

RADIONUCLIDE DATA SHEET

HYDROGEN -3

Physical Characteristics

- Half-life: 12.3 years
- Emissions: Beta particles with a maximum energy of 18.6 keV and an average energy of 5.7 keV.
- Maximum Range in Air: 4.7 mm in air; 6 mm in tissue.
- Fraction transmitted through the dead layer of the skin: none

Dose

- Dose rate to the skin at 10 cm: None
- Dose rate to epidermal basal cells from skin contamination of 1 mCi/cm²: None

Shielding

- Not required because of low energy of the beta

Annual Intake Limits (ALI)

- Ingestion: 8×10^4 μ Ci
- Inhalation: 8×10^4 μ Ci

Note: 1.0ALI = 5,000 mrem CEDE

Detection

- Liquid scintillation counting is the preferred method for detecting H-3.
- Most G-M detectors will not detect the presence of H-3.
- Whole Body dosimeter: Not required
- Finger dosimeter: Not required

Precautions

H-3 contamination cannot be detected with a G-M meter, and special precautions are needed to keep the work environment clean. The regular use of wipe testing, using a liquid scintillation counter, is the only way to insure that your workspace does not contain contamination.

CABRON-14

Physical Characteristics

- Half-life: 5,730 years
- Emissions: Beta particles with a maximum energy of 156 keV and an average energy of 49 keV.
- Maximum Range in Air: 22 cm in air; 0.027 cm in tissue.
- Fraction transmitted through the dead layer of the skin: 0.11

Dose

- Dose rate to the skin at 10 cm: 600 mrad/hour/mCi
(for an unshielded point source)
- Dose rate to epidermal basal cells from skin contamination of 1 mCi/cm²: 1400 mrad/hour

Shielding

- None needed, when used in millicuries quantities under normal laboratory conditions.

Annual Intake Limits (ALI)

- Ingestion: 2×10^3 μ Ci

Note: 1.0ALI = 5,000 mrem CEDE

Detection

- Liquid scintillation counter is the preferred method for detecting C-14. Most G-M detectors are not likely to detect the presence of C-14 in amounts less than about 0.05 μCi (100,000 dpm).
- Whole Body dosimeter: Not required
- Finger dosimeter: Not required

Precautions

Low-level C-14 contamination cannot be easily detected with a G-M meter, and special precautions are needed to keep the work environment clean. The regular use of wipe testing, using a liquid scintillation counter, is the only way to insure that your work space does not contain low-level removable contamination.

PHOSPHORUS 32

Physical Characteristics

- Half-life: 14.3 days
- Emissions: Beta particles with a maximum energy of 1.71 MeV and an average energy of 0.7 MeV.
- Maximum Range in Air: 620 cm in air; 0.8 cm in tissue; 0.6 cm in Plexiglas
- Fraction transmitted through the dead layer of the skin: 0.95

Dose

- Dose rate to the skin at 10 cm: 4070 mrad/hour/mCi (for an unshielded point source)
- Dose rate to epidermal basal cells from skin contamination of 1 mCi/cm²: 9200 mrad/hour

Shielding

- $\frac{1}{2}$ to $\frac{3}{4}$ inch Plexiglas/acrylic/Lucite/plastic/wood
- Do not use lead foil or sheets as primary barrier! Penetrating bremsstrahlung x-ray will be produced.
- Use lead sheets or foil to shield bremsstrahlung x-rays only after low density Plexiglas/acrylic/Lucite/wood shielding.

Annual Intake Limits (ALI)

- Ingestion: $6 \times 10^2 \mu\text{Ci}$ (class D)
- Inhalation: $4 \times 10^2 \mu\text{Ci}$ (class W)

Note: 1.0ALI = 5,000 mrem CEDE

- Liquid scintillation counting is also an acceptable method for detecting removable P-32 contamination.
- A NaI survey meter may be used; however, the efficiency of detection is low as it is detecting bremsstrahlung x-rays.
- Whole Body dosimeter: Required
- Finger dosimeter: Required

Precautions

High-localized doses are possible while handling millicurie amounts of P-32 and as a result of skin contamination. Reduce doses by wearing safety glasses (for shielding the eyes), using remote handling tools such as tongs, using shielding extensively to shield storage and experimental containers and work areas, and performing thorough and frequent surveys of the work area, clothing and the body.

SULFUR-35

Physical Characteristics

- Half-life: 87.6 days
- Emissions: Beta particles with a maximum energy of 167 keV and an average energy of 49 keV.
- Maximum Range in Air: 24 cm in air; 0.030 cm in tissue.
- Fraction transmitted through the dead layer of the skin: 0.12

Dose

- Dose rate to the skin at 10 cm: 625 mrad/hour/mCi (for an unshielded point source)
- Dose rate to epidermal basal cells from skin contamination of 1 mCi/cm²: 1460 mrad/hour

Shielding

- ¼ inch Plexiglas/acrylic/lucite/plastic/wood
- Do not use lead foil or sheets as primary barrier! Penetrating bremsstrahlung x-ray will be produced!
- Use lead sheets or foil to shield bremsstrahlung x-rays only after low density Plexiglas/acrylic/lucite/wood shielding.

Annual Intake Limits (ALI)

- 10 millicuries via ingestion for most compounds of sulfur.
- Note: 1.0ALI = 5,000 mrem CEDE

Detection

- Survey meter equipped with a G-M pancake or thin-window probe can be used to detect the betas from the S-35. Typical efficiency for a G-M pancake survey meter is between 4% and 6%.
- A liquid scintillation counter should be used to detect removable S-35 contamination on wipe tests smears. Typical efficiency for a LSC to detect S-35 is greater than 85%.
- Whole Body dosimeter: Not required
- Finger dosimeter: Not required

Precautions

³⁵S-labeled methionine/cysteine compounds can volatilize. Stock solutions and thawed materials should be opened within a fume hood. Activated charcoal can be used to trap contamination within equipment such as incubators. Contact EHS for further information. Low-level S-35 contamination cannot be easily detected with a G-M meter, and special precautions are needed to keep the work environment clean. The regular use of wipe testing, using a liquid scintillation counter, is the only way to insure that the workspace does not contain low-level removable contamination.

IODINE-125

Physical Characteristics

- Half-life: 60.1 days
- Emissions: Principal emissions are a 35 keV gamma ray and 27 - 32 keV x-rays.
- Half-Value Layer: 0.02 mm lead; 2 cm in tissue.
- The half-value layer is the amount of material required to reduce the radiation intensity by 50%.

Dose

- Dose rate at 10 cm: 15 mrem/hour/mCi (for an unshielded point source)

Shielding

- Lead foil for shielding I-125 gamma rays
- Half value layer for I-125 gamma ray is 0.02mm (i.e. every 0.02 mm. of Lead reduces the I-125 gamma ray beam by 50%)

Annual Intake Limits (ALI)

- Ingestion: $4 \times 10^1 \mu\text{Ci}$ Thyroid ingestion $1 \times 10^2 \mu\text{Ci}$
 - Inhalation: $6 \times 10^1 \mu\text{Ci}$ Thyroid inhalation $2 \times 10^2 \mu\text{Ci}$
- Note: 1.0ALI = 5,000 mrem CEDE

Detection

- A survey meter equipped with a G-M pancake or thin-window probe is not recommended for detecting I-125. Typical efficiency for a G-M pancake is <1%.
- A survey meter equipped with a thin crystal NaI scintillation probe is best for detection of the I-125 gamma. Typical efficiency is 29%-33%.
- Either a gamma counter or a liquid scintillation counter can be used to detect removable I-125 contamination on wipe tests smears. Both have efficiencies for detecting I-125 of about 70%.
- Whole Body dosimeter: Required
- Finger dosimeter: Required.

Precautions

Volatile iodine can be released from iodinated compounds containing hundreds of microcuries or more of I-125. Containers of I-125, including sample vials of iodinated compounds, should always be opened in a fume hood. Personnel using I-125 in hundreds of microcuries or more must wear double gloves and should change gloves as soon as the gloves become contaminated. Thyroid count bioassays must be performed following an iodination.

CALCIUM -45

(⁴⁵Ca)

Physical Characteristics

- Half-life: 162.7days
- Emissions: Beta radiation with a maximum energy of 0.257MeV

Dose

- Dose rate to epidermal basal cells from skin contamination of 1 mCi/cm²: 3200mrads per hours
- Maximum ranges of these betas are 20 inches in air, about 0.02 inches in plastic and only 0.009 inches in glass.

Shielding

- Glass and plastic are the best shields for beta particles from Ca-45. Plexiglas is recommended.

Annual Intake Limits (ALI)

- Ingestion: 2mCi
- Inhalation: 0.08mCi

Note: 1.0ALI = 5,000 mrem CEDE

Detection

- Liquid scintillation counting is the preferred after work
- Thin-window GM for survey during routine work
- Whole Body dosimeter: Not required
- Finger dosimeter: Not required but when handling quantities of 5 millicuries or more finger rings could be used during initial use so as to establish any significant dose to the fingers.

- Urine assays may be required after spills or contamination incidents.

Precautions

- The major concern with using Ca-45 is that it cannot be easily monitored during its use, therefore, special precautions are needed to keep the work environment clean. The regular use of wipe testing is the only way to insure that your work space is not contaminated. Contamination on the skin will not likely cause a significant dose to the skin, however, it could lead to the internal absorption of Ca-45.
- Wear a radiation badge when handling 1.0 mCi or more vials.