HARVARD
Campus Services
ENVIRONMENTAL HEALTH & SAFETY

Radioactive Materials Reference Sheet:

Carbon-14

Long Lived Radionuclide

Half-life	**:**	**5730 years**
Type of Emitter	**:**	**Beta**
Beta Energy	**:**	**0.156 MeV**
Travel Distance in air	**:**	**24.2 cm or 9.54 inches**
Travel Distance in Tissue	**:**	**Insignificant**
Travel Distance in Plexiglas/Lucite:		**0.25 mm**

Annual Intake Limits

Inhalation	**:**	**2 mCi**
Ingestion	**:**	**2 mCi**

CONCERNS

Some ^{14}C labeled compounds can penetrate gloves and skin. Wearing two pairs of gloves and changing the outer pair every fifteen or twenty minutes will reduce the chances of absorption through the skin. ^{14}C may be difficult to distinguish from ^{35}S. If both nuclides are being used in the same laboratory, establish controls to ensure they are kept separate, if practical.

Care should be taken NOT to generate $^{14}CO_2$ gas which could be inhaled. There are 3 main classes of carbon compounds: organic compounds, gases (CO or CO_2), and aerosols of carbon containing compounds such as carbonates and carbides. Most organic compounds are NOT very volatile under normal circumstances and the probability of these being inhaled as vapors is therefore small. Internal exposure is the major concern, as ^{14}C can readily penetrate the skin and may become volatile.

SHIELDING

- None required

DETECTION

- The preferred method of detection for ^{14}C is by wipe survey (bench tops, floors, refrigerator handles, phone, etc.) and counting the wipes in a Liquid Scintillation Counter.

- A survey meter with a GM probe is not likely to detect the presence of ^{14}C in amounts less than about 7 nCi due to low detection efficiency. The average efficiency for ^{14}C with a pancake probe is approximately 3% (under ideal conditions). However, covering the window with plastic wrap or paraffin film will stop most or all of the betas from entering the detector.

SAFETY RULES FOR ^{14}C

- Follow General Safety Precautions for all isotopes.

Specific Recommendations:

WHILE WORKING

- Suitable traps may be necessary to collect carbon dioxide if gas or vapor releases are anticipated. This reduces environment releases.

- Monitor surfaces routinely and keep records of the results. A GM probe may detect ^{14}C if the probe is used within a ½ inch of the surface and the proper probe is used.

- Submit urine samples for bioassay if requested by the RPO or if an intake is suspected.

POST-USE

- Conduct a wipe test of work areas and equipment surfaces and count them in a Liquid Scintillation Counter.

- Dispose ^{14}C waste according to the waste disposal guidelines. If by sink disposal, ensure that it is soluble in water and does not exceed the posted limit (100 μCi daily, if only one radionuclide is being disposed of). Do not exceed this limit, unless otherwise authorized by the Radiation Safety Committee in the permit.

- ^{3}H and ^{14}C waste may be combined but must be segregated from short-lived waste.

GENERAL RADIOLOGICAL SAFETY INFORMATION

^{14}C is a low energy beta emitter and does not pose a significant external dose hazard. The beta radiation barely penetrates the outer protective dead skin layer of the body. The major concern for individuals working with this isotope is the possibility of an internal exposure. Such an exposure may occur if an individual contaminates bare skin, accidentally ingests the material, or breathes in the gas or vapor (usually radioactive CO_2). The highest exposed organ for most ^{14}C labeled compounds is the fat of the whole body. Be careful with ^{14}C labeled carbonate since it is incorporated into bone. Ingested carbon is metabolized very quickly and much of the radionuclide is exhaled in the form of carbon dioxide. Urinalysis is an effective sampling technique for ^{14}C uptake monitoring.

Some ^{14}C labeled compounds, depending on their chemical properties, may migrate through gloves and skin. ^{14}C compounds should be handled with gloved hands, and in some cases, with double gloves. Change gloves often. One should be careful not to contaminate the skin as some ^{14}C beta particles can penetrate the dead layer of the epidermis. Special cautions should be taken when handling ^{14}C labeled halogenated acids. These compounds may be absorbed in the skin, causing significant skin doses and a pathway into the body.