

# Phosphorus-33 Handling Precautions

This document contains general information designed to provide a basic understanding of radiation safety. While we believe the information to be accurate, regulatory requirements may change and information contained herein is not tailored to individual needs. A radiation protection specialist should be consulted for specific applications.

$^{33}\text{P}$   
25.4 d  
 $\beta^-$  0.249  
No  $\gamma$   
E 0.249

## Physical data

Maximum beta energy: 0.249 MeV (100%)<sup>(1)</sup>  
Maximum range of beta in air: 46 cm (18 in)<sup>(2)</sup>

## Occupational limits<sup>(3)</sup>

Annual limit on intake: 6 mCi (220 MBq) for oral ingestion and 3 mCi (110 MBq) for inhalation

## Dosimetry

Millicurie (37 MBq) quantities of  $^{33}\text{P}$  do not present a significant external exposure hazard because the low-energy betas emitted barely penetrate gloves and the outer dead layer of skin. Uptakes of phosphorus are assumed to be retained with a biological half-life of 0.5 days<sup>(4)</sup>. Of this phosphorus, 15% is rapidly excreted; 15% is retained

in intracellular fluids with a biological half-life of 2 days; 40% is retained in soft tissue with a biological half-life of 19 days; and 30% retained permanently in mineral bone where  $^{33}\text{P}$  is reduced by radioactive decay<sup>(4)</sup>.

## Decay table

Physical half-life: 25.4 days<sup>(1)</sup>.

To use the decay table, find the number of days in the top and left hand columns of the chart, then find the corresponding decay factor. To obtain a precalibration number, divide by the decay factor. For a postcalibration number, multiply by the decay factor. Visit [www.perkinelmer.com/toolkit](http://www.perkinelmer.com/toolkit) to use our online Radioactive Decay Calculator.

	Days									
	0	1	2	3	4	5	6	7	8	9
0	1.000	0.973	0.947	0.921	0.897	0.872	0.849	0.826	0.804	0.782
10	0.761	0.741	0.721	0.701	0.683	0.664	0.646	0.629	0.612	0.595
20	0.579	0.564	0.549	0.534	0.520	0.506	0.492	0.479	0.466	0.453
30	0.441	0.429	0.418	0.406	0.395	0.385	0.374	0.364	0.355	0.345
40	0.336	0.327	0.318	0.309	0.301	0.293	0.285	0.277	0.270	0.263
50	0.256	0.249	0.242	0.236	0.229	0.223	0.217	0.211	0.205	0.200
60	0.195	0.189	0.184	0.179	0.174	0.170	0.165	0.161	0.156	0.152
70	0.148	0.144	0.140	0.136	0.133	0.129	0.126	0.122	0.119	0.116
80	0.113	0.110	0.107	0.104	0.101	0.098	0.096	0.093	0.091	0.088
90	0.086	0.084	0.081	0.079	0.077	0.075	0.073	0.071	0.069	0.067
100	0.065	0.064	0.062	0.060	0.059	0.057	0.055	0.054	0.053	0.051
110	0.050	0.048	0.047	0.046	0.045	0.043	0.042	0.041	0.040	0.039
120	0.038	0.037	0.036	0.035	0.034	0.033	0.032	0.031	0.030	0.030

**PerkinElmer has developed the following suggestions for handling Phosphorus-33 after years of experience working with this low-energy beta emitter.**

**General handling precautions for Phosphorus-33**

1. Designate area for handling  $^{33}\text{P}$  and clearly label all containers.
2. Prohibit eating, drinking, smoking and mouth pipetting in room where  $^{33}\text{P}$  is handled.
3. Use transfer pipets, spill trays and absorbent coverings to confine contamination.
4. Handle  $^{33}\text{P}$  compounds that are potentially volatile or in powder form in ventilated enclosures.
5. If airborne activity is suspected, sample exhausted effluent and room air by continuously drawing a known volume through membrane filters.
6. Wear lab coat, wrist guards and disposable gloves for secondary protection.
7. Maintain contamination control by regularly monitoring and promptly decontaminating gloves and surfaces.
8. Use pancake or end-window Geiger-Mueller detector or liquid scintillation counter to detect  $^{33}\text{P}$ .
9. Submit urine samples for bioassay from two hours to seven days after handling  $^{33}\text{P}$  to indicate uptake by personnel.
10. Isolate waste in clearly labeled containers and hold for decay.
11. Establish surface contamination, air concentration and urinalysis action levels below regulatory limits. Investigate and correct any conditions which may cause these levels to be exceeded.
12. On completing an operation, secure all  $^{33}\text{P}$ ; remove protective clothing; dispose of protective coverings; monitor and decontaminate self and surfaces; wash hands and monitor them again.

**References**

1. Kocher, David C., Radioactive Decay Data Tables, Springfield: National Technical Information Service, 1981 DOE/TIC-11026.
2. Kaplan, Irving, Nuclear Physics, New York: Addison-Wesley, 1964.
3. U.S. Nuclear Regulatory Commission. 10 CFR 20 Appendix B – Standards for Protection Against Radiation, 1994.
4. ICRP Publication 30, Part 1, Limits for Intakes of Radionuclides by Workers. Pergamon Press, Oxford, 1979.