Manganese-54
Handling Precautions

^{54}Mn
312.7 d
EC
γ 0.835
E 1.377

Physical Data

Principal Radiation Emissions[1]

Gamma:	0.835 MeV (100%)
Auger Electron:	0.005 MeV (64%)
K X-ray:	0.005 MeV (18%)

Unshielded Exposure Rate at 1 cm from a 1 mCi point Source: 4 R/h[2].

Unshielded Exposure Rate at 1 m from a 1 MBq Point Source: 32 nC/kg/h

Half-Value Layer for Lead Shielding: 0.72 cm (0.28 in.)[2]

Occupational Limits[3]

Annual Limit on Intake: 2 mCi (74 MBq) for oral ingestion and 800 µCi (30 MBq) for inhalation.

Derived Air Concentration: 3 x 10^{-7} µCi/ml (11 kBq/m^3).

Dosimetry

Gamma emissions from ^{54}Mn present an external dose hazard. It may be assumed that 35% of uptake of ^{54}Mn transfers to the bone and is retained with a biological half-life of 40 days. 10% and 15% of the uptake transfers to the liver and is retained with biological half-lives of 4 days and 40 days respectively, and 20% and 20% of the uptake is distributed uniformly to other organs and tissues of the body and retained with biological half-lives of 4 days and 40 days respectively[4].

Decay Table

Physical Half-Life: 312.7 Days[1]

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.

Days	0	1	2	3	4	5	6	7	8	9
0	1.000	0.998	0.996	0.993	0.991	0.989	0.987	0.985	0.982	0.980
10	0.978	0.976	0.974	0.972	0.969	0.967	0.965	0.963	0.961	0.959
20	0.957	0.954	0.952	0.950	0.948	0.946	0.944	0.942	0.940	0.938
30	0.936	0.934	0.931	0.929	0.927	0.925	0.923	0.921	0.919	0.917
40	0.915	0.913	0.911	0.909	0.907	0.905	0.903	0.901	0.899	0.897
50	0.895	0.893	0.891	0.889	0.887	0.885	0.883	0.881	0.879	0.877
60	0.875	0.873	0.871	0.870	0.868	0.866	0.864	0.862	0.860	0.858
70	0.856	0.854	0.852	0.850	0.849	0.847	0.845	0.843	0.841	0.839
80	0.837	0.835	0.834	0.832	0.830	0.828	0.826	0.824	0.823	0.821
90	0.819	0.817	0.815	0.813	0.812	0.810	0.808	0.806	0.805	0.803
100	0.801	0.799	0.797	0.796	0.794	0.792	0.790	0.789	0.787	0.785
110	0.783	0.782	0.780	0.778	0.776	0.775	0.773	0.771	0.770	0.768
120	0.766	0.764	0.763	0.761	0.759	0.758	0.756	0.754	0.753	0.751
130	0.749	0.748	0.746	0.744	0.743	0.741	0.739	0.738	0.736	0.735
140	0.733	0.731	0.730	0.728	0.726	0.725	0.723	0.722	0.720	0.718
150	0.717	0.715	0.714	0.712	0.710	0.709	0.707	0.706	0.704	0.703
160	0.701	0.700	0.698	0.696	0.695	0.693	0.692	0.690	0.689	0.687

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PerkinElmer Life Sciences has developed the following suggestions for handling Manganese-54 after years of experience working with this high-energy gamma emitter.

General Handling Precautions for Manganese-54

1. Designate area for handling ^{54}Mn and clearly label all containers.
2. Store ^{54}Mn behind thick lead shields.
3. Wear extremity and whole body dosimeters while handling mCi (37 MBq) quantities.
4. Use shielding to minimize exposure while handling ^{54}Mn.
5. Use tools to indirectly handle unshielded sources and potentially contaminated vessels.
6. Prohibit eating, drinking, smoking and mouth pipetting in room where ^{54}Mn is handled.
7. Use transfer pipets, spill trays and absorbent coverings to confine contamination.
8. Handle potentially volatile compounds in ventilated enclosures.
9. Sample exhausted effluent and room air by continuously drawing a known volume through membrane filters.
10. Wear lab coat, wrist guards and disposable gloves for secondary protection.
11. Maintain contamination and exposure control by regularly monitoring and promptly decontaminating gloves and surfaces.
12. Use end-window Geiger-Mueller detector, NaI(Tl) detector or liquid scintillation counter to detect ^{54}Mn.
13. Submit urine sample for bioassay from 4 to 24 hours after handling ^{54}Mn to indicate uptake by personnel.
14. Isolate waste in clearly labeled, shielded containers and dispose of according to approved guidelines.
15. Establish air concentration, surface contamination and bioassay action levels below regulatory limits. Investigate and correct any conditions which may cause these levels to be exceeded.
16. On completing an operation, secure all ^{54}Mn; remove and dispose of protective clothing and coverings; monitor and decontaminate self and surfaces; wash hands and monitor them again.

Only a small fraction of ^{54}Mn in the body is excreted in the urine. Whole body counting or fecal analysis are alternative bioassay methods that can be more sensitive than urinalysis.

References

1. Kocher, David C., Radioactive Decay Data Tables, Springfield: National Technical Information Service, 1981 DOE/TIC-11026.
2. Calculated with computer code "Gamma" utilizing decay scheme data from Kocher(1) and mass attenuation coefficients for lead and mass energy absorption coefficients for air from the Radiological Health Handbook, Washington: Bureau of Radiological Health, 1970. The HVL reported here is the initial HVL for narrow beam geometry.
3. U.S. Nuclear Regulatory Commission. 10CFR 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.

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H78358 rev. 01/01