

## Phosphorus-32 ( <sup>32</sup>P ) safety information and specific handling precautions

### General:

Phosphorus-32 is an energetic beta emitter which can penetrate up to 0.8 cm into living skin tissue. Therefore, this isotope poses an external (skin) dose hazard to persons as well as a potential internal hazard. An internal exposure may occur if an individual contaminates bare skin, accidentally ingests the material, splashes it into the eyes, or breathes it in the form of a gas or vapor. The bone is the critical organ for intake of <sup>32</sup>P transportable compounds. Although about 60% of ingested Phosphorus-32 is excreted within the first 24 hours, only 1% per day is excreted after the second or third day following ingestion. Dose evaluations will require knowledge of the approximate date and time of exposure to the isotope. The external hazard of <sup>32</sup>P can be reduced by applying the principles of time, distance and shielding. The dose rate at the open combi-vial top containing 1 mCi of <sup>32</sup>P in 1 ml of liquid is roughly 26 rem/hour! Since this dose rate will not be attenuated significantly by air, shielding materials should be placed between the source and personnel to absorb most of the radiation.

Never work over an unshielded open container of <sup>32</sup>P. The best shield for a <sup>32</sup>P source is a material like lucite or plexiglass (about 1/2 inch thick), which will absorb the beta particles while generating little secondary radiation (Bremsstrahlung). For mCi amounts of <sup>32</sup>P, thin lead shielding (1/8 to 1/4 inch thickness) may be added to the exterior of the plexiglass shield to attenuate the higher intensity secondary radiation. However, thin sheets of lead should not be used alone to shield <sup>32</sup>P. In addition, the less time spent near a radiation source of <sup>32</sup>P, the lower the exposure.

A high local skin dose can be received if the radioactive material is touched and allowed to remain on the skin or gloves. An amount of 1 uCi of <sup>32</sup>P deposited in 1 cm<sup>2</sup> area of bare skin would exceed the NRC annual skin exposure limit in less than eight hours. The face, eyes and hands can receive considerable exposure from an open container of <sup>32</sup>P, particularly if the radioactivity is in a concentrated form. The eye itself may receive a high local dose as well as providing a pathway into the body. The eyes should be protected from <sup>32</sup>P by wearing safety glasses. Safety goggles will prevent splashes from getting into the eyes and will also act as shielding for the eyes. The distance between yourself and a <sup>32</sup>P source can be easily increased by using remote handling devices such as tongs or forceps. This safe handling technique of using distance can substantially reduce exposure from <sup>32</sup>P.

### Physical Data:

**Maximum beta energy:** 1.71 MeV, 100% emission.

**Maximum range in air:** 18 to 20 feet.

**Radiological half-life:** 14.29 days.

### Internal Occupational Limits:

#### Annual Limits on Intake-

**Inhalation:** 0.9 mCi

**Ingestion:** 0.6 mCi

### Precautions:

1. Follow General Safety Precautions for all isotopes.
2. Perform dry runs and practice routine operations to improve dexterity and speed before using <sup>32</sup>P.
3. Avoid skin exposure by using tools to indirectly handle unshielded sources and potentially contaminated vessels.
4. Traps may be necessary to collect <sup>32</sup>P if large gas or vapor releases are anticipated. This is to reduce the release to the environment.
5. Monitor surfaces routinely and keep records of the results. Geiger counters with a pancake probe should be used for <sup>32</sup>P radiation. Average efficiency for detecting <sup>32</sup>P with a pancake probe is 30%. Use wipe tests and a Liquid Scintillation Counter to determine levels of removable <sup>32</sup>P contamination.
6. Do not work over open containers of <sup>32</sup>P without shielding. Work with plexiglass shields (1/4 to 1/2 inch thickness). Shield all stock vials of <sup>32</sup>P. Do not use thin sheets of lead to shield <sup>32</sup>P.
7. Radiation badges are issued for individuals working with significant activities of <sup>32</sup>P. Individuals working with 10 mCi or greater will be issued an extremity dosimeter. Wear, store and return radiation badges as instructed by Radiation Safety.

# <sup>32</sup>P LAB INFO SHEET

ALARA: Time—Distance—Shielding.

NO EATING, DRINKING, OR SMOKING in lab.

## <sup>32</sup>P Phosphorus



High Energy Beta Emitter  
Half-Life: 14.29 days  
Max energy: 1710 KeV (at 100%)  
Max range in air: 18-20 ft  
ALI: .9 mCi via inhalation  
.6 mCi via ingestion  
Critical Organ: Whole Body  
Bioassay: Urine

Detection: GM or LSC  
GM meter w/Pancake probe  
(20-35%) efficient  
LSC (90-95%) efficient



Shielding: 3/8" plastic, Plexiglas®

PPE: Double gloves,  
Lab coat, Safety glasses

Dosimetry: Film Badge or TLD



## Notes and Special Precautions

- Skin dose main external hazard. Call EHS if skin is contaminated. High skin dose can occur in a short period of time. For example - 1  $\mu$ Ci on skin for 8 hrs = over NRC ANNUAL skin dose limit of 50,000 mrem. Personal surveys are vital.
- Use of safety glasses is important when working with <sup>32</sup>P. Safety glasses serve as a radiation shield against the <sup>32</sup>P betas as well as providing splash protection.
- Wear double gloves and change gloves often.
- Max Beta Energy = 1710 KeV: These high energy betas can penetrate into tissue – but only 0.8cm – so not a whole body dose. Only skin and eyes are at risk of an external exposure.
- Ring badges issued for users of 10 mCi or more.
- Plexiglas shielding (3/8 in.) is very effective.
- Short half-life -14.3 Days. If clothing items become contaminated, items may be returned after 12 half-lives.
- Shielding note: DO NOT use lead to shield <sup>32</sup>P as high energy betas in lead can generate bremsstrahlung radiation (x-ray).



**Class I Waste < 15 days**

**EMERGENCY SPILLS  
or  
SKIN CONTAMINATION**

**203-785-3555**

**Yale Environmental Health & Safety** 203-785-3550