

# Iron-55 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.

$^{55}\text{Fe}$   
2.7 y  
EC  
No  $\gamma$   
E 0.231

## Physical data

Principal radiation emissions<sup>(1)</sup>

K x-ray: 0.006 MeV (27.8%)

Auger electron: 0.005 MeV (60.7%)

## Occupational limits<sup>(2)</sup>

Annual limit on intake: 9 mCi (330 MBq) for oral ingestion and 2 mCi (74 MBq) for inhalation

Derived air concentration:  $8 \times 10^{-7}$   $\mu\text{Ci}/\text{ml}$  (30 kBq/m<sup>3</sup>)

## Dosimetry

External radiation from  $^{55}\text{Fe}$  is low energy and does not normally present an external exposure hazard. In adult man about 70% of total body iron is bound in hemoglobin<sup>(3)</sup>. It may be assumed that 80% and 1.3% of  $^{55}\text{Fe}$  uptakes transfer to the liver and spleen respectively. The rest is assumed to

be uniformly distributed to all other organs and tissues of the body<sup>(3)</sup>. Iron is retained in organs and tissues with a biological half-life of 2000 days<sup>(3)</sup>. One or two percent of an uptake of  $^{55}\text{Fe}$  is eliminated in urine during the first 24 hours, the rest of the uptake is eliminated in feces<sup>(4)</sup>.

## Decay table

Physical half-life: 2.7 years<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	10	20	30	40	50	60	70	80	90
0	1.000	0.993	0.986	0.979	0.972	0.965	0.959	0.952	0.945	0.938
100	0.932	0.925	0.919	0.912	0.906	0.899	0.893	0.887	0.881	0.874
200	0.868	0.862	0.856	0.850	0.844	0.838	0.832	0.826	0.821	0.815
300	0.809	0.803	0.798	0.792	0.786	0.781	0.775	0.770	0.765	0.759
400	0.754	0.748	0.743	0.738	0.733	0.728	0.722	0.717	0.712	0.707
500	0.702	0.697	0.692	0.688	0.683	0.678	0.673	0.668	0.664	0.659
600	0.654	0.650	0.645	0.641	0.636	0.632	0.627	0.623	0.618	0.614
700	0.610	0.605	0.601	0.597	0.593	0.589	0.584	0.580	0.576	0.572
800	0.568	0.564	0.560	0.556	0.552	0.548	0.545	0.541	0.537	0.533
900	0.529	0.526	0.522	0.518	0.515	0.511	0.507	0.504	0.500	0.497

**PerkinElmer has developed the following suggestions for handling Iron-55 after years of experience working with this low-energy x-ray emitter.**

**General handling precautions for Iron-55**

1. Designate area for handling  $^{55}\text{Fe}$  and clearly label all containers.
2. Store mCi (37 MBq) quantities of  $^{55}\text{Fe}$  behind thin lead shielding.
3. Use tools to indirectly handle unshielded sources and potentially contaminated vessels.
4. Prohibit eating, drinking, smoking and mouth pipetting in room where  $^{55}\text{Fe}$  is handled.
5. Use transfer pipets, spill trays and absorbent coverings to confine contamination.
6. Handle potentially volatile compounds and powders in ventilated enclosures.
7. Sample exhausted effluent and room air by continuously drawing a known quantity through membrane filters.
8. Wear disposable lab coat, wrist guards and gloves for secondary protection.
9. Maintain contamination control by regularly monitoring and decontaminating gloves and surfaces.
10. Use open-window proportional counter, NaI(Tl) detector or liquid scintillation counter to detect  $^{55}\text{Fe}$ .
11. Collect urine for bioassay for 24 hours after handling  $^{55}\text{Fe}$  to indicate uptake by personnel.
12. Isolate waste in sealed, clearly labeled containers and dispose of according to approved guidelines.
13. 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.
14. On completing an operation, secure all  $^{55}\text{Fe}$ ; remove and dispose of protective clothing and coverings, monitor and decontaminate self and surfaces; wash hands and monitor them again.

$^{55}\text{Fe}$  emits low energy x-rays and electrons that are strongly absorbed in the dead outer skin layer. The use of protective clothing should provide sufficient protection against external exposure. Urinalysis is only an effective indicator of uptake when obtained within 24 hours of handling  $^{55}\text{Fe}$ . Urine samples normally need to be radiochemically processed in order to achieve adequate bioassay sensitivity. Fecal analysis may be used to determine uptakes weeks or years after handling  $^{55}\text{Fe}$ .

**References**

1. Kocher, David C., Radioactive Decay Data Tables, Springfield: National Technical Information Service, 1981 DOE/TIC-11026.
2. U.S. Nuclear Regulatory Commission. 10 CFR 20 Appendix B – Standards for Protection Against Radiation, 1994.
3. ICRP Publication 30, Part 2, Limits for Intakes of Radionuclides by Workers. Pergamon Press, Oxford, 1980.
4. ICRP Publication 10, Evaluation of Radiation Doses to Body Tissues from Internal Contamination Due to Occupational Exposure; Pergamon Press, London, 1968.