The ToxGuide™ is developed to be used as a pocket guide. Tear off at perforation and fold along lines.

Sources of Exposure

General Populations

- The general population may be exposed to manganese through consumption of food and water, inhalation of air, and dermal contact with air, water, soil, and consumer products that contain manganese.
- Manganese is an essential nutrient required as a cofactor for a variety of enzymes.
- The primary source of manganese exposure for the general population is food; the highest concentrations of manganese are found in grains, nuts, legumes, and fruit.

Occupational Populations

- Occupational exposure is most likely to occur by inhalation of manganese fumes or manganese-containing dusts.
- Workers in the ferromanganese, iron and steel, dry-cell battery, and welding industries may be exposed to airborne manganese.

Toxicokinetics and Normal Human Levels

Toxicokinetics

- In general, the extent of absorption of inhaled manganese is a function of particle size. Manganese from smaller particles that are deposited in the lower airways is mainly absorbed into blood and lymph fluids. Manganese from larger particles or nanosized particles deposited in the nasal mucosa may be directly transported to the brain via olfactory or trigeminal nerves.
- The amount of manganese absorbed across the gastrointestinal tract is variable, but typically averages about 3–5%. Adults maintain stable tissue levels of manganese through the regulation of gastrointestinal absorption and hepatobiliary excretion.
- Absorbed manganese is widely distributed throughout the body, with higher levels found in the liver, pancreas, and kidney.
- The primary route of elimination is fecal elimination via hepatobiliary excretion.

Normal Human Levels

- The mean urinary manganese concentration in individuals aged 6–88 years was 1.19 µg/L.

Biomarkers/Environmental Levels

Biomarkers

- Manganese is an essential element and is normally present in blood and urine.
- In workers, group average blood levels appear to be related to manganese body burden, while group average urinary excretion levels were considered to be most indicative of recent exposures.
- Blood and urine levels may also be useful in detecting groups with above-average current exposure to manganese. However, measurements in individuals may only be related to exposure dose after exposure has ceased.

Environmental Levels

Air

- The average background level in urban areas is 40 ng/m^3.
- In rural areas, manganese levels are typically <10 ng/m^3.

Sediment and Soil

- The mean background level of manganese in soil is 330 mg/kg.

Water

- The median level in drinking water is 10 µg/L.

Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2012. Toxicological Profile for Manganese. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

ToxGuide™ for Manganese

Mn

CAS# 7439-96-5

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U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
www.atsdr.cdc.gov

Contact Information:
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http://www.atsdr.cdc.gov/toxprofiles/index.asp

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Chemical and Physical Information

Manganese is a Metal

- Manganese is a naturally occurring substance found mainly as oxides, carbonates, and silicates.
- Manganese is used principally in steel production to improve hardness, stiffness, and strength.
- Inorganic manganese compounds are also used in the production of dry-cell batteries, and glass and fireworks; in leather textile industries; and as a fertilizer. The inorganic pigment known as manganese violet is found in cosmetics.
- Methylcyclopentadienyl manganese tricarbonyl (MMT) is an organic manganese compound added to gasoline to improve the antiknock properties of fuel.
- Other organic manganese compounds are used as fungicides, fuel-oil additives, smoke inhibitors, and a medical imaging agent.

Routes of Exposure

- Inhalation –Predominant route of exposure for occupational populations; minor route of exposure for the general population.
- Oral – Predominant route of exposure for the general population.
- Dermal – Minor route of exposure.

Manganese in the Environment

- Manganese is released into the atmosphere via natural and anthropogenic sources.
- Major industrial sources of manganese are iron and steel production facilities, power plants, and coke oven emissions.
- Manganese has the potential to bioconcentrate, particularly in lower organisms of the food chain.

Relevance to Public Health (Health Effects)

Health effects are determined by the dose (how much), the duration (how long), and the route of exposure.

Minimal Risk Levels (MRLs)

Inhalation

- No acute- or intermediate-duration inhalation MRLs have been derived for inorganic manganese.
- An MRL of 0.0003 mg Mn/m^3 has been derived for chronic-duration inhalation exposure to inorganic manganese (≥1 year).
- No acute-, intermediate-, or chronic-duration inhalation MRLs have been derived for MMT.

Oral

- No acute-, intermediate-, or chronic duration oral MRLs have been derived for inorganic manganese.
- No acute-, intermediate-, or chronic duration oral MRLs have been derived for MMT.

Health Effects

- Inhaled manganese can be directly transported to the brain and can result in a permanent neurological disorder known as manganism with symptoms that include tremors, difficulty walking, and facial muscle spasms.
- Exposure to high levels of manganese dust can result in lung inflammation and impaired lung function.
- Oral exposure can also result in adverse neurological effects.
- There is no evidence that manganese causes cancer in humans and there are little data to suggest that inorganic manganese is carcinogenic in animals. EPA has classified manganese as a group D chemical, not classifiable as to human carcinogenicity.

Children's Health

- Neurological effects, similar to those observed in adults exposed to high levels of manganese, and neurodevelopmental effects including changes in behavior, memory, and learning ability have been observed in children exposed to extremely high levels of manganese. However, it is not known whether children are more sensitive than adults, but there is some indication from laboratory animal experiments that they may be more sensitive.