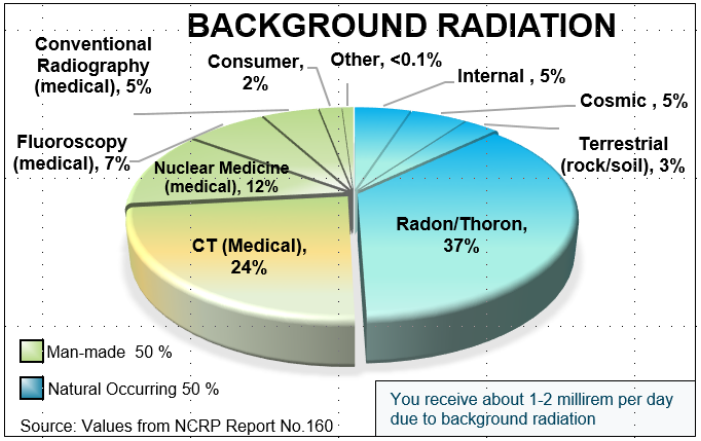
Share your ID or access codes with anyone

Leave escorted persons alone with irradiator

Escort a non-radiation worker into irradiator rooms or bring anyone into the irradiator room that you do not know.



Background Radiation



	Living next to a nuclear power plant	<1 mrem		Cosmic Radiation (Denver)	80 mrem
	Eating 1 banana a day	3.5 mrem		Radon in Avg. Home	228 mrem
	Terrestrial Radioactivity	21 mrem		Whole Body CT (1-time)	1000 mrem
	Cosmic Radiation (sea-level)	30 mrem		Radiation Worker Limit (Whole Body)	5000 mrem

Annual radiation dose comparison. Data from epa.gov/radiation/radiation-sources-and-doses
Inspired by xkcd.com/radiation

= 100 mrem

NEVER

Never Irradiate any of the following in any of the irradiator facilities.

- Corrosives
- Explosives
- Pyrophoric
- Highly Flammable Materials

Dose Limits

Whole Body	(5 rem)
Lens of Eye	(15 rem)
Extremities	(50 rem)
DPW*	(0.5 rem)
General Public	(0.1 rem)

*Declared Pregnant Worker

Most MIT radiation workers receive less than 10 mrem each year from occupational exposure!

Personal Dosimetry

Anyone likely to receive 500 mrem (10% of the annual dose limit) is required to wear a dosimetry badge. At MIT, you will be assigned a dosimeter if you are working with an Irradiator.

Emergency Response

If alarms sound while you are in the room with the irradiator, leave immediately, ensuring door is fully closed, and notify MIT police (dial 100).

If MIT Police show up, provide full cooperation and assist them as needed.

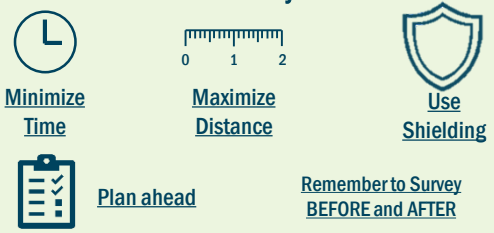
If phone rings while you are in the room, answer it.. MIT Police or EHS RPP may need to reach you.

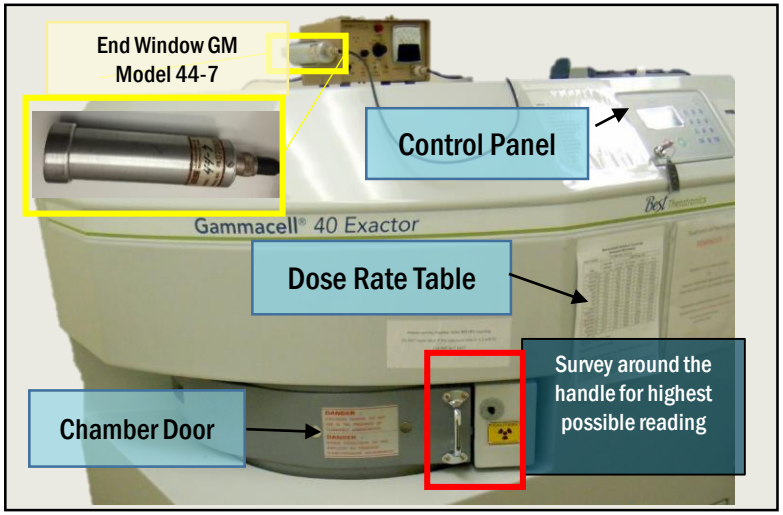
Common Isotopes

Cesium-137 (Cs-137)
Half-life: 30.7 years
Gamma Emission: 661.6 keV gamma at 85%
Cobalt-60 (Co-60)
Half-life: 5.27 years
Gamma Emitter: 2 photons; 1.17 MeV and 1.33 MeV
LEAD SHIELDING IS USED FOR BOTH

ALARA

As Low As Reasonably Achievable





How to Frisk

- **Always** frisk slowly, at a rate of ~2 cm/s and
- **Never** touch the detector directly, always leave ~1 cm between the object you are frisking and the detector head.
- **When frisking out,** frisk both bottom of feet and hands. Only pick up frisker after frisking that hand.
- Be sure to **check any personal items** you are carrying (books, clipboards, backpacks, etc...) for contamination.

Definitions

Absorbed Dose: The energy imparted per ions or charged particles. unit mass or irradiated material. Measured in **rad,** where 1 rad equals 0.01 Joules/kg of absorbing material. The SI unit is the Gray (Gy).

Note 1 Gy = 100 rad =1J/kg

Exposure: A measure of the ionization produced in *AIR* by X or Gamma radiation. Measured in **Roentgen (R),** where 1R = 2.58 x 10^4 Coulombs per kilogram of dry air at STP.

Gamma Radiation (γ): Short wavelength electromagnetic radiation of nuclear origin.

VERY high penetration ability.

Ionizing Radiation: Electromagnetic (X ray and gamma) or particulate (alpha, beta) radiation capable of producing

Radiation: Energy transmitted as electromagnetic waves or particles from a source.

Radioactivity: The property of certain nuclides of spontaneously emitting particles or gamma radiations or emitting X-rays following orbital electron capture. Measured units are Curies (Ci) or SI unit, Becquerel's (Bq). 1 Bq = 1 disintegration per second. 1 Ci = 3.7x10^{10} Bq.

RAM: Radioactive Material

Rule for Irradiator Use

After completing the security entrance requirements:

- As the user or the escort, you must fill in the user log sheet. Be sure to fill in all fields and do NOT use "ditto" or check marks.
- Check the irradiation timer to ensure the irradiator is not currently in use.
- Survey the Chamber door prior to opening it.
- Do not remove someone else's sample unless authorized to do so.
- Answer the room phone when/if it rings.
- Wear your dosimeter.
- Clean compartment after use, remove all generated trash from the room.

Decay Correction Equation

D(t) = dose rate at desired time

D_o = reference dose rate

λ= Ln(2)/ $T_{1/2}$

$T_{1/2}$ = half life of isotope

t = time lapse in years

**This formula is used to generate the dose rate table posted for each irradiator.

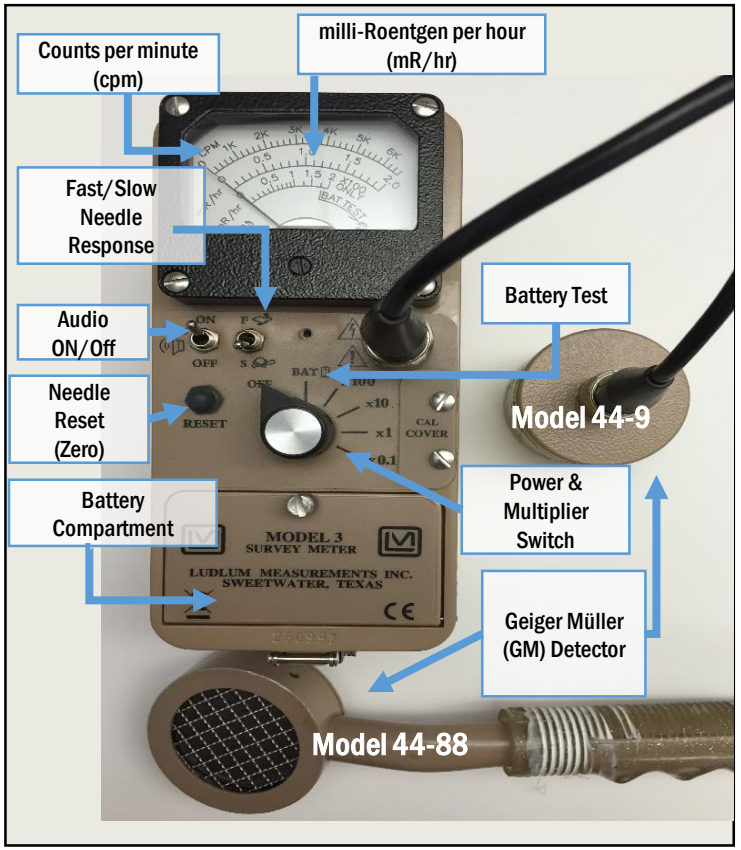
$$D(t) = D_o\, e^{-\lambda t}$$

Performing a Survey

Before and after working with the irradiator, always perform a survey of the chamber door before opening.

- Check calibration date on detector
- Check battery
- Check response using check source mounted on instrument.
- Measure the background exposure rate in an area known to have low radiation.
- Scan around the chamber door by holding detector face ~1 cm away from the surface moving slowly (about 2 inches/s).

Notify RPP if unusually high exposure levels are detected



9 Traits of a Positive Safety Culture

1. Leadership Safety Values and Actions
2. Problem Identification
3. Personal Accountability
4. Work Processes
5. Continuous Learning
6. Environment for Raising Concerns
7. Effective Safety Communication
8. Respectful Work Environment
9. Questioning Attitude

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