Radionuclide Safety Data Sheet

PHYSICAL DATA

Radionuclide:	Hydrogen-3 (H-3), aka “Tritium”
Decay Mode:	Beta (100% abundance)
Beta Energy:	18.6 keV (maximum); 5.7 keV (average)
Physical Half-Life:	12.3 years
Biological Half-Life:	10 - 12 days
Effective Half-Life:	10 - 12 days *
	* Forcing liquids to tolerance (3-4 liters/day) will reduce the effective half-life of H-3 by a factor of 2 or 3 (relatively easy to flush out of system with fluids).
Specific Activity:	9650 curies / gram
Maximum Beta Range in Air:	5 mm = 0.5 cm = 1/4"
Maximum Beta Range in Water:	0.005 mm = 0.0005 cm = 3/10,000"
Penetrability of Beta Particle in Tissue:	Insignificant (cannot penetrate dead layer of skin)

RADIOLOGICAL DATA

Least radiohazardous of all radionuclides

Critical Organ:	Body Water or Tissue
Routes of Intake:	Ingestion, Inhalation, Puncture, Wound, Skin Contamination (Absorption)
Exposure Concerns:	Internal exposure & contamination are primary concerns; EXTERNAL EXPOSURE NOT A CONCERN
Committed Effective Dose Equivalent (CEDE):	Tritiated Water: 64 mrem/mCi Organic Compounds: 160 mrem/mCi
Annual Limit on Intake (ALI):	80 mCi (ingestion or inhalation) (1 ALI = 5,000 mrem CEDE)
Skin Contamination Exposure Rate (0.007 cm):	0 mrad/hr per 1.0 mCi (cannot penetrate dead layer of skin)

SHIELDING/LABELING

Shielding: None Required

Labeling: Container with $\geq$ 1 mCi must be labeled “Caution, Radioactive Material”

SURVEY INSTRUMENTATION

H-3 CANNOT be detected using a G-M or NaI survey meter
Must use wipes/smears and count a liquid scintillation counter to detect H-3 contamination. Counting efficiency on a Perkin Elmer liquid scintillation counter is approximately 60%.

PERSONAL RADIATION MONITORING DOSIMETERS

Personnel dosimetry (whole body & ring badges) are **NOT** needed (H-3 beta energy is too weak).

BIOASSAY REQURIEMENTS

For HTO (Tritiated Water) and other Tritiated compounds (including nucleotide precursors), the following activities if handled at any one time or processed in a month period require a bioassay:

100 mCi in an open room or bench
1000 mCi in a certified hood

If bioassay required, at least 100 ml of urine must be collected within 72 hours of use
Rule of Thumb: About 0.001 uCi/liter of H-3 in urine sample is indicative of a total integrated whole body dose of approximately 10 millirem (average person) if no treatment is instituted (flush with fluids) [NCRP-65 / 1980]

DOSIMETRY

Millicurie quantities of tritium do not present an external exposure hazard because the low energy betas emitted cannot penetrate the outer dead layer of skin. The critical organ for tritium uptake is the whole body water. Three to four hours after intake, tritiated water is uniformly distributed in all body water. On average, tritiated water is eliminated with a ten-day biological half-life. Elimination rates may be increased by increasing water intake.

RADIOACTIVE WASTE

Isolate waste from other radionuclides in clearly labeled containers. H-3 waste may be mixed with C-14 waste if approved by Radiation Safety.

Sanitary sewer disposal limit is 10 mCi in any one day via a designated “hot” sink provided it is readily soluble, dispersible in water, and contains no hazardous materials. A sewer log must be maintained.

GENERAL RADIOLOGICAL SAFETY INFORMATION (H-3)

(Permission from University of Michigan Radiation Safety Office)

- Inherent Volatility (at STP): SUBSTANTIAL
- Experimental uses include total body water measurements & in-vivo labeling of proliferatory cells by injection of tritium-labeled compounds (ie: thymidine). Tritium labeling is also used in a variety of metabolic studies.
- Many tritium compounds readily penetrate gloves and skin; handle such compounds remotely and wear double gloves, changing out gloves frequently (every 20 – 30 minutes)
- Oxidation of H-3 gas in air is usually slow (< 1% per day)

- Absorption of H-3 inhaled in air is much less when it is present as elemental H-3 than as tritiated water (HTO).
- Tritium penetrates the skin, lungs, and GI tract either as tritiated water or in the gaseous form.
- As gaseous hydrogen, H-3 is not significantly absorbed into the body and does NOT exchange significantly with hydrogen in the body compounds.
- As water (HTO), the H-3 entering the lung or GI tract is completely absorbed and is rapidly dispersed throughout the body.
- Some H-3 is incorporated into cellular components and has a long turnover rate. Forcing fluid reduces internal exposures from H-3.
- Monitor for H-3 contamination using only smears, swabs, swipes, or wipe testing (bench tops, floors, refrigerator/freezer handles, phone, etc).
- Always wear a lab coat & disposable gloves when handling H-3.
- Skin contamination, ingestion, inhalation, and punctures involving H-3 are primary radiological concerns (internal doses).
- Tritiated water, taken into the body by inhalation, ingestion, or absorption through the skin is assumed to be completely and instantaneously absorbed and rapidly mixed with total body water.
- The volume of total body water (standard man) is 42,000 ml.
- The concentration of H-3 (uCi/ml) in urine is assumed to be the same as that in total body water. (urine concentration = body concentration)).
- For a continuous inhalation exposure at a rate of 1/365 of an ALI per day, the equilibrium concentration of H-3 in urine is 0.073 uCi/ml. (NOTE: 1/365 of 80 mCi (ALI) = 219 uCi)
- The predicted concentration activity normalized to unit intake from inhalation is 2.204 E-5 uCi/ml per uCi of H-3 intake.
- Tritiated thymidine, if not catabolized, is taken up only by the nuclei of those cells synthesizing DNA.
- The ingestion ALI of tritiated thymidine is likely to be approximately 1/10 of that for tritiated water.
- The ALI for tritiated thymidine might be as much as 50-times smaller than the ALi for tritiated water.
- Ingested tritiated water is assumed to be completely and instantaneously absorbed from the GI tract and to mix rapidly with the total body water so that, at all times following ingestion, the concentration in sweat, urine, sputum, blood, insensible perspiration, and expired water vapor is the same.
- Tritiated water is instantaneously distributed uniformly among all the soft tissues of the body after inhalation.
- Organic compounds of H-3 are not very volatile under normal circumstances and the probability of their being inhaled as vapors is, therefore, small.