IODINE - 125
[I-125]

PHYSICAL DATA

Gamma Energies:	31.0 keV (25% abundance)
(No Betas Emitted)	35.5 keV (7% / 93% internally converted)
	27.2 keV (39.2%)
	27.4 keV (73.2%)
Specific Gamma Ray Constant:*	0.142 - 0.27 mrem/h at 1 meter per millicurie

* [Literature varies from 0.142 to 0.7 mrem/h at 1 meter per 1 mCi]

Physical Half-Life:	60.1 days
Biological Half-Life:	120-138 days (unbound iodine) - thyroid elimination
Effective Half-Life:	42 days (unbound iodine) - thyroid gland
Specific Activity:	17,353 curies / gram (theoretical/carrier free)
Intrinsic Specific Activity:	2,175 curies / millimole

RADIOLOGICAL DATA

- Critical Organ (Biological Destination): Thyroid
- Routes of Intake: Ingestion, Inhalation (most probable), Puncture, Wound, Skin Contamination (Absorption)
- External & internal exposure **and** contamination concerns from I-125

Committed Dose Equivalent (CDE) - Organ Doses Based on Intake (not uptake)

833 mrem / uCi (thyroid / inhalation / Class "D")
1250 mrem / uCi (thyroid / ingestion / all compounds)

Committed Effective Dose Equivalent:	25 mrem / uCi (WB / inhalation)
(Whole Body / CEDE)	50 mrem / uCi (WB / ingestion)

Annual Limit on Intake (ALI):

- 40 uCi (all compounds) (ingestion / CDE / 50 rem to Thyroid)
- 100 uCi (all compounds) (ingestion / CEDE / 5 rem to Whole Body)
- 60 uCi (all compounds) (inhalation / CDE / 50 rem to Thyroid)
- 200 uCi (all compounds) (inhalation / CEDE / 5 rem to Whole Body)

[1.0 ALI = 40 uCi (ingested) = 50,000 millirem CDE to Thyroid]
[1.0 ALI = 60 uCi (inhaled) = 50,000 millirem CDE to Thyroid]
[1.0 ALI = 200 uCi (inhaled) = 5,000 millirem CEDE to Whole Body]

- The thyroid accumulates 30% of the soluble radioiodine taken in by the body; the remaining 70% is excreted quite rapidly via the urine.

  Example: An intake of 3.15 uCi I-125 will result in an uptake by the body of approximately 2.4 uCi and an uptake by the thyroid of approximately 0.71 uCi

Skin Contamination Exposure Rate (Basal Cells): * -0- mrem/h per uCi/cm^2
* [HP / April 1990 / Vol. 58 / No. 4 and Varskin (et al) calculations]

SHIELDING: * lead foil or sheets (1/32" to 1/16" thick)
* 0.152 mm lead foil = approximately 1% transmission
* 7.2 mm lead-impregnated plastic or acrylic shield (30% by weight) << 0.1% transmission

Half-Value Layer (lead):	0.0018 cm = 0.02 mm = 0.0008"
Half-Value Layer* (water / tissue):	1.70 cm
Half-Value Layer (concrete):	0.21 cm
Tenth-Value Layer** (lead):	0.056 mm
Tenth-Value Layer (concrete):	7.30 mm

* Half-Value Layer (HVL) = amount of shielding necessary to reduce a radiation exposure rate to 1/2 (50%) of its original value.

** Tenth-Value Layer (TVL) = amount of shielding necessary to reduce a radiation exposure rate to 1/10 (10%) of its original value.

SURVEY INSTRUMENTATION:

- Survey meter equipped with a low-energy NaI scintillation probe is preferred for the detection of I-125. Low-energy NaI probe efficiency for I-125 ~ 13%.

- Survey meters equipped with G-M pancake/frisker (15.5 cm^2 area) or standard cylindrical style G-M probes are very **inefficient** (very low counting efficiencies) for the detection of low-energy I-125 gamma rays. G-M probes are only effective for gross I-125 contamination. [G-M efficiency ~ 0.5% at 1 cm].

- Liquid scintillation counter (indirect counting) should be used to detect removable I-125 contamination on smears or swabs.

PERSONAL RADIATION MONITORING DOSIMETERS (Whole Body and Finger Tabs): **REQUIRED** when handling > 5.0 millicuries of I-125 at **any** time.

Dose Rates from unshielded 1.0 millicurie isotropic point source of I-125:

Distance	mrem/hour
1.0 cm	1560 - 2750
10.0 cm	15.5 - 27.5
100.0 cm	0.142 - 0.27 *
6.0 in	6.5

* [Literature varies: 0.142 - 0.7 mrem/hour at 100 cm per 1 mCi]

REGULATORY COMPLIANCE INFORMATION (10 CFR 20 / Appendix B)

- Derived Air Concentration (DAC): 3.0E-8 uCi/mL (occupational)
- Airborne Effluent Release Limit: 3.0E-10 uCi/mL *
  (Annual Average)

  * [Applicable to the assessment & control of dose to the public (10 CFR 20.1302). If this concentration was inhaled continuously for > 1 year the resulting TEDE would be 50 millirem.]

- Unrestricted Area Removable Contamination Limit: 20 dpm / 100 cm^2
- Container Labeling Quantity [10 CFR 20.1905]: $\geq$ 1 uCi
- Thyroid Bioassay: **REQUIRED** when handling $\geq$ 1.0 mCi of unbound (NaI) I-125 on a bench top or $\geq$ 10 mCi of I-125 in an exhaust hood; contact Radiation Safety Service (764-6200) for appointment.

IODINATION PROCEDURES

- Iodinations **must** be conducted in an RSS-approved exhaust hood.
- Iodinations **must** only be conducted using an RSS-approved **"closed"** system (no pipetting and no open containers during iodination process). Only use rubber-septum sealed vials or containers and syringes.
- Initial cold run and hot run iodination procedures **must** be observed by a Radiation Safety Service (RSS) health physicist.
- Thyroid bioassays are **required** after each iodination using $\geq$ 1 mCi of unbound I-125 on a bench top or $\geq$ 10 mCi in an exhaust hood (Byproduct Material License / Regulatory Guide 8.20).
- Whenever possible, perform iodination reactions in the original sealed shipping vial when handling potentially volatile radioiodine.
- Vent the airspace of stock and reaction vials through an activated charcoal-filled syringe trap during iodination procedures.
- Remove contaminated syringe needles from stock and reaction vials through absorbent material (tissue paper, etc).
- Store I-125 contaminated objects (syringes, stock vials, waste, etc) in sealed containers (zip-lock bags, plastic containers, etc).
- Always have a solution of sodium thiosulfate on-hand during iodination procedures.
- Obtain iodination safety protocols from Radiation Safety Service.

GENERAL RADIOLOGICAL SAFETY INFORMATION

- Inherent Volatility (STP): **"SUBSTANTIAL"** [volatilization is a very significant concern with I-125 especially in disassociated (free) form or in acidic solutions]

- Internal exposure and contamination represent the primary hazards for most I-125 applications. Iodine-125 is easily shielded using 1/16" - 1/8" lead sheets to reduce external radiation exposures.

- Acidic and frozen solutions enhance radioiodine volatility.

- Soluble iodide ion is oxidized to elemental (free) iodine which has low solubility in water and high vapor pressure. Acidic solutions enhance the oxidation of sodium iodide to elemental (free) iodine; thereby, increasing volatility.

- Alkaline sodium thiosulfate should be used to chemically stabilize I-125 prior to initiating decontamination of an I-125 spill (0.1 M NaI, 0.1 M NaOH, and 0.1 M $Na_2S_2O_3$).

- Store at room temperature: DO NOT FREEZE (whenever possible)

- Radioiodine labeled compounds should be assumed to be potentially volatile since radiolytic decomposition can give rise to free iodine in solution. Radiolytic decomposition is minimized by maintaining solutions at low (dilute) concentrations.

- Addition of antioxidants (sodium thiosulfate) to either labeled or NaI solutions of I-125 will help reduce both decomposition & volatilization.

- Regulatory limits on personal intake and environmental releases of I-125 are quite restrictive because of the relatively high radiotoxicity relative to other common university-related radionuclides.

- Intakes of I-125 greater than 242 nanocuries over a 7-day period requires a health physicist and authorized user investigation, correction action, and documentation according to NRC Regulatory Guide 8.20 and the U-M Byproduct Material License (21-00215-04).

- Urine Bioassays - should be conducted 24-hours after a suspected intake of I-125.

- Thyroid bioassays conducted by Radiation Safety Service (RSS) personnel **must** be conducted within 10-days after handling > 10 millicuries of free or unbound (NaI) form of I-125. Contact RSS for an appointment (764-6200).

- The urinary excretion rate decreases by about two orders of magnitude during the first 5-days after intake. Thus, uncertainties in interpretation of urinary excretion that arise because of the unknown time of intake in routine monitoring may be large.

- For continuous exposure at the rate of 1/365 ALI per day, the following equilibrium levels are attained: Inhalation Class "D" = thyroid activity (1.86 uCi) = 0.081 uCi/day (81 nCi/day).