

## Sources of Exposure

## Toxicokinetics and Normal Human Levels

## Biomarkers/Environmental Levels

### General Populations

- The general population is exposed to low levels of molybdenum from ingestion of food and drinking water and by inhalation of dust. Dermal exposure may also occur through skin contact with soil, water, or other substances containing molybdenum.

### Occupational Populations

- Occupational exposure may occur at facilities that produce molybdenum alloys or stainless steel.
- Occupational exposure can also occur at mining operations.
- Occupational exposure can also occur at other facilities using molybdenum.

### Toxicokinetics

- Molybdenum is absorbed through the lungs, although quantitative estimates have not been identified.
- Absorption from the gastrointestinal tract is estimated to be 40–100% depending on the specific compound, dose, and whether it is consumed with a meal.
- Molybdenum is poorly absorbed through the skin (approximately 0.2%).
- Absorbed molybdenum is widely distributed, with the highest concentrations in the kidneys and liver.
- Molybdenum is primarily excreted in the urine, with lesser amounts excreted in feces.

### Normal Human Levels

- National survey of the U.S. general population conducted in 2015–2016 reported a geometric mean urinary molybdenum level of 32.0 µg/L.

### Biomarkers

- Molybdenum can be measured in blood and urine.

### Environmental Levels

#### *Air*

- Background levels in ambient air range from below the detection level to 0.03 mg/m<sup>3</sup> with higher levels in urban areas.

#### *Sediment and Soil*

- Molybdenum levels in most soils range between 0.6 and 3.5 mg/kg.
- A survey of soils conducted by the U.S. Geological Survey (USGS) showed concentrations ranging from <0.05 to 75.5 mg/kg with a median of 0.78 mg/kg.

#### *Water*

- Mean molybdenum levels in groundwater is 1.0 µg/L.
- Molybdenum levels in surface water are generally <1.0 µg/L.

### Reference

Agency for Toxic Substances and Disease Registry (ATSDR). 2019. Toxicological Profile for Molybdenum. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Services.

# ToxGuide™ for Molybdenum Mo

CAS# 7439-98-7  
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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](http://www.atsdr.cdc.gov)

Mo



## Chemical and Physical Information

## Routes of Exposure

## Relevance to Public Health (Health Effects)

### Molybdenum is a Naturally Occurring Metal

- Molybdenum is a naturally occurring trace element found in minerals, but not as the free metal.
- It has six oxidation states, the most common are Mo(VI) and Mo(IV).
- Molybdenum is primarily used in metallurgical applications, including as an alloying agent in cast iron and steel. The primary molybdenum form used by industry, particularly in stainless steel production, is molybdenum trioxide.
- Non-metallurgical uses of molybdenum include catalysts, lubricants, and pigments.

- Inhalation – Minor route of exposure for general population. Predominant route of occupational exposure.
- Oral – Predominant route of exposure for the general population through ingestion of molybdenum in food and to a lesser extent through drinking water.
- Dermal – Not likely an exposure route of concern for general population.

### Molybdenum in the Environment

- Molybdenum released into air by industrial processes will be subject to atmospheric deposition.
- Molybdenum is a natural constituent of soil; found as the mineral molybdenite, powellite, wulfenite, ferrimolybdate, and ilsemanite.
- Molybdenum compounds in water rapidly transform into the molybdate ion under environmental conditions.

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 were derived for molybdenum.
- A chronic-duration ( $\geq 365$  days) inhalation MRL of 0.002 mg Mo/m<sup>3</sup> was derived for molybdenum trioxide.

#### Oral

- No acute- or chronic-duration oral MRLs were derived for molybdenum.
- An intermediate-duration (15–364 days) oral MRL of 0.06 mg Mo/kg/day was derived for molybdenum.

### Health Effects

- Molybdenum is an essential element. Molybdenum cofactors are involved in the degradation of sulfur-containing amino acids, purine degradation pathway, and oxidation of hypoxanthine and xanthine.
- Studies in laboratory animals provide evidence that copper status, particularly the copper content of the diet, can influence the toxicokinetics and toxicity of molybdenum.

### Health Effects

- Nasal lesions have been observed in animals exposed to molybdenum trioxide following inhalation exposure.
- Renal effects, including histological alterations and decreases in renal function, have been observed in animals following oral exposure.
- Higher levels of molybdenum can also result in liver damage in animals exposed by oral exposure.
- There is inconsistent evidence of reproductive and developmental toxicity.
- The International Agency for Research on Cancer (IARC) has determined that molybdenum trioxide is possibly carcinogenic to humans (group 2B).

### Children's Health

- It is not known if children are more sensitive to molybdenum exposure than adults.