

Occupational Safety & Environmental Health

Radiation Safety Service

1239 Kipke Drive 1010

[764-4420]

SULFUR - 35

[S-35]

PHYSICAL DATA

Beta Energy: 167 keV (maximum)
49 keV (average)(100%)

Physical Half-Life:	87.1 days	87.1 days
Biological Half-Life:	623.0 days (testes)	90.0 days (total body)
Effective Half-Life:	76.6 days (testes)	44.3 days (total body)

Specific Activity: 42,707 curies/gram

Maximum Beta Range in Air: 26.00 cm = 10.500"

Maximum Beta Range in Water or Tissue: 0.04 cm = 0.015"

Maximum Beta Range in Plexiglass or Lucite: 0.25 mm = 0.010"

- [Fraction of S-35 betas transmitted through dead layer of skin = 17%]
- [Fraction of S-35 betas transmitted to lens-of-the-eye = 0%]

RADIOLOGICAL DATA

- Critical Organ: Testis
- Routes of Intake: Ingestion, Inhalation, Puncture, Wound, Skin Contamination (Absorption)
- External exposure (deep dose) from weak S-35 beta particles is not a radiological concern. Radiation monitoring dosimeters not needed.
- Internal exposure & contamination are primary radiological concerns.

Committed Dose Equivalent (CDE):	5.00 millirem / uCi (ingested)
(LLI Wall / Sulfides/Sulfates)	0.352 millirem / uCi (puncture)

Committed Effective Dose Equivalent (CEDE): 0.6256 mrem/uCi (ingested)

* [Assumes a 90-day biological half-life]

Annual Limit on Intake (ALI):	10 mCi (ingestion: sulfides/sulfates / LLI)
	6 mCi (ingestion: elemental S-35 / WB)
	8 mCi (ingestion: sulfides/sulfates / WB)
	10 mCi (inhalation: S-35 vapors / WB)
	20 mCi (inhalation: sulfides/sulfates / WB)
	2 mCi (inhalation: elemental S-35 / WB)

[1.0 ALI = 10 mCi (inhaled S-35 vapors) = 5,000 millirem CEDE / WB]

[1.0 ALI = 8 mCi (ingestion sulfides/sulfates LLI) = 50,000 mrem CDE]

Skin Contamination Dose Rate: 1,139 millirem/hour per 1.0 uCi/cm²

- [Dose to Basal Cells at a tissue depth of 7 mg/cm² or 0.007 cm without air reflection]

Skin Contamination Dose Rate (Extremities): S-35 betas cannot penetrate 30 mg/cm² (0.3 cm) tissue

Beta Dose Rates (S-35): 14.94 rad/h (contact) in air per 1.0 mCi
(unshielded) 0.20 rad/h (6 inches) in air per 1.0 mCi

SHIELDING: None Required (≤ 3 mm plexiglass)

SURVEY INSTRUMENTATION:

- Can detect S-35 using a thin-window G-M survey meter; however, survey meter probe **must** be at close range (≤ 1 inch).
- G-M survey meter equipped with a pancake/frisker (15.5 cm² area) has a very low counting efficiency (4%).
- Liquid scintillation counter (indirect counter) should be used to detect removable S-35 contamination on smears, swipes, swabs, etc.

PERSONNEL RADIATION MONITORING DOSIMETERS (Whole Body Badge or Finger Tabs): Not Needed (S-35 beta particle energy is too weak).

Half-Value Layer (HVL): 0.0053 cm = 0.053 mm
Tenth-Value Layer (TVL): 0.0180 cm = 0.180 mm

Dose Rate from a 1 millicurie unshielded isotropic point source of S-35:

<u>DISTANCE</u>	<u>RAD/HOUR</u>
1.0 cm	1173.6
2.5 cm	93.7
15.24 cm	0.2
20.00 cm	0.01

REGULATORY COMPLIANCE INFORMATION (10 CFR 20 / Appendix B)

- Derived Air Concentration (DAC): 6.0E-6 uCi/cc (S-35 vapors)
(Occupational) 7.0E-6 uCi/cc (sulfide/sulfate)
9.0E-7 uCi/cc (elemental sulfur)

- Inhalation of the gases SO_2 , COS , H_2S , and CS_2 must be considered. Sulfur entering the lungs in these forms is completely and instantaneously translocated to the transfer compartment and from there its metabolism is the same as that of sulfur entering the transfer compartment following ingestion or inhalation of any other organic compound of sulfur.
- Contamination of internal surfaces of storage and reaction vessels may occur (rubber o-rings).
- Vials of S-35 labeled amino acids (cysteine & methionine) should be opened and used in ventilated enclosures (exhaust hoods). In addition, S-35 vapors may be released when opening vials containing labeled S-35 amino acids, during any incubating of culture cells containing S-35, and the storage of S-35 contaminated wastes.
- The volatile components of S-35 labeled cysteine & methionine are presumed to be hydrogen sulfide (H_2S) and methyl mercaptan (CH_3SH), respectively.
- Excessive contamination can be noted on the inside surfaces and in water reservoirs of incubators used for S-35 work. Most notable surface contamination can be found on rubber seals of incubators & centrifuges.
- Radiolytic breakdown may also occur during freezing process, releasing as much as 1.0 μCi of S-35 per 8.0 mCi vial of S-35 amino acid during the thawing process.
- S-35 labeled amino acids work should be conducted in an exhaust hood designated for radiolytic work.
- Vent S-35 amino acid stock vials with an open-ended charcoal-filled disposable syringe. Activated charcoal has a high affinity for S-35 vapors.
- Place an activated carbon or charcoal canister, absorbent sheet, or tray (50-100 grams of granules evenly distributed in a tray or dish) into an incubator to passively absorb S-35 vapors. Discard absorbers which exhibit survey meter readings of > 10 -times facility background levels.
- **Always** wear a lab coat and disposable gloves when handling S-35.
- Monitor personnel (hands, clothing, shoes, etc), work areas, and floors using a G-M survey meter equipped with a G-M pancake / frisker probe for gross contamination. A urinalysis should be conducted by an RSS Health Physicist after researchers have worked with > 10 millicuries of S-35 amino acids.
- Monitor for removable surface contamination by smearing, swiping, swabbing, or wipe testing where S-35 is used. Count smears or swabs in a liquid scintillation counter (LSC).
- Research personnel **must** maintain a current inventory of S-35 sources at all times.
- Expelling S-35 solutions through syringe needles and pipette tips can generate airborne aerosols.
- Drying can cause airborne S-35 dust contamination and rapid boiling can volatilize S-35 or cause airborne S-35 aerosol contamination.
- Skin contamination (dose), ingestion, inhalation, puncture/injection, absorption through skin, and area contamination are primary radiological safety concerns.

TRAINS35

ORIGINAL:	MARCH	1994	(MLD)
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